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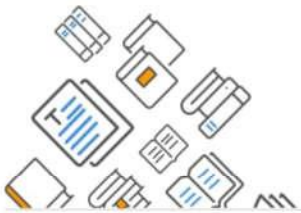

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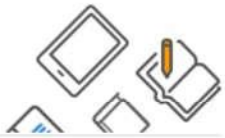

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Position Control Using a Physics-Based Model for Biomimetic Underwater Propulsor Actuated by IPMC

Ankur Gupta, Satyendra K. Prajapati & Sujoy Mukherjee

Conference paper | First Online: 04 October 2022

Part of the Lecture Notes in Mechanical Engineering book series (LNME)

Abstract

In this paper, an effort is made to provide a better position control model using the physics-based model for biomimetic underwater propulsor actuated by ionic polymer-metal composite (IPMC). The biomimetic underwater propulsor considering the body caudal fin-type locomotion is undertaken where the oscillating fin tail of the original fish is

replaced by a fin tail comprising an active IPMC beam. The supported cantilevered IPMC beam model is analyzed and the relations for displacement and velocity are studied using physics-based modeling in a fluidic environment. The robotic swimming velocity response due to the active IPMC tail fin deflection under applied electric potential has been observed. Considering the Laplace transform of the mathematical model, the transfer function relating the tail tip deflection and input voltage has been generated and proportional, integral and derivative (PID) closed-loop controller has been developed to control the deflection from IPMC in an underwater environment. The controlled and efficient desired displacement response of 1 mm through simulations was achieved. The PID gains are tuned using the Ziegler–Nichols tuning method to make the output response quick and robust.

Keywords

Position control **Physics-based model** **PID control** **IPMC** **Underwater propulsor**

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DOI	Published	Publisher Name
https://doi.org/10.1007/978-981-19-3716-3_53	04 October 2022	Springer, Singapore

Print ISBN	Online ISBN	eBook Packages
978-981-19-3715-6	978-981-19-3716-3	Engineering Engineering (R0)

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Shashank Chaudhary
Dr. Mona Sahay • Dr. Suruchi Satsangi

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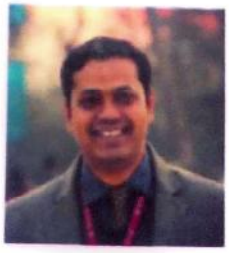

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CHAPTER - 11

Effect of Augmented Reality on Online Beauty Accessory Purchase during Covid 19 Pandemic: A study of L'Oréal Paris Makeup Section

Ashima Jaswal
(Research Scholar)
School of commerce and management
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Dr. Samriti Mahajan
Associate Professor & Head of Department, School of Commerce & Management (Lingaya's Vidyapeeth Faridabad, Haryana)

Abstract:

The COVID-19 pandemic that happened in the course of 2020 affects the financial area in the cosmetic Industry. Shoppers can general lyutilize on-line channels to diminish eye to eye contact with consumers. This examination expects to interrupt down the result of Augmented Reality during COVID-19 pandemic on retail customer conduct. This research utilizes subjective ways with auxiliary data sources non heritable from Delhi NCR working professionals and University students were taken. For this research qualitative analytical technique have been used with the help of questionnaire and data has been collected with the help of online voice records through social media, so this research is an exploratory cum descriptive research the outcomes show that the patterns during the COVID-19 pandemic are internet rooming and pure web primarily based shopping. This exploration is needed to be valuable for advertisers however Augmented Reality helps in rising retail showcasing procedures throughout the COVID-19 pandemic and increase a superior agreement and a lot of in-depth viewpoints how this new innovation (AR) creates interest in web based looking and make it more powerful for the corrective business.

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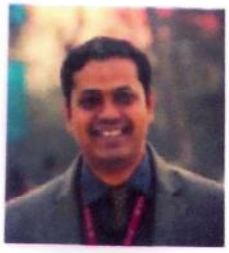

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CHAPTER – 9

Conversational Commerce for Millennials in Apparel Industry: Chatbots

Author- Ms. Priya Diwan

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Corresponding Author-

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Associate Professor & Head of Department, School of Commerce & Management (Lingaya's Vidyapeeth Faridabad, Haryana)

Abstract

Conversational gadgets are best portrayed as frameworks that have human-like highlights and can be sent in service settings. Considering the high speed of online trade, such specialists are viewed as a future in each industry. With the propagation of new-age technological advances, conversational gadgets have replaced the conventional sales representatives in web-based business in a way helping the buyers to look, assess and settle on product choices. Conversational commerce is a spinoff involving conversational gadgets in online business. Because of Covid 19 pandemic, the world economy has seen computerized change and development of online trade. Chatbots have turned into an innovative channel for retailers to address youthful clients' issues anyplace and without fail. This digitally native generation has turned into the new purchasers and internet shopping has overwhelmed the whole market section. The reception of such innovation is probably going to affect different retailers, society, workers, and clients. Therefore, one ought to have a wide comprehension of the idea and peculiarity.

In this chapter, we describe the concept of conversational commerce and its implications in Apparel Industry. The methodology adopted is exploratory in nature based on primary and secondary research methods

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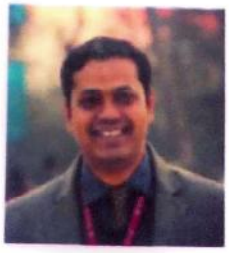

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CHAPTER – 12

...vation and Future Trends in Corporate Cultures

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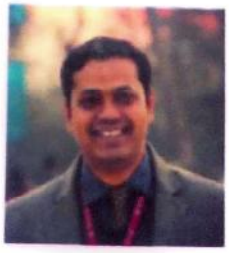

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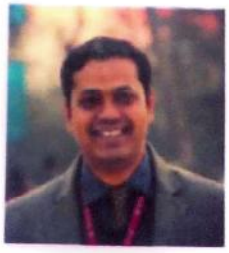

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OUTCOME BASED STRATEGIC PERFORMANCE MANAGEMENT SYSTEM WITH STAKEHOLDERS' PERSPECTIVE

Shashank Chaudhary
Dr. Mona Sahay • Dr. Suruchi Satsangi

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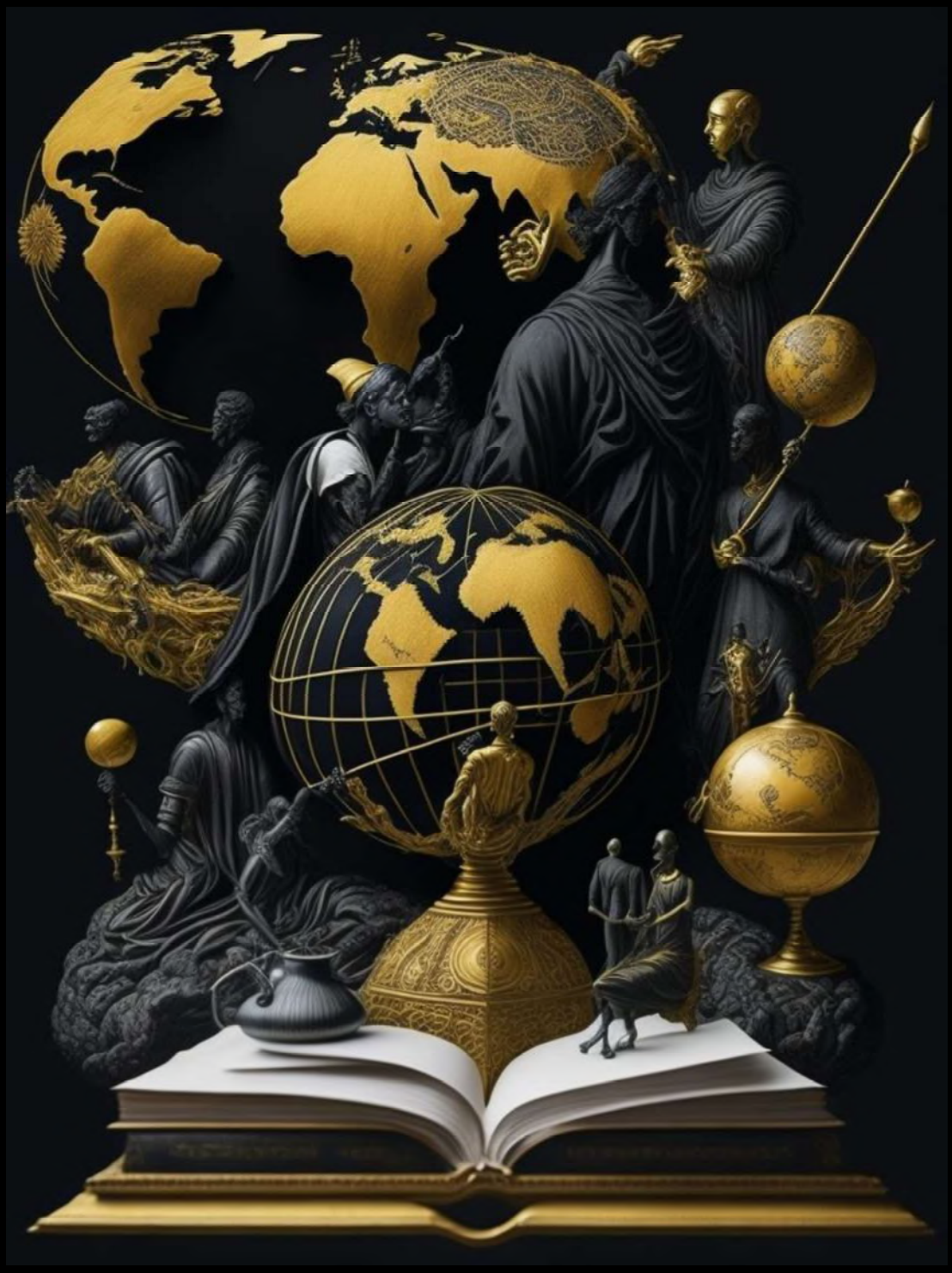
International Conference on Multidisciplinary Research



Editors

Dr. Sohel Rana Sarkar

Dr. Soumya Mohan Ghosh

International Conference on Multidisciplinary Research ICMR- 2023

MULTIDISCIPLINARY RESEARCH

CONFERENCE MONOGRAPH

Editors

Dr. Sohel Rana Sarkar

Dr. Soumya Mohan Ghosh

Organized by

Dakshin Dinajpur D.Ed. College

(NCTE Recognized College)

Affiliated to WBUTTEPA and WBBPE

Shihur, Tapan, Dakshin Dinajpur, Pin- 733127 (W.B.)

International Conference on Multidisciplinary Research

Editors: Dr. Sohel Rana Sarkar, and Dr. Soumya Mohan Ghosh

Conference Monograph

ISBN: 978-93-5912-962-4

Price: 700/-

Published by:

Dr. Sohel Rana Sarkar

Vill.- Bhadrail, Post- Gurail, Dakshin Dinajpur, West Bengal, Pin- 733142

Phone: 91-9775859039

E-mail: sohelranasarkareducation@gmail.com

Cover design: Dr. Soumya M. Ghosh

Printed at Dhar Brothers, 4, Rammohan Roy Rd, Yogi Para, Garpar, Machuabazar, Kolkata, West Bengal 700009

Shoukat, et al., (2015). Perception of teachers and students towards the functionality of semester system at university level in the context of Pakistani social and administrative set-ups. *International Journal of Teaching and Education.* III. 68-80. 10.20472/TE.2015.3.4.006.

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An exploratory study on Multidisciplinary dimension of social worker role in education to Improve the Quality Education in India

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NSS Programme coordinator

Abstract

Education, directly and indirectly, gives learners or young people the opportunity to develop their social skills at school or in after-school level, learners interact with other learners/people, building their relationships with friends, teachers and other students of different ages and cultures, and help them to improving their lives.

Education refers to the discipline that is concerned with methods of teaching and learning in schools or school-like environments, as opposed to various non-formal and informal means of socialization. If we

ISBN: 978-93-5912-962-4

can talk about socialization then there is scope to improve quality education techniques in India with the help of social work.

We can define that Social work is a profession in which trained professionals are devoted to helping vulnerable people and communities work through challenges they face in everyday life. Social workers as a professional worker have commitment to advocating Individual, group and communities for improving the lives as individuals, families, groups and societies.

We can improve the quality of teacher education in India with some techniques.

Need-based training: Every teacher has unique skill sets and might face different challenges in each classroom.

Collaboration and involvement of teachers: Collaboration is very important for high-quality teacher training.

Continuous professional development.

A social worker can do better to improve these qualities because a social worker is well trained in assessment of any individuals, groups and Communities. A social worker helps a lot to teachers in need assessment for students and as well as in teaching learning process and techniques.

AS a social worker it's easy to gage out the problems in teaching process because a teacher can have some problems at inter personal level and that effects his/her teaching techniques. We can use social work techniques and methods to resolve his/her problems and motivate them to fulfill their professional responsibilities.

Key Words: Need assessment, teaching techniques, quality education and scope of improvement at individual and group level.

Introduction:

Education is a systematic process by which a person is able to understand anything in scientific way and have skills and knowledge to perform her/his role in society. The literacy rate is 77.70%, with literate males at 84.70% and literate females at 70.30%, according to the National Family Health Survey (NFHS-5) and National Statistical Office: NSO (2021 and 2022).

Education, directly and indirectly, gives learners or young people the opportunity to develop their social skills at school or in after-school level, learners interact with other learners/people, building their relationships with friends, teachers and other students of different ages and cultures, and help them to improving their lives. In ancient time there was a system for education that called Gurukuls. Now a days there are many more schools and institutes for education and knowledge. According to the first Public Report on Basic Education **(PROBE),** this report is written from the perspective of those who despite yearning for good quality education find themselves excluded from learning and acquiring decent education. The data is based on the findings of a survey conducted in 2006, along the lines of an earlier survey conducted by PROBE in 1996 - it 'revisited' the same sample villages covering schools and households, with some modifications. Apart from basic and primary education, this report looks at upper-primary schooling in Bihar, Madhya Pradesh, Uttar Pradesh, and Rajasthan, and in Himachal Pradesh. It highlights major progress in areas such as schooling facilities

ISBN: 978-93-5912-962-4

and enrolment rates. At the same time, it finds that fundamental problems remain, such as low classroom activity, poor quality of education, and discrimination due to social disparities in schooling opportunities. It is an indispensible tool for educationists, planners and policymakers, funding agencies, NGOs, and researchers across the social sciences and all those concerned with elementary education in India.

Objectives of the research:

- Identified the scope of social work to help out and resolves the issues of education.
- Need assessment for quality education.
- Assure things for the fruitful quality education in India.
- To make a bridge between education and social work for quality education.

Methodology: An exploratory research done to fulfill the requirement of this research. Exploratory research gives chance to understand the existing researches and records and after the exploring studies to gage out the needs and to do a research for betterment of that topic. So to gage out the gapes and needs an exploratory research to be done by the researcher.

A Good Teacher: A good teacher to be a good friend, guide, supervisor, guardian, leader and mentor. A good teacher has also some qualities like-

Quality of a Good Teacher:

A good teacher should have several qualities and some of them are-

Quality education is supported by three main pillars: availability to qualified teachers, the utilization of quality learning resources and professional development, and the creation of safe and supportive learning environments.

- A good teacher should be a good communicator and must know not only how to communicate with the students but also with the other teachers and school authorities especially when it comes to sharing the problems of the students as well.
- A good teacher is a good listener and must know to listen to the students and know their needs
- Adaptability is a crucial value of a good teacher, especially in these times as schools are moving online
- Good teachers are empathetic and patient with their students and understand what they are feeling and need.

Education: Education refers to the discipline that is concerned with methods of teaching and learning in schools or school-like environments, as opposed to various non-formal and informal means of socialization.

If we can talk about socialization then there is scope to improve quality education techniques in India with the help of social work. A person as a student or as a teacher has to a human being firstly and as a human being they have socio economic or personal problems in their lives. The problems of any student and teacher may affect their performance and their learning process also. We can explain their problems as-

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1. **Personal problem:** A student or a teacher has personal problems like family's issues problem in interaction with group or particular person at workplace or institute, psychological issues, health issues etc.
2. **Social problem:** There are many more social problems like neighborhood problem, school friends' problem, peer pressure and group teasing problem etc.
3. **Economical problem:** this common problem faces by the most of Indians as a teacher or as a student. We can say that economic problem is the most important problem in present scenario. If an economic issue affects teacher's life then there are possibility that it affects their teaching performance and also effect quality education.

These problems may affect their teaching performance and also affects the quality education. There is scope for a social worker to help out them to resolves their issues. Because poor quality education is leading to poor learning outcomes in India, ultimately pushing children out of the education system and leaving them vulnerable to child labor, abuse and violence.

A social worker can use their scientific methods and techniques to help them. AS a social worker it's easy to gage out the problems in teaching process because a teacher can have some problems at inter personal level and that effects his/her teaching techniques. We can use social work techniques and methods to resolve his/her problems and motivate them to fulfill their professional responsibilities.

Social work: Social work is a profession in which trained professionals are devoted to helping vulnerable people and communities work through challenges they face in everyday life. Social workers as a professional worker have commitment to advocating Individual, group and communities for improving the lives as individuals, families, groups and societies. Social workers assist people by helping them cope with issues in their everyday lives, deal with their relationships, and solve personal and family problems. The functions of social work are to change individuals and institutions with respect to individual social welfare. Social development focuses on the institutions of society.

We can improve the quality of teacher education in India with some techniques.

i) Need-based training: Every teacher has unique skill sets and might face different challenges in each classroom.

ii) Collaboration and involvement of teachers: Collaboration is very important for high-quality teacher training.

iii) Continuous professional development.

Many identified tools provided by the School of Social Work include finding their own learning style, how to develop effective lesson plans, reflective teaching and professional development, resources by subject, and effortless teaching among others. The educator role involves giving information to group members and teaching them new skills. To become an effective educator, the social worker should be knowledgeable about all situations and problem solving techniques. In addition she or he should have to be a good communicator so that information is clearly conveyed and readily understood by the receiver.

There is a strong correlation between social change and education since sometimes education may be the cause of social change and at other times there will be changes in education due to social change. The need for literate and educated people is a prerequisite for the development of a society. Society plays a significant role in education. It can influence it both ways, positively and negatively. The values, morals, and principles of a society will create an education system that upholds the same values, morals,

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and principles. A social worker continues work on societies so they can easily gauge out the problems about any socio personal problems.

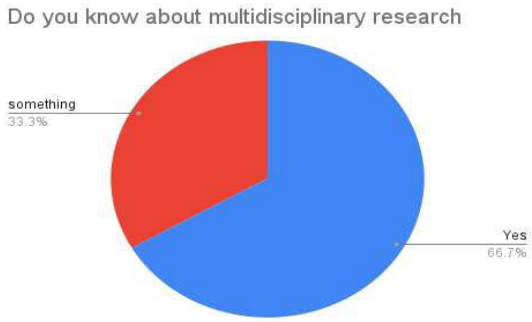
Healthy social enrichment allows us to establish positive relationships with family, friends, teachers, and other people in our lives. Social enrichment involves learning the values, knowledge, and skills of social interaction. As we can say, learners will learn communication and interaction with teachers, other learners, and friends in a school environment. Social and emotional skills are passed on to children directly by those who care for and teach them, as well as indirectly through social relationships within the family or with friends.

An exploratory research has done with B.Ed. students by the researcher. The researcher wants to know that what perspective have the B.Ed. students about multidisciplinary research and collaboration of social work and education.

A sort research has done on same; the findings to be explore and complied for documentation.

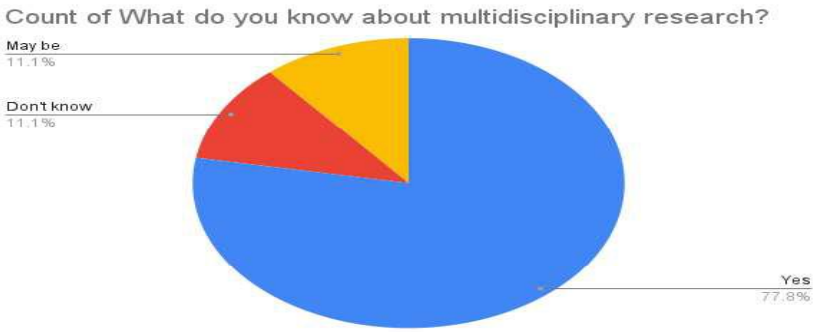
In this short research 9 B.Ed. students have been participated. Researcher has been collected data done through online mode by the. The students provided their valuable feedbacks on many questions. The detailed feedback is -

- Do you know about multidisciplinary research?



33.3% students are know something about multidisciplinary research and rest 66.7% students know verywell about multidisciplinary research.

- What do you know about multidisciplinary research?



77.8% students have enough knowledge about multidisciplinary research and rest 22.2% students are confuse about multidisciplinary research. They said that they hear something about this but not so much aware.

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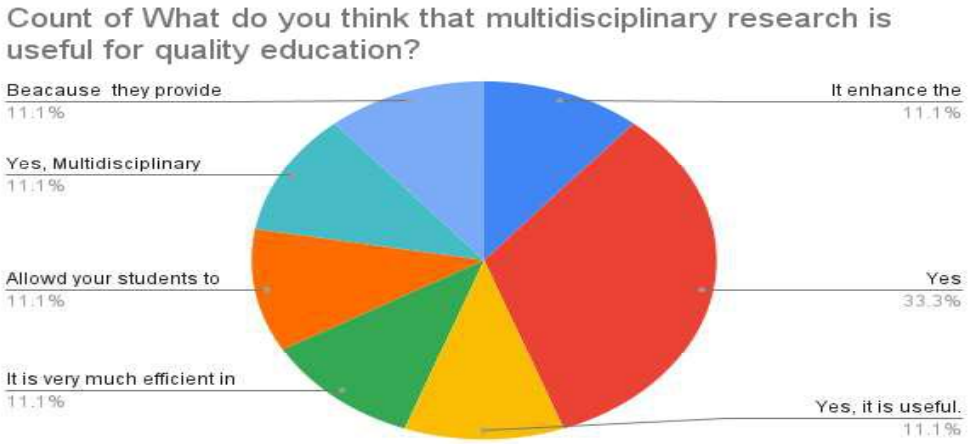
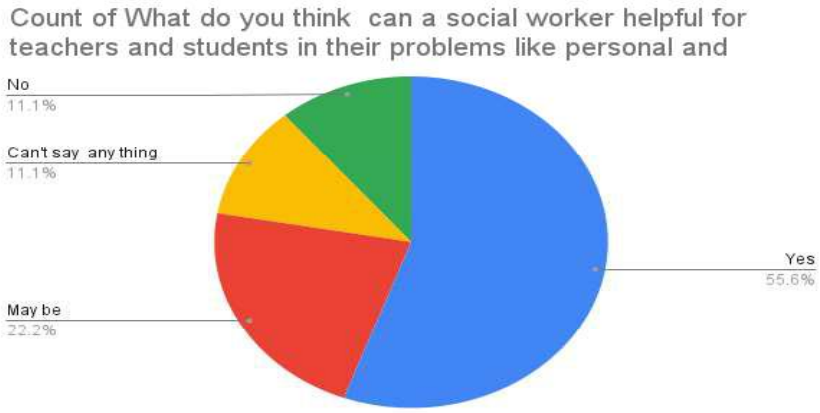
- What do you think that multidisciplinary research is useful for quality education?



When talked about the importance of multidisciplinary research in education the students have more mix responses, like it is very much effective for quality education. It is useful, it enhance the teaching learning process.

- What do you think can a social worker helpful for teachers and students in their problems like personal and professional?



- If we talked about social worker roll in multidisciplinary research the students have mix thoughts about them. Some 22.2% said that there are “no” role for a social worker and “can’t say anything” about that. Other 55.6% said yes to social worker role as problem solver. They do agree with social workers role to solve problems of teachers and students in personal and professional manner.

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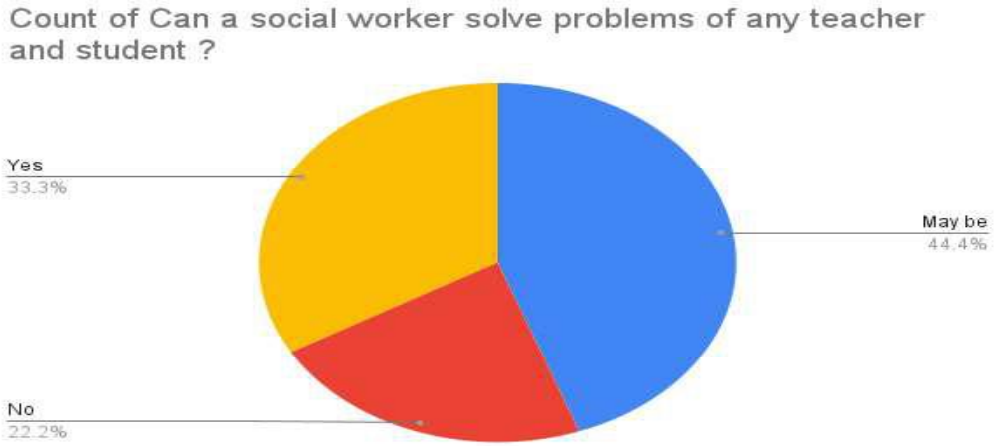
- Can a social worker solve problems of any teacher and student?



The 33.3% students think that a social worker solves the problems of any teachers and students. 44.4% students are having confusion about social worker role in problem solving. Rest 22.2% students denied the role of a social worker in problem solving.

On the bases of their knowledge on multidisciplinary research the students provide feedbacks about collaboration of Social work and education as multidisciplinary research approach for problem solving to enhance our education system and teaching learning process.

A complied detailed suggestions of students on "collaboration of Social work and education as multidisciplinary research approach for problem solving to enhance our education system and teaching learning process" are given below as it is-

Give your suggestions for Social work and education collaboration to improve quality education.

- Education in the village area or in the slums to motivate the children of slums and village and educate them for free.
- Without any discrimination there will be inclusive and skills based learning
- Extracurricular activities and pedagogy skills
- Social worker use education as a key tool inclined and community interaction
- Collaboration education for all students
- Spread Knowledge to them and guide for better education for bright future

Conclusion:

A social worker can do better to improve any situation or problem because a social worker is well trained in assessment of any individuals, groups and Communities. A social worker helps a lot to teachers in need assessment for students and as well as in teaching learning process and techniques. A social worker can be a link or bridge for the students, parents and teachers. There are many more lacks of information and knowledge about a social worker's role and responsibilities as a problem solver in education. Many students as B.Ed. student are not aware about social work and their importance in society. Whenever A B.Ed. student will be becomes a teacher he/she also faces issues in their personal

ISBN: 978-93-5912-962-4

and professional life. That time this collaboration would help them in problem solving and also helps them to improve quality education and their performance.

Suggestions: There are copious scope for study and programs to build a knowledge and understanding about multidisciplinary research. If B.Ed. students are aware about multidisciplinary research and social work then they can assess their services, whenever they become a teacher. Teacher and their students would take help from a social worker in their personal as well as professional life issues. This multidisciplinary research will be a game changer or bridge for students and teachers in quality education.

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Yogic Lifestyle and Mental Well Being

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Abstract

Yoga is a positive and normative science. Besides analysing human personality and its development, it also establishes normative standards and suggests methods for achieving these goals. The main goal of yoga psychology is to expand awareness and become the master of one's own mind. Yoga literature dating back thousands of years contains extensive descriptions of the topological elements of the mind as Freud described it in terms of subconscious, conscious and unconscious levels. A healthy yoga practice enables one to have a disease-free body and a sharp mind. Children and teens can build resilience and mental toughness by incorporating yoga and positive psychology principles into their daily routine. The benefits of such measures can be determined by further research with reliable study designs. This study shows the benefits of yoga.

ISBN: 978-93-5912-962-4

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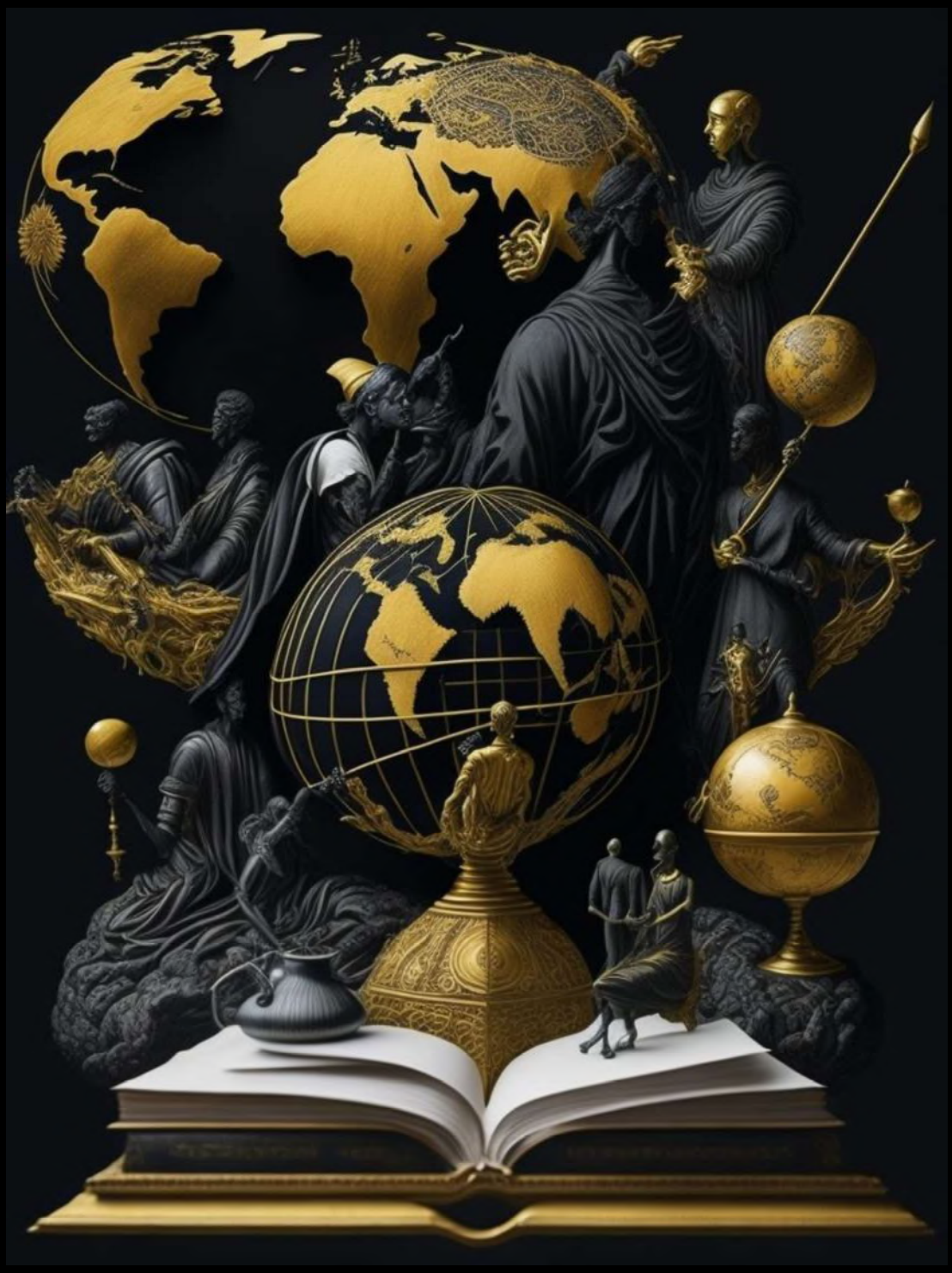

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ISBN: 978-93-5912-962-4

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Published by:

Dr. Sohel Rana Sarkar

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Phone: 91-9775859039

E-mail: sohelranasarkareducation@gmail.com

Cover design: Dr. Soumya M. Ghosh

Printed at Dhar Brothers, 4, Rammohan Roy Rd, Yogi Para, Garpar, Machuabazar, Kolkata, West Bengal 700009

PILOT STUDY: MULTIDISCIPLINARY APPROACH ACT AS A BRIDGE BETWEEN DIFFERENT ACADEMIC SUBJECT

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ABSTRACT

Instruction is an interactive process between teachers and learners which requires advance preparation and efficient contribution of students. Encouraging approach of teachers towards teaching –learning process helps for maximum participation of students. Maximum participation is also possible when students are able to understand the content. Effective Pedagogy with Multidisciplinary approach will act as a meaningful tool for the teachers to deliver the content in the class. Multidisciplinary approach involves two or more academic areas to learn the particular content. Aim of Multidisciplinary Approach is to develop logical thinking, deeper understanding and knowledge of content among teachers and students both. Learning through multidisciplinary approach enables the students to apply their classroom learning in their daily lives through problem Solving Strategies. In this research paper, researchers will try to conclude the effectiveness of Multidisciplinary Approach as a bridge between different academic subjects for Pre- service trainees of B.Ed. from Lingaya's Vidyapeeth. This research study is qualitative and quantitative in nature. Opinionnaire will develop to know the effectiveness of MULTIDISCIPLINARY APPROACH from B.Ed. first year and second year trainees. Researchers will conclude the importance of multidisciplinary approach and encourage the trainees to consider this approach to connect with learners.

KEY WORDS- Instruction, multidisciplinary, logical, Problem solving.

INTRODUTION

Instruction is an interaction for sharing knowledge and talent between two or more persons. Positive attitude of the teacher towards teaching profession and teaching approach adopted by the teacher towards the subject information decided quality of learning. The main idea of learning is to communicate useful change in behavior of students to make information more significant and applicable.

In-service teachers and Pupil teachers (pre-service teachers) can involve in the progress of the social order by teaching children through Multidisciplinary Approach. In Multi-disciplinary approach similar theme is studied through integration of more than one discipline. This Approach can be used to teach ethics, beliefs, and skills to learners.Multi-disciplinaryApproach can be used in instruction by pupil teachers to make teaching-learning process effective. This approach prepared the learners as well as pupil teachers for their future with inspired and reasonable thinking.

So, it is more important to understand the efficiency of Multi-disciplinary Approach to teach students by teacher trainees in teaching profession to make understanding more inspiring and pleasing for students.

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The aim of this study is to examine effectiveness ofMulti-disciplinary Approach as a bridge between different teaching subjects taught by pre-service teachers of B.Ed. in schools during their school experience programme. This type of research is important to bring encouraging outcomes rather than harmful.

REVIEW OF RELATED LITERATURE

A number of studies have been conducted to judge the influence of Multi-disciplinary Approach in teaching profession to create interactive feeling.

- 'Case Studies of Multidisciplinary Approaches to Integrating Mathematics, Science and Technology Education'—research done by Robert and John in 1995 and found that multi disciplinary approach has positive effect for both teachers and students.
- 'Developing a methodology for multidisciplinary action research'--, done by T.hindle in 1995 and concluded that there is a need to develop an approach capable of guiding the work in team.

- 'Multidisciplinary approaches, disciplinary boundaries, and institutional response in American higher education: A history of international relations as a field of study'---studied by F.Plantn, 2002, Pennsvlvania university and concluded that multidisciplinary research and teaching **main focus is on the internal decision-making, managerial processes, and bureaucratic policy within colleges and universities .**
- **'**Justification of a Multidisciplinary Approach to Teaching Language in Botswana Junior Secondary Schools'—research finished by Adeyemi in2010 and found that Multidisciplinary instruction enables learners to identify distinct perspectives, synthesize, feel vitally, and re-examine.
- 'Multidisciplinary approaches to educational research': a case study from Europe and the developing world**-:** Sadaf Rizvi in 2012 and concluded that relevance of multi disciplinary approach is different in national setting because of barriers of language and culture.

- 'Multidisciplinary Approach in te**acher education program':** A Study—finished by Dr Kishore Roy in 2014and found that this approach is useful **in** teacher education programme to develop all round individuals with 21st century skills in different fields.
- 'A multidisciplinary approach to research in small scale societies':Study emotions and facial expression in the field,'---conducted by Alan,2016 and found that multidisciplinary research enhanced the quality of data for the solution of the problems.

- 'Benefits of a multidisciplinary approach to research order Development'-- done by N. Jagirdar in 2016 and concluded that introduction of multidisciplinary process proceeded towards cost savings ,consistency, Quality and enhancement in clinical trial productivity.

- 'Multidisciplinary Approach to enhance Quality Education for Marginalized Students'—conducted by Sh,Sivakumar,Alagappa university,2018 and concluded that multidisciplinary approach provide quality education for the students at margin.

- 'Multidisciplinary approach as a complex system'---- conducted by A.DALTON in 2021' and concluded that multidisciplinary research system needed self management to improve the design and fostering the system.

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- 'Multidisciplinary Research in social science' By V. Janaki and found multidisciplinary research ensure greater transparency and efficiency.

- 'Multidisciplinary approach to the study of large format of oil painting'—conducted by P Calderón-Mesén in 2023 and found that multidisciplinary approach is helpful to obtain key information about the artist's artistic process, materials used along with better understand its state of conservation.

There is a need to study the effectiveness of multi disciplinary approach as a bridge in between different teaching subjects for pupil teachers during their teaching because of qualitative improvement in instructional procedure.NEP2020 also suggested to develop well rounded individuals with 21st century skills (like higher order skills,computer literacy etc.)to enrich and enhance class room instructions.

STATEMENT OF THE PROBLEM

- Using Multidisciplinary approach by Pupil Teachers as a bridge for different teaching subjects in teaching to enhance students learning.

OBJECTIVES OF THE STUDY

- To evaluate the value of Multi disciplinary Approach for pupil teachers in their teaching profession to improve information of learners.

DELIMITATION OF THE STUDY

- The study was delimited to Lingaya's Vidyapeeth, Faridabad only.
- The study was delimited only to B.Ed.trainees of first and second years of School of Education

METHODOLOGY

The research method is qualitative and quantitative in nature.

POPULATION

32 pupil teachers from B.Ed. First and Second years of Lingaya's Vidyapeeth, Faridabad involved as population.

SAMPLE SIZE

The sample size remains restricted to 32 B.Ed. trainees of Lingaya's Vidyapeeth.

TOOL USED

In the present study, researchers developed OPINIONNAIRE to judge the efficiency of Multidisciplinary Approach. Statements of the opinionnaire were finalized after discussions /planning with experts of education from Educational Institutions and School of Education ,Lingaya's Vidyapeeth.Based on the experts remark on the items 'content and face validity 10 statements were retained. Therefore to assess the utility of Multidisciplinary Approach for student teachers in teaching

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profession, OPINIONNAIRE with YES/NO options developed by researchers as a tool and this scale was standardized after administration on B.Ed. trainees.

THE OPINIONNAIRE HAS DIVIDED IN THREE SECTIONS--

A .First section contains personal information—

- Name of trainee--
- Father's name---
- Year—1st/11nd---
- Session—
- Roll no—
- 12th class subjects
- qualification

B. Second section contains 10 statementswih yes and no options.

S No	STATEMENTS	YES	NO
1	Multi-disciplinary approach enables pupil teachers from different subject backgrounds to communicate better about role of all subjects in teaching.		
2	Multi-disciplinary approach helps trainees to explore problems from different disciplines of curriculum and helps to solve the problems based on understanding of new Situations.		
3	Multi-disciplinary approach enables the pupil teachers to gain skill of critical thinking For teaching.		
4	Multi-disciplinary approach aware the trainees regarding self-management and time Management to become effective teacher.		
5	Communication and writing skills developed among trainees through multi-Disciplinary approach.		
6	Qualities like team work and research analysis important to become efficient teacher can be developed among trainees through multi-disciplinary approach		
7	Sometimes Pupil teachers lost interest during teaching of particular subject Through multidisciplinary approach.		
8	Pupil teachers became confused to understand the particular content during teaching and to choose right path through Multi-disciplinary approach.		
9	Multi-disciplinary approach enables Pupil trainees to understand Holistically different subject's relationship for training purpose.		
10	Pupil teachers able to compile and collaborate with students from Other disciplines.		

ISBN: 978-93-5912-962-4

C.Please suggest the list of topics can be teach through multi-disciplinary approach

The pupil teacher responded by choosing the alternative against the serial number of the OPINIONNAIRE statement. There was no time limit for recording responses, but pupil teachers were asked to complete it as soon as possible

COLLECTION OF DATA

For the collection of data, OPINIONNAIRE was administered to the pupil-teachers through Google form. General instructions were given to the pupil-teachers and the purpose was also explained to them. Responses of Pupil teachers were gathered on the spot for data analysis.

STATISTICAL TECHNIQUE USED

The data was analyzed by using statistical techniques –percentage, Bar diagram

RESULTS AND DISCUSSION

ANALYSIS AND INTERPRETATION OF DATA

Section A—From section A informations

Researchers found that trainees from different streams in 12th class got admission in B.Ed. and they have graduate and post graduate qualifications.

Section B--

S NO	STATEMENTS	YES	PERCENTAGE	NO	PERCENTAGE
1	Multi-disciplinary approach enables pupil teachers from different subject backgrounds to communicate better about role of all subjects in teaching.	28	87.5%	4	12.5%
2	Multi-disciplinary approach helps trainees to explore problems from different disciplines of curriculum and helps to solve the problems based on understanding of new Situations.	28	87.5%	4	12.5%
3	Multi-disciplinary approach enables the pupil teachers to gain skill of critical thinking For teaching.	22	68.75%	10	31.25%
4	Multi-disciplinary approach aware the trainees regarding self-management and time Management to become effective teacher.	21	65.63%	11	34.37%
5	Communication and writing skills developed among trainees through multi-Disciplinary approach.	30	93.75%	2	6.25%
6	Qualities like team work and research analysis important to become efficient teacher can be developed among trainees through multi-disciplinary approach	29	90.63%	3	9.37%

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7	Sometimes Pupil teachers lost interest during teaching of particular subject Through multidisciplinary approach.	27	84.37%	5	15.63%
8	Pupil teachers became confused to understand the particular content during teaching and to choose right path through Multi-disciplinary approach.	20	62.5%	12	37.5%
9	Multi-disciplinary approach enables Pupil trainees to understand Holistically different subject's relationship for training purpose.	16	50%	16	50%
10	Pupil teachers able to compile and collaborate with students from Other disciplines.	28	87.5%	4	12.5%

SECTION C—TRAINEES SUGGESTED SOME TOPICS—

TOPIC	MATHS	HEALTH AND PHYSICAL EDUCATION	SOCIAL SCIENCE	LANGUAGE	ART	SOCIAL SCIENCE
FOOD	percentage of each minerals for nutrition	food and hygiene	food of different culture/states	to learn difficult words from the topic	drawing of fruits/vegetables	balanced diet
WATER	Percentage of use of water	Prevention of water pollution	Sources of water	Poem, story	Drawings of sources	Reasons of water pollutions
FESTIVALS	------	Safety measures during deepavali, holi	Different cultures festivals	Poems, stories	Drawings	Special dishes during festivals
AIR	Percentage of gases in air	Safety precautions to remove the pollutants from air	climate	Story ,Poem	Drawings	Air Pollution
Plants	-	To clean the environment	Plants nature according to climate and region	Poem	Drawing/ Formation of masks of different plants	To study the nature of different plants and collection of leaves
Health and Hygiene	-	Ways to keep ourselves fit and healthy	-	Essay writing Report writing	Drawing	Food ,ways for healthy living
Climate	Pie diagram for weather of different areas	Balanced food according to the climate	Climate change part of geography temprature, weather	Poem Essay Report writing	Drawing	Seasons

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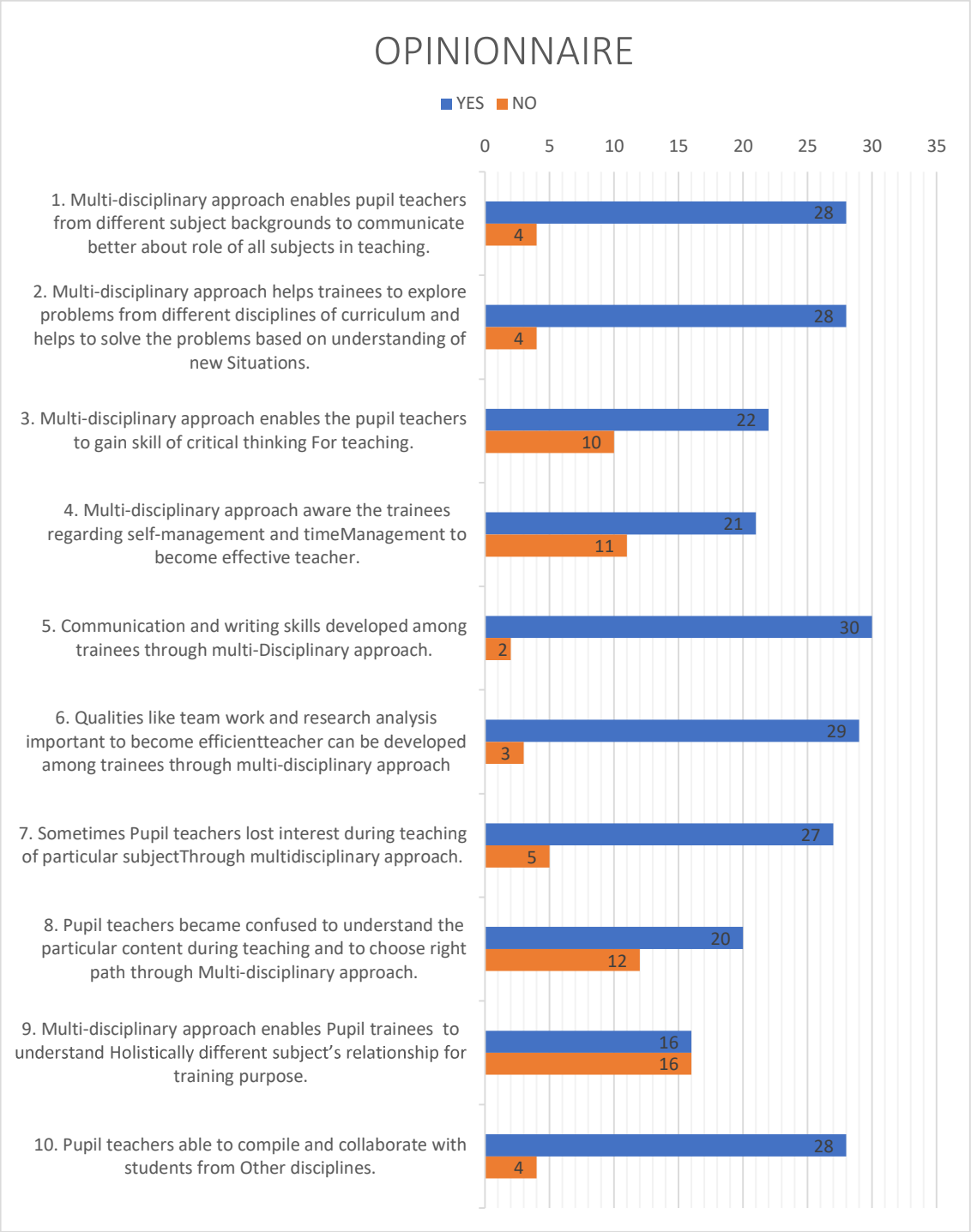

(figure 1)

DIAGRAMMATIC REPRESENTATION OF OPINIONNAI

ISBN: 978-93-5912-962-4

From the percentages and diagrammatic representation, researchers concluded that multidisciplinary approach is act as bridge to teach particular content through integration of different subjects. But, sometimes Pupil teachers became confused to understand the particular content during teaching through this approach. Pupil teachers unable to respond that Multi-disciplinary approach enables them to understand holistically different subject's relationship for training purpose.But researcher found that this approach is useful

CONCLUSIONS

It was found that MULTIDISCIPLINARY APPROACH is effective for student teachers in their teacher training programme to teach the content. As we all know NEP 2020 given emphasis on Multidisciplinary and interdisciplinary approach at all the levels to increase higher order skills among the students as well as pupil trainees/ in -service teachers like Problem solving skill , critical thinking , logical thinking., time-management, self-management, communication and writing skill , team work.

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Effectiveness Of School Field Trip For Secondary School Students

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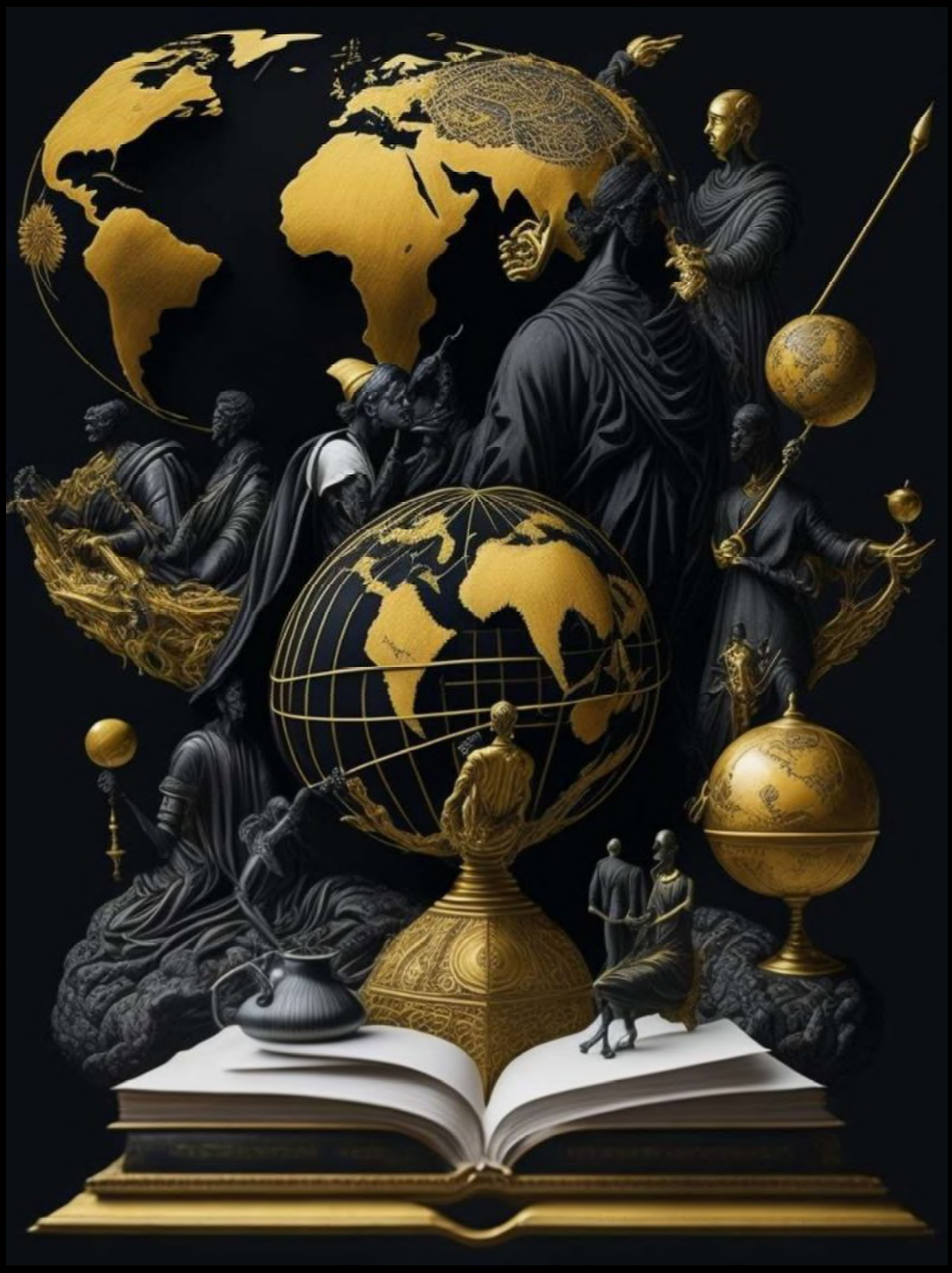
Department of Education (CIE) University of Delhi

Abstract

School field trip are part of experiential learning and first-hand experience of the real world where students have own concepts about school field trip field trips are one of the most crucial things teachers can offer their pupils since they not only broaden their knowledge and experiences but also help them to better understand the environment in which they live. Although field trips that stress hands-on, real-world, and practical applications of learning have been proven to be effective by research, instructors still face a challenge in demonstrating student learning because the current trend in education tends to place a heavy emphasis on assessments. Students learn through experiential learning or hands-on learning. Students participate in this sort of learning with their own concepts, ideas, and knowledge. Through hands-on learning, students make various observations. In this study researcher will try to find out effectiveness of school field trip for secondary school.

KEY WORDS: Experiential learning, Field visit, First- hand experience, Real world, Practical application of learning.

International Conference on Multidisciplinary Research



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Dr. Sohel Rana Sarkar

Dr. Soumya Mohan Ghosh

International Conference on Multidisciplinary Research ICMR- 2023

MULTIDISCIPLINARY RESEARCH

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Dakshin Dinajpur D.Ed. College

(NCTE Recognized College)

Affiliated to WBUTTEPA and WBBPE

Shihur, Tapan, Dakshin Dinajpur, Pin- 733127 (W.B.)

International Conference on Multidisciplinary Research

Editors: Dr. Sohel Rana Sarkar, and Dr. Soumya Mohan Ghosh

Conference Monograph

ISBN: 978-93-5912-962-4

Price: 700/-

Published by:

Dr. Sohel Rana Sarkar

Vill.- Bhadrail, Post- Gurail, Dakshin Dinajpur, West Bengal, Pin- 733142

Phone: 91-9775859039

E-mail: sohelranasarkareducation@gmail.com

Cover design: Dr. Soumya M. Ghosh

Printed at Dhar Brothers, 4, Rammohan Roy Rd, Yogi Para, Garpar, Machuabazar, Kolkata, West Bengal 700009

Shoukat, et al., (2015). Perception of teachers and students towards the functionality of semester system at university level in the context of Pakistani social and administrative set-ups. *International Journal of Teaching and Education.* III. 68-80. 10.20472/TE.2015.3.4.006.

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An exploratory study on Multidisciplinary dimension of social worker role in education to Improve the Quality Education in India

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Lingaya's Vidyapeeth
NSS Programme coordinator

Abstract

Education, directly and indirectly, gives learners or young people the opportunity to develop their social skills at school or in after-school level, learners interact with other learners/people, building their relationships with friends, teachers and other students of different ages and cultures, and help them to improving their lives.

Education refers to the discipline that is concerned with methods of teaching and learning in schools or school-like environments, as opposed to various non-formal and informal means of socialization. If we

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can talk about socialization then there is scope to improve quality education techniques in India with the help of social work.

We can define that Social work is a profession in which trained professionals are devoted to helping vulnerable people and communities work through challenges they face in everyday life. Social workers as a professional worker have commitment to advocating Individual, group and communities for improving the lives as individuals, families, groups and societies.

We can improve the quality of teacher education in India with some techniques.

Need-based training: Every teacher has unique skill sets and might face different challenges in each classroom.

Collaboration and involvement of teachers: Collaboration is very important for high-quality teacher training.

Continuous professional development.

A social worker can do better to improve these qualities because a social worker is well trained in assessment of any individuals, groups and Communities. A social worker helps a lot to teachers in need assessment for students and as well as in teaching learning process and techniques.

AS a social worker it's easy to gage out the problems in teaching process because a teacher can have some problems at inter personal level and that effects his/her teaching techniques. We can use social work techniques and methods to resolve his/her problems and motivate them to fulfill their professional responsibilities.

Key Words: Need assessment, teaching techniques, quality education and scope of improvement at individual and group level.

Introduction:

Education is a systematic process by which a person is able to understand anything in scientific way and have skills and knowledge to perform her/his role in society. The literacy rate is 77.70%, with literate males at 84.70% and literate females at 70.30%, according to the National Family Health Survey (NFHS-5) and National Statistical Office: NSO (2021 and 2022).

Education, directly and indirectly, gives learners or young people the opportunity to develop their social skills at school or in after-school level, learners interact with other learners/people, building their relationships with friends, teachers and other students of different ages and cultures, and help them to improving their lives. In ancient time there was a system for education that called Gurukuls. Now a days there are many more schools and institutes for education and knowledge. According to the first Public Report on Basic Education **(PROBE),** this report is written from the perspective of those who despite yearning for good quality education find themselves excluded from learning and acquiring decent education. The data is based on the findings of a survey conducted in 2006, along the lines of an earlier survey conducted by PROBE in 1996 - it 'revisited' the same sample villages covering schools and households, with some modifications. Apart from basic and primary education, this report looks at upper-primary schooling in Bihar, Madhya Pradesh, Uttar Pradesh, and Rajasthan, and in Himachal Pradesh. It highlights major progress in areas such as schooling facilities

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and enrolment rates. At the same time, it finds that fundamental problems remain, such as low classroom activity, poor quality of education, and discrimination due to social disparities in schooling opportunities. It is an indispensible tool for educationists, planners and policymakers, funding agencies, NGOs, and researchers across the social sciences and all those concerned with elementary education in India.

Objectives of the research:

- Identified the scope of social work to help out and resolves the issues of education.
- Need assessment for quality education.
- Assure things for the fruitful quality education in India.
- To make a bridge between education and social work for quality education.

Methodology: An exploratory research done to fulfill the requirement of this research. Exploratory research gives chance to understand the existing researches and records and after the exploring studies to gage out the needs and to do a research for betterment of that topic. So to gage out the gapes and needs an exploratory research to be done by the researcher.

A Good Teacher: A good teacher to be a good friend, guide, supervisor, guardian, leader and mentor. A good teacher has also some qualities like-

Quality of a Good Teacher:

A good teacher should have several qualities and some of them are-

Quality education is supported by three main pillars: availability to qualified teachers, the utilization of quality learning resources and professional development, and the creation of safe and supportive learning environments.

- A good teacher should be a good communicator and must know not only how to communicate with the students but also with the other teachers and school authorities especially when it comes to sharing the problems of the students as well.
- A good teacher is a good listener and must know to listen to the students and know their needs
- Adaptability is a crucial value of a good teacher, especially in these times as schools are moving online
- Good teachers are empathetic and patient with their students and understand what they are feeling and need.

Education: Education refers to the discipline that is concerned with methods of teaching and learning in schools or school-like environments, as opposed to various non-formal and informal means of socialization.

If we can talk about socialization then there is scope to improve quality education techniques in India with the help of social work. A person as a student or as a teacher has to a human being firstly and as a human being they have socio economic or personal problems in their lives. The problems of any student and teacher may affect their performance and their learning process also. We can explain their problems as-

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1. **Personal problem:** A student or a teacher has personal problems like family's issues problem in interaction with group or particular person at workplace or institute, psychological issues, health issues etc.
2. **Social problem:** There are many more social problems like neighborhood problem, school friends' problem, peer pressure and group teasing problem etc.
3. **Economical problem:** this common problem faces by the most of Indians as a teacher or as a student. We can say that economic problem is the most important problem in present scenario. If an economic issue affects teacher's life then there are possibility that it affects their teaching performance and also effect quality education.

These problems may affect their teaching performance and also affects the quality education. There is scope for a social worker to help out them to resolves their issues. Because poor quality education is leading to poor learning outcomes in India, ultimately pushing children out of the education system and leaving them vulnerable to child labor, abuse and violence.

A social worker can use their scientific methods and techniques to help them. AS a social worker it's easy to gage out the problems in teaching process because a teacher can have some problems at inter personal level and that effects his/her teaching techniques. We can use social work techniques and methods to resolve his/her problems and motivate them to fulfill their professional responsibilities.

Social work: Social work is a profession in which trained professionals are devoted to helping vulnerable people and communities work through challenges they face in everyday life. Social workers as a professional worker have commitment to advocating Individual, group and communities for improving the lives as individuals, families, groups and societies. Social workers assist people by helping them cope with issues in their everyday lives, deal with their relationships, and solve personal and family problems. The functions of social work are to change individuals and institutions with respect to individual social welfare. Social development focuses on the institutions of society.

We can improve the quality of teacher education in India with some techniques.

i) Need-based training: Every teacher has unique skill sets and might face different challenges in each classroom.

ii) Collaboration and involvement of teachers: Collaboration is very important for high-quality teacher training.

iii) Continuous professional development.

Many identified tools provided by the School of Social Work include finding their own learning style, how to develop effective lesson plans, reflective teaching and professional development, resources by subject, and effortless teaching among others. The educator role involves giving information to group members and teaching them new skills. To become an effective educator, the social worker should be knowledgeable about all situations and problem solving techniques. In addition she or he should have to be a good communicator so that information is clearly conveyed and readily understood by the receiver.

There is a strong correlation between social change and education since sometimes education may be the cause of social change and at other times there will be changes in education due to social change. The need for literate and educated people is a prerequisite for the development of a society. Society plays a significant role in education. It can influence it both ways, positively and negatively. The values, morals, and principles of a society will create an education system that upholds the same values, morals,

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and principles. A social worker continues work on societies so they can easily gauge out the problems about any socio personal problems.

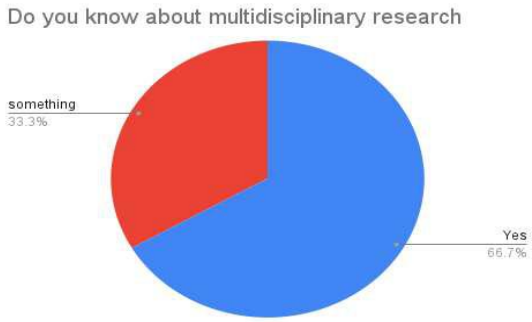
Healthy social enrichment allows us to establish positive relationships with family, friends, teachers, and other people in our lives. Social enrichment involves learning the values, knowledge, and skills of social interaction. As we can say, learners will learn communication and interaction with teachers, other learners, and friends in a school environment. Social and emotional skills are passed on to children directly by those who care for and teach them, as well as indirectly through social relationships within the family or with friends.

An exploratory research has done with B.Ed. students by the researcher. The researcher wants to know that what perspective have the B.Ed. students about multidisciplinary research and collaboration of social work and education.

A sort research has done on same; the findings to be explore and complied for documentation.

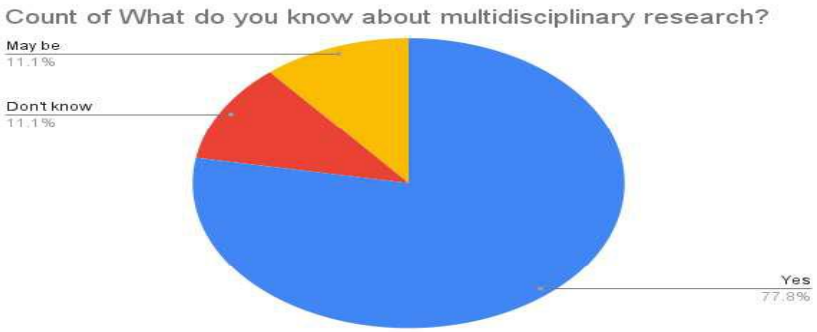
In this short research 9 B.Ed. students have been participated. Researcher has been collected data done through online mode by the. The students provided their valuable feedbacks on many questions. The detailed feedback is -

- Do you know about multidisciplinary research?



33.3% students are know something about multidisciplinary research and rest 66.7% students know verywell about multidisciplinary research.

- What do you know about multidisciplinary research?



77.8% students have enough knowledge about multidisciplinary research and rest 22.2% students are confuse about multidisciplinary research. They said that they hear something about this but not so much aware.

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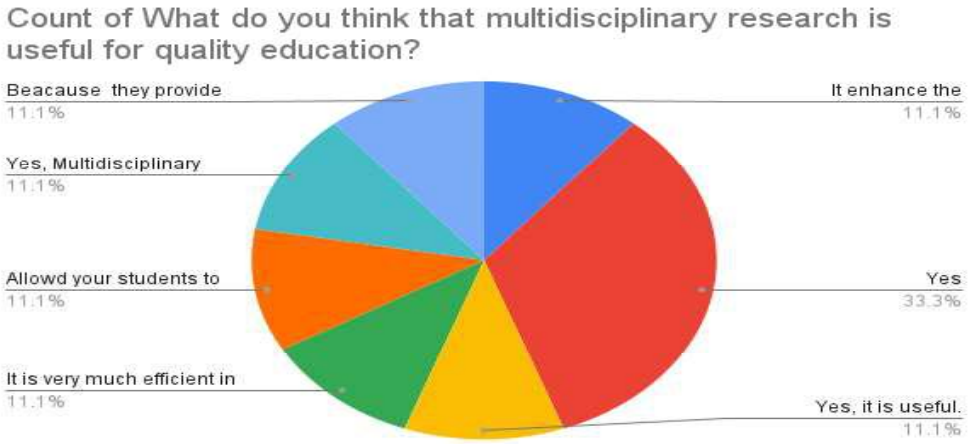
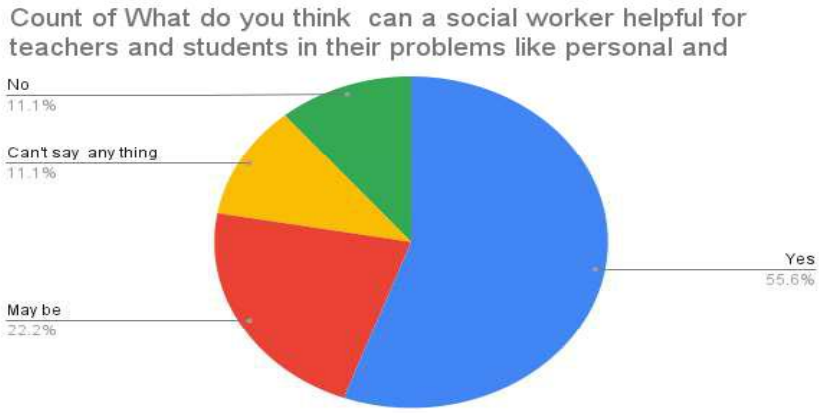
- What do you think that multidisciplinary research is useful for quality education?



When talked about the importance of multidisciplinary research in education the students have more mix responses, like it is very much effective for quality education. It is useful, it enhance the teaching learning process.

- What do you think can a social worker helpful for teachers and students in their problems like personal and professional?



- If we talked about social worker roll in multidisciplinary research the students have mix thoughts about them. Some 22.2% said that there are “no” role for a social worker and “can’t say anything” about that. Other 55.6% said yes to social worker role as problem solver. They do agree with social workers role to solve problems of teachers and students in personal and professional manner.

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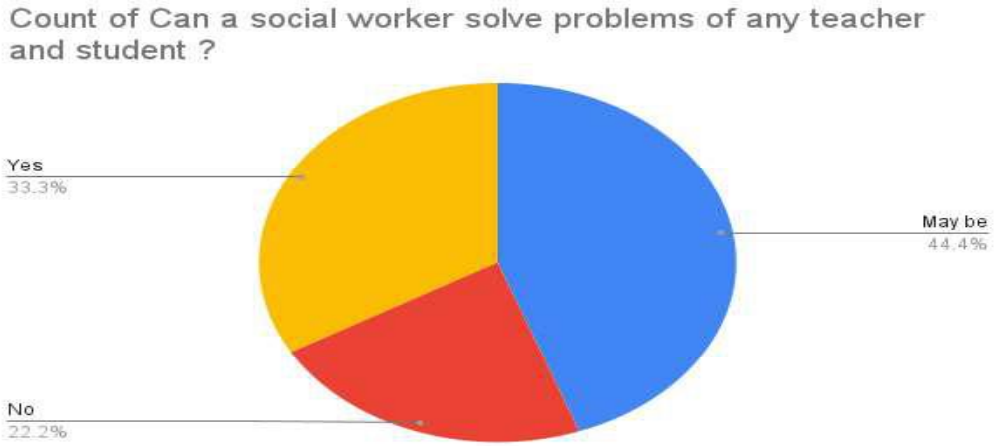
- Can a social worker solve problems of any teacher and student?



The 33.3% students think that a social worker solves the problems of any teachers and students. 44.4% students are having confusion about social worker role in problem solving. Rest 22.2% students denied the role of a social worker in problem solving.

On the bases of their knowledge on multidisciplinary research the students provide feedbacks about collaboration of Social work and education as multidisciplinary research approach for problem solving to enhance our education system and teaching learning process.

A complied detailed suggestions of students on "collaboration of Social work and education as multidisciplinary research approach for problem solving to enhance our education system and teaching learning process" are given below as it is-

Give your suggestions for Social work and education collaboration to improve quality education.

- Education in the village area or in the slums to motivate the children of slums and village and educate them for free.
- Without any discrimination there will be inclusive and skills based learning
- Extracurricular activities and pedagogy skills
- Social worker use education as a key tool inclined and community interaction
- Collaboration education for all students
- Spread Knowledge to them and guide for better education for bright future

Conclusion:

A social worker can do better to improve any situation or problem because a social worker is well trained in assessment of any individuals, groups and Communities. A social worker helps a lot to teachers in need assessment for students and as well as in teaching learning process and techniques. A social worker can be a link or bridge for the students, parents and teachers. There are many more lacks of information and knowledge about a social worker's role and responsibilities as a problem solver in education. Many students as B.Ed. student are not aware about social work and their importance in society. Whenever A B.Ed. student will be becomes a teacher he/she also faces issues in their personal

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and professional life. That time this collaboration would help them in problem solving and also helps them to improve quality education and their performance.

Suggestions: There are copious scope for study and programs to build a knowledge and understanding about multidisciplinary research. If B.Ed. students are aware about multidisciplinary research and social work then they can assess their services, whenever they become a teacher. Teacher and their students would take help from a social worker in their personal as well as professional life issues. This multidisciplinary research will be a game changer or bridge for students and teachers in quality education.

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Yogic Lifestyle and Mental Well Being

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Abstract

Yoga is a positive and normative science. Besides analysing human personality and its development, it also establishes normative standards and suggests methods for achieving these goals. The main goal of yoga psychology is to expand awareness and become the master of one's own mind. Yoga literature dating back thousands of years contains extensive descriptions of the topological elements of the mind as Freud described it in terms of subconscious, conscious and unconscious levels. A healthy yoga practice enables one to have a disease-free body and a sharp mind. Children and teens can build resilience and mental toughness by incorporating yoga and positive psychology principles into their daily routine. The benefits of such measures can be determined by further research with reliable study designs. This study shows the benefits of yoga.

ISBN: 978-93-5912-962-4

CHAPTER 5

Reflections on Female Madness in Literature

Dr. Priya Raghav and *Ms. Sarita*

Abstract

Throughout history women who have transgressed the boundaries assigned to them have been labelled as monsters, madwomen or witches. Moreover, the representations of such women in literature has been controlled by men. It is through male eyes that we see women who have become hysterical, insane or suicidal. In fact, madness was considered as a disease which was inherently feminine. It was not until the advent of psychiatry in the 19th century that a more humane approach was taken towards women who suffered from mental illnesses. How does literature reflect such women? Moreover, what is the relationship between women and madness? In this paper I will look at some of the most prominent literary instances of women who suffer from mental illness. We need to look deeper into such instances of mental health if we are to gain any concrete understanding on the subject. Today mental health is no longer a taboo subject. People are openly acknowledging their personal narratives in dealing with mental health issues. Since the outbreak of Covid issues surrounding mental health have once again been brought out of the closet. Dealing with instances of anxiety, depression, suicidal thoughts and loss have more support as such instances have become widespread during the pande

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ISBN: 978-91-987980-4-3
ISBN-10: 91-987980-4-9
DOI: 10.25215/9198798049
DIP: 18.10.9198798014
Price: kr 100
First Edition: August, 2022

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Printed in Stockholm | Title ID: 9198783041

INDEX

ISBN: 978-91-987980-4-3

DIP: 18.10.9198798014.004

ICT AND INCLUSION – SAMR MODEL

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❖ ABSTRACT:

Usage of Information and communication technology (ICT) as a subject in general and as a necessity in particular, has become imperative in schools and colleges. Assistive technology, used for inclusive classroom, is a big help in reducing the big chasm between what people can do and what needs to be done by them. This technology helps to bring special people at par with those in the mainstream. Understanding the use of technology in language learning, in particular, has helped to arouse the curiosity of both educators and their charges. The current paper describes an attempt to teach English language through an inclusive pedagogical perspective by combining ICT and Special Education. Besides ICT, it shall also discuss the need of Assistive Technology in the classroom. It investigates how a creative application of information and communication technology can aid in the creation of inclusive web environments. The study specifically focuses on how students respond to diversity and e-inclusion using the SAMR model. SAMR, a model designed to assist educators in embedding technology skills into the classroom learning process, is one of the language learning technologies.

Keywords: *ICT, Inclusive Classroom, SAMR Model*

ISBN: 978-91-987980-4-3

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The International policy and legislation on the rights of people with disabilities strongly favours children with disabilities receiving an inclusive, rather than a segregated, education. Children with special needs, including those with disabilities, are valued members of the school community. It is the responsibility of the teachers to help create a positive school environment that values inclusion and provides equal opportunities for children with special abilities, from diverse social backgrounds, and with diverse learning needs. As a result, an inclusive classroom promotes learning for all children, including those with special abilities, from diverse social backgrounds, and with a wide range of learning needs. The Information and Communication Technologies (ICT) can provide good opportunities to spread and create inclusion processes: bringing together different people and subjects moving from an informal to a formal dimension and vice versa, during the learning process can enhance and develop a common background dimension to meet people's diverse educational needs [Della Volpe, V. (2012)]. In an inclusive context, we can provide more learning opportunities by encouraging knowledge development and enhancing the process of developing competencies in relation to everyone's potential.

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❖ SAMR MODEL:

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The role of the educator is, to connect Bloom's Taxonomy with SAMR steps so that the as the lesson plan's objectives move from lower to the upper level of Bloom's Taxonomy concurrently with the SAMR levels. The three lower levels of Bloom's Taxonomy ((Remember, Understand, Apply) are associated with the two Enhancement levels of SAMR (Substitution, Augmentation), while the two Transformation levels of SAMR (Modification, Redefinition) are associated with the upper levels of Bloom (Analyze, Evaluate, Create). There is a simple ordering system within each grouping, Remember-type tasks are primarily associated with S-level uses of the technology, Understand-type tasks are associated with either S- or A-level uses of the technology etc. The diagram below depicts this relationship.

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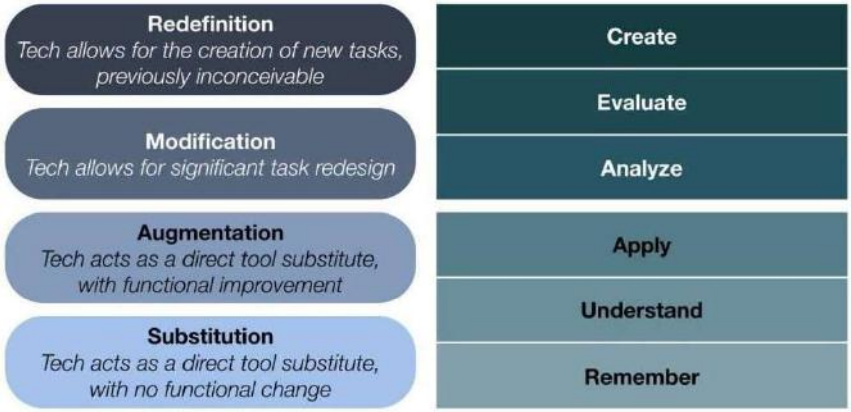

Citing the example of digital story-telling, which is a very creative form used by faculty and students and loved by those with special needs, where users create and share collaborative stories, one can align the levels of Bloom's Taxonomy with the SAMR model. From writing a story through the SAMR model, (Substitution level) to writing the story on the Story telling tool or app, progressing further to the augmentation level by making it three dimensional, to the modification level of collaboration, to making something new where students share their stories with each other, add a new aspect in the story and collaborate with each other creating another threads where other students can begin or end a story of their own, which was something inconceivable in a real life story telling class, especially in an inclusive classroom.

SAMR is an acronym for the 4 levels of technology integration: *Substitution, Augmentation, Modification and Redefinition*. It aims at helping the educators to pick and choose the right strategy to effectively teach the lesson at hand.

Substitution Level: Basically, at this level, technology is used as a mere well-thought-out ancillary with no purposeful change. The process used at this level is up gradation of tools, without changing its functional use. The mantra used is to 'substitute' traditional classroom teaching activities with digital versions. Educators can deliver both synchronous and asynchronous versions of their lectures or instructional videos so that students can see them at their own pace. Flash cards Deluxe, Easy Word Count, Franklin Speller etc. are those applications which help students

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with learning disabilities to understand the written word properly and use the same in their assignments.

Citing the example of writing assignments, earlier one used to rely on pen-paper tools to complete their assignments. This has been replaced with applications like Microsoft Word, Google Docs etc. to write and submit the assignments. These applications are a big help to students with learning disabilities

Augmentation Level: At this level too, technology is just a tool substitute with a few useful improvements. Educators research and apply interactive digital enhancements like comments, hyperlinks etc. to the technology that they are using, in this level. There is no change in the content, at the same time, the students can take advantage of the digital features to enrich their understanding. Dyslexic students can also write with their voice using Dictation tools. Text to Speech readout has been made possible through applications like 'NaturalReader' which helps students who cannot decipher the written word properly.

For example students use the various functions provided by Microsoft Word like spell check, grammar check, Thesaurus etc. while writing their assignments through the application, in fact students with dyslexia truly benefit from these. Another example is that instead of giving paper quizzes, the teachers can give quiz through Kahoot or Gamify etc.

Modification Level: It is in this level that educators use technology as an instrument to make major remodeling of entire lessons or even small portions to enhance student learning. For example, students with physical disabilities can use a voice-to-text application for writing and submitting an assignment. Also, the 'share and comment' features of Google Docs help the students to work on the rough drafts of feedbacks and assignments before submission.

Redefinition Level: At this level teachers create new activities which were hitherto unheard of in traditional classrooms. This infuses a new energy in the teaching-learning process. For example, the students can be asked to create multimedia presentations with the help of various applications and tools. Applications like 'Virtual Pen Pals', 'Virtual Field Trips' helps students with disabilities to connect with their counterparts

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around the world and visit places that they would have read in books. In this level, students learn to create their own blogs, even if they are differently abled.

To summarize, the SAMR Model for technology integration proves a big help to teachers while evaluating the suitability and effectiveness of technology for their classrooms, simplifying the process of selection and implementation of that technology. SAMR is just a tool-box and the objective over here is not to use this so called erudite box but to use the one most suited for the task at hand.

❖ CONCLUSION:

Through the study one can come to the conclusion that all students can benefit through the use of ICT. In this way, students, in an inclusive classroom, will get engaged in the teaching-learning process as well as in the development of the course through the various topics. The cognitive, meta-cognitive, and social skills of the students will be enhanced due to working in online groups. ICT aids in advancing the inclusion processes and students need such experiences for their academic progress. The use and testing of methods and practices of inclusive education, helps strengthen the self-esteem of students and create a sense of belonging to a learning community where every student gets equal opportunity and a positive atmosphere to interact and collaborate with others. Students will develop a sense of individual responsibility while doing justice to the task at hand.

This study proposes further research to take place in the area of inclusive education at the university level using the SAMR model. More research is required on the model itself and also on the application of the model. Using this model, research can be carried out to demonstrate the level of technological integration occurring within a given institution. The findings of that study can help to allocate resources to support further technological integration in the classroom.

- Through the study one can come to the conclusion that all students can benefit through the use of ICT. Students, including disabled ones, will get involved in the learning process and in the construction of the course through the various topics.

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- Working in online groups will help to develop cognitive, meta-cognitive, and social skills of the students.
- ICT can advance the inclusion processes and they need such experiences for their academic progress.
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- Students will have a sense of individual responsibility in their performance of assigned tasks.

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CHAPTER 5

Reflections on Female Madness in Literature

Dr. Priya Raghav and *Ms. Sarita*

Abstract

Throughout history women who have transgressed the boundaries assigned to them have been labelled as monsters, madwomen or witches. Moreover, the representations of such women in literature has been controlled by men. It is through male eyes that we see women who have become hysterical, insane or suicidal. In fact, madness was considered as a disease which was inherently feminine. It was not until the advent of psychiatry in the 19th century that a more humane approach was taken towards women who suffered from mental illnesses. How does literature reflect such women? Moreover, what is the relationship between women and madness? In this paper I will look at some of the most prominent literary instances of women who suffer from mental illness. We need to look deeper into such instances of mental health if we are to gain any concrete understanding on the subject. Today mental health is no longer a taboo subject. People are openly acknowledging their personal narratives in dealing with mental health issues. Since the outbreak of Covid issues surrounding mental health have once again been brought out of the closet. Dealing with instances of anxiety, depression, suicidal thoughts and loss have more support as such instances have become widespread during the pande

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Emerging Technologies in Education

Edited by: *Dr.Dilipkumar A. Ode, Madan Mohan Laddunuri, Dr. Nana N Shejwal, Prof. M Devendra, Bijoy Sarak, Dr.T.Milton, Dr. Pavankumar R. Sonawane & Pragati Singh*

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Stockholm, Sweden
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ISBN: 978-91-987980-4-3
ISBN-10: 91-987980-4-9
DOI: 10.25215/9198798049
DIP: 18.10.9198798014
Price: kr 100
First Edition: August, 2022

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www.redshine.se | info.redshine.se@europe.com
Printed in Stockholm | Title ID: 9198783041

INDEX

ISBN: 978-91-987980-4-3

DIP: 18.10.9198798014.004

ICT AND INCLUSION – SAMR MODEL

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Lingayas Vidyapeeth, Faridabad (Haryana), India.

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Lingayas Vidyapeeth, Faridabad (Haryana), India.

❖ ABSTRACT:

Usage of Information and communication technology (ICT) as a subject in general and as a necessity in particular, has become imperative in schools and colleges. Assistive technology, used for inclusive classroom, is a big help in reducing the big chasm between what people can do and what needs to be done by them. This technology helps to bring special people at par with those in the mainstream. Understanding the use of technology in language learning, in particular, has helped to arouse the curiosity of both educators and their charges. The current paper describes an attempt to teach English language through an inclusive pedagogical perspective by combining ICT and Special Education. Besides ICT, it shall also discuss the need of Assistive Technology in the classroom. It investigates how a creative application of information and communication technology can aid in the creation of inclusive web environments. The study specifically focuses on how students respond to diversity and e-inclusion using the SAMR model. SAMR, a model designed to assist educators in embedding technology skills into the classroom learning process, is one of the language learning technologies.

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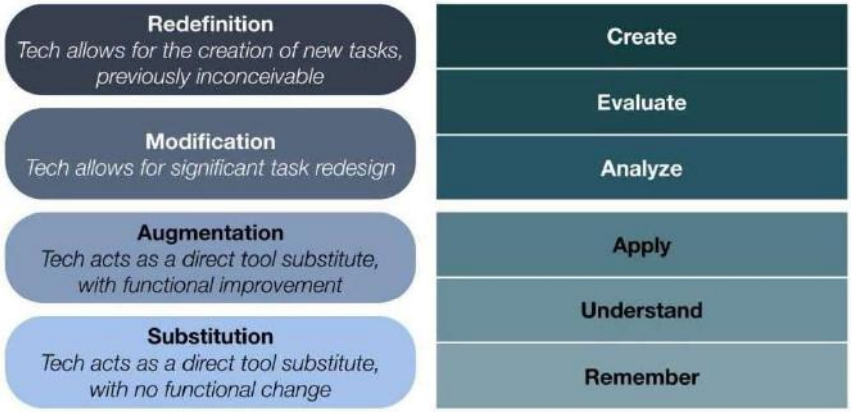
ISBN: 978-91-987980-4-3



Citing the example of digital story-telling, which is a very creative form used by faculty and students and loved by those with special needs, where users create and share collaborative stories, one can align the levels of Bloom's Taxonomy with the SAMR model. From writing a story through the SAMR model, (Substitution level) to writing the story on the Story telling tool or app, progressing further to the augmentation level by making it three dimensional, to the modification level of collaboration, to making something new where students share their stories with each other, add a new aspect in the story and collaborate with each other creating another threads where other students can begin or end a story of their own, which was something inconceivable in a real life story telling class, especially in an inclusive classroom.

SAMR is an acronym for the 4 levels of technology integration: *Substitution, Augmentation, Modification and Redefinition*. It aims at helping the educators to pick and choose the right strategy to effectively teach the lesson at hand.

Substitution Level: Basically, at this level, technology is used as a mere well-thought-out ancillary with no purposeful change. The process used at this level is up gradation of tools, without changing its functional use. The mantra used is to 'substitute' traditional classroom teaching activities with digital versions. Educators can deliver both synchronous and asynchronous versions of their lectures or instructional videos so that students can see them at their own pace. Flash cards Deluxe, Easy Word Count, Franklin Speller etc. are those applications which help students

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with learning disabilities to understand the written word properly and use the same in their assignments.

Citing the example of writing assignments, earlier one used to rely on pen-paper tools to complete their assignments. This has been replaced with applications like Microsoft Word, Google Docs etc. to write and submit the assignments. These applications are a big help to students with learning disabilities

Augmentation Level: At this level too, technology is just a tool substitute with a few useful improvements. Educators research and apply interactive digital enhancements like comments, hyperlinks etc. to the technology that they are using, in this level. There is no change in the content, at the same time, the students can take advantage of the digital features to enrich their understanding. Dyslexic students can also write with their voice using Dictation tools. Text to Speech readout has been made possible through applications like 'NaturalReader' which helps students who cannot decipher the written word properly.

For example students use the various functions provided by Microsoft Word like spell check, grammar check, Thesaurus etc. while writing their assignments through the application, in fact students with dyslexia truly benefit from these. Another example is that instead of giving paper quizzes, the teachers can give quiz through Kahoot or Gamify etc.

Modification Level: It is in this level that educators use technology as an instrument to make major remodeling of entire lessons or even small portions to enhance student learning. For example, students with physical disabilities can use a voice-to-text application for writing and submitting an assignment. Also, the 'share and comment' features of Google Docs help the students to work on the rough drafts of feedbacks and assignments before submission.

Redefinition Level: At this level teachers create new activities which were hitherto unheard of in traditional classrooms. This infuses a new energy in the teaching-learning process. For example, the students can be asked to create multimedia presentations with the help of various applications and tools. Applications like 'Virtual Pen Pals', 'Virtual Field Trips' helps students with disabilities to connect with their counterparts

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around the world and visit places that they would have read in books. In this level, students learn to create their own blogs, even if they are differently abled.

To summarize, the SAMR Model for technology integration proves a big help to teachers while evaluating the suitability and effectiveness of technology for their classrooms, simplifying the process of selection and implementation of that technology. SAMR is just a tool-box and the objective over here is not to use this so called erudite box but to use the one most suited for the task at hand.

❖ CONCLUSION:

Through the study one can come to the conclusion that all students can benefit through the use of ICT. In this way, students, in an inclusive classroom, will get engaged in the teaching-learning process as well as in the development of the course through the various topics. The cognitive, meta-cognitive, and social skills of the students will be enhanced due to working in online groups. ICT aids in advancing the inclusion processes and students need such experiences for their academic progress. The use and testing of methods and practices of inclusive education, helps strengthen the self-esteem of students and create a sense of belonging to a learning community where every student gets equal opportunity and a positive atmosphere to interact and collaborate with others. Students will develop a sense of individual responsibility while doing justice to the task at hand.

This study proposes further research to take place in the area of inclusive education at the university level using the SAMR model. More research is required on the model itself and also on the application of the model. Using this model, research can be carried out to demonstrate the level of technological integration occurring within a given institution. The findings of that study can help to allocate resources to support further technological integration in the classroom.

- Through the study one can come to the conclusion that all students can benefit through the use of ICT. Students, including disabled ones, will get involved in the learning process and in the construction of the course through the various topics.

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- Working in online groups will help to develop cognitive, meta-cognitive, and social skills of the students.
- ICT can advance the inclusion processes and they need such experiences for their academic progress.
- Use and testing of methods and practices of inclusive education, will help strengthen their self-esteem, create a sense of belonging to a learning community where every student gets the same educational opportunities and a positive atmosphere to interact and collaborate with others.
- Students will have a sense of individual responsibility in their performance of assigned tasks.

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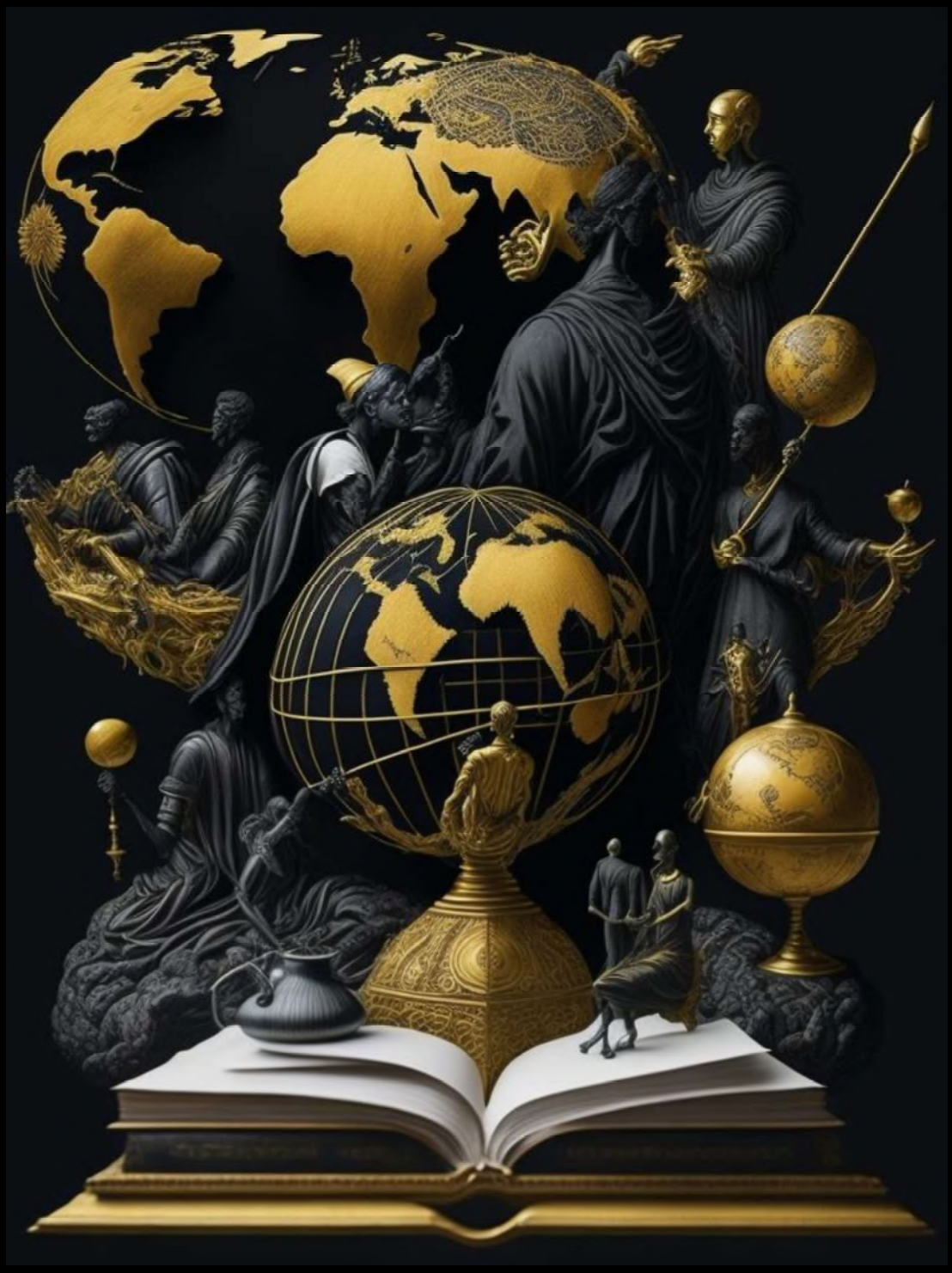

Editors

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International Conference on Multidisciplinary Research ICMR- 2023

MULTIDISCIPLINARY RESEARCH

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Shihur, Tapan, Dakshin Dinajpur, Pin- 733127 (W.B.)

International Conference on Multidisciplinary Research

Editors: Dr. Sohel Rana Sarkar, and Dr. Soumya Mohan Ghosh

Conference Monograph

ISBN: 978-93-5912-962-4

Price: 700/-

Published by:

Dr. Sohel Rana Sarkar

Vill.- Bhadrail, Post- Gurail, Dakshin Dinajpur, West Bengal, Pin- 733142

Phone: 91-9775859039

E-mail: sohelranasarkareducation@gmail.com

Cover design: Dr. Soumya M. Ghosh

Printed at Dhar Brothers, 4, Rammohan Roy Rd, Yogi Para, Garpar, Machuabazar, Kolkata, West Bengal 700009

Shoukat, et al., (2015). Perception of teachers and students towards the functionality of semester system at university level in the context of Pakistani social and administrative set-ups. *International Journal of Teaching and Education.* III. 68-80. 10.20472/TE.2015.3.4.006.

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An exploratory study on Multidisciplinary dimension of social worker role in education to Improve the Quality Education in India

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Abstract

Education, directly and indirectly, gives learners or young people the opportunity to develop their social skills at school or in after-school level, learners interact with other learners/people, building their relationships with friends, teachers and other students of different ages and cultures, and help them to improving their lives.

Education refers to the discipline that is concerned with methods of teaching and learning in schools or school-like environments, as opposed to various non-formal and informal means of socialization. If we

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can talk about socialization then there is scope to improve quality education techniques in India with the help of social work.

We can define that Social work is a profession in which trained professionals are devoted to helping vulnerable people and communities work through challenges they face in everyday life. Social workers as a professional worker have commitment to advocating Individual, group and communities for improving the lives as individuals, families, groups and societies.

We can improve the quality of teacher education in India with some techniques.

Need-based training: Every teacher has unique skill sets and might face different challenges in each classroom.

Collaboration and involvement of teachers: Collaboration is very important for high-quality teacher training.

Continuous professional development.

A social worker can do better to improve these qualities because a social worker is well trained in assessment of any individuals, groups and Communities. A social worker helps a lot to teachers in need assessment for students and as well as in teaching learning process and techniques.

AS a social worker it's easy to gage out the problems in teaching process because a teacher can have some problems at inter personal level and that effects his/her teaching techniques. We can use social work techniques and methods to resolve his/her problems and motivate them to fulfill their professional responsibilities.

Key Words: Need assessment, teaching techniques, quality education and scope of improvement at individual and group level.

Introduction:

Education is a systematic process by which a person is able to understand anything in scientific way and have skills and knowledge to perform her/his role in society. The literacy rate is 77.70%, with literate males at 84.70% and literate females at 70.30%, according to the National Family Health Survey (NFHS-5) and National Statistical Office: NSO (2021 and 2022).

Education, directly and indirectly, gives learners or young people the opportunity to develop their social skills at school or in after-school level, learners interact with other learners/people, building their relationships with friends, teachers and other students of different ages and cultures, and help them to improving their lives. In ancient time there was a system for education that called Gurukuls. Now a days there are many more schools and institutes for education and knowledge. According to the first Public Report on Basic Education **(PROBE),** this report is written from the perspective of those who despite yearning for good quality education find themselves excluded from learning and acquiring decent education. The data is based on the findings of a survey conducted in 2006, along the lines of an earlier survey conducted by PROBE in 1996 - it 'revisited' the same sample villages covering schools and households, with some modifications. Apart from basic and primary education, this report looks at upper-primary schooling in Bihar, Madhya Pradesh, Uttar Pradesh, and Rajasthan, and in Himachal Pradesh. It highlights major progress in areas such as schooling facilities

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and enrolment rates. At the same time, it finds that fundamental problems remain, such as low classroom activity, poor quality of education, and discrimination due to social disparities in schooling opportunities. It is an indispensible tool for educationists, planners and policymakers, funding agencies, NGOs, and researchers across the social sciences and all those concerned with elementary education in India.

Objectives of the research:

- Identified the scope of social work to help out and resolves the issues of education.
- Need assessment for quality education.
- Assure things for the fruitful quality education in India.
- To make a bridge between education and social work for quality education.

Methodology: An exploratory research done to fulfill the requirement of this research. Exploratory research gives chance to understand the existing researches and records and after the exploring studies to gage out the needs and to do a research for betterment of that topic. So to gage out the gapes and needs an exploratory research to be done by the researcher.

A Good Teacher: A good teacher to be a good friend, guide, supervisor, guardian, leader and mentor. A good teacher has also some qualities like-

Quality of a Good Teacher:

A good teacher should have several qualities and some of them are-

Quality education is supported by three main pillars: availability to qualified teachers, the utilization of quality learning resources and professional development, and the creation of safe and supportive learning environments.

- A good teacher should be a good communicator and must know not only how to communicate with the students but also with the other teachers and school authorities especially when it comes to sharing the problems of the students as well.
- A good teacher is a good listener and must know to listen to the students and know their needs
- Adaptability is a crucial value of a good teacher, especially in these times as schools are moving online
- Good teachers are empathetic and patient with their students and understand what they are feeling and need.

Education: Education refers to the discipline that is concerned with methods of teaching and learning in schools or school-like environments, as opposed to various non-formal and informal means of socialization.

If we can talk about socialization then there is scope to improve quality education techniques in India with the help of social work. A person as a student or as a teacher has to a human being firstly and as a human being they have socio economic or personal problems in their lives. The problems of any student and teacher may affect their performance and their learning process also. We can explain their problems as-

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1. **Personal problem:** A student or a teacher has personal problems like family's issues problem in interaction with group or particular person at workplace or institute, psychological issues, health issues etc.
2. **Social problem:** There are many more social problems like neighborhood problem, school friends' problem, peer pressure and group teasing problem etc.
3. **Economical problem:** this common problem faces by the most of Indians as a teacher or as a student. We can say that economic problem is the most important problem in present scenario. If an economic issue affects teacher's life then there are possibility that it affects their teaching performance and also effect quality education.

These problems may affect their teaching performance and also affects the quality education. There is scope for a social worker to help out them to resolves their issues. Because poor quality education is leading to poor learning outcomes in India, ultimately pushing children out of the education system and leaving them vulnerable to child labor, abuse and violence.

A social worker can use their scientific methods and techniques to help them. AS a social worker it's easy to gage out the problems in teaching process because a teacher can have some problems at inter personal level and that effects his/her teaching techniques. We can use social work techniques and methods to resolve his/her problems and motivate them to fulfill their professional responsibilities.

Social work: Social work is a profession in which trained professionals are devoted to helping vulnerable people and communities work through challenges they face in everyday life. Social workers as a professional worker have commitment to advocating Individual, group and communities for improving the lives as individuals, families, groups and societies. Social workers assist people by helping them cope with issues in their everyday lives, deal with their relationships, and solve personal and family problems. The functions of social work are to change individuals and institutions with respect to individual social welfare. Social development focuses on the institutions of society.

We can improve the quality of teacher education in India with some techniques.

i) Need-based training: Every teacher has unique skill sets and might face different challenges in each classroom.

ii) Collaboration and involvement of teachers: Collaboration is very important for high-quality teacher training.

iii) Continuous professional development.

Many identified tools provided by the School of Social Work include finding their own learning style, how to develop effective lesson plans, reflective teaching and professional development, resources by subject, and effortless teaching among others. The educator role involves giving information to group members and teaching them new skills. To become an effective educator, the social worker should be knowledgeable about all situations and problem solving techniques. In addition she or he should have to be a good communicator so that information is clearly conveyed and readily understood by the receiver.

There is a strong correlation between social change and education since sometimes education may be the cause of social change and at other times there will be changes in education due to social change. The need for literate and educated people is a prerequisite for the development of a society. Society plays a significant role in education. It can influence it both ways, positively and negatively. The values, morals, and principles of a society will create an education system that upholds the same values, morals,

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and principles. A social worker continues work on societies so they can easily gauge out the problems about any socio personal problems.

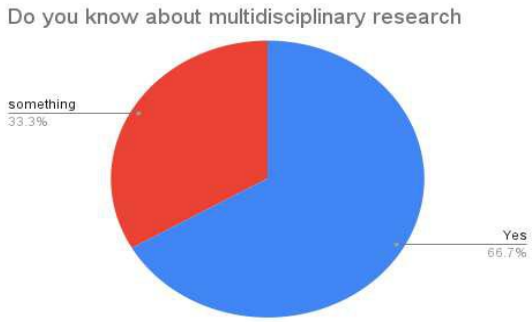
Healthy social enrichment allows us to establish positive relationships with family, friends, teachers, and other people in our lives. Social enrichment involves learning the values, knowledge, and skills of social interaction. As we can say, learners will learn communication and interaction with teachers, other learners, and friends in a school environment. Social and emotional skills are passed on to children directly by those who care for and teach them, as well as indirectly through social relationships within the family or with friends.

An exploratory research has done with B.Ed. students by the researcher. The researcher wants to know that what perspective have the B.Ed. students about multidisciplinary research and collaboration of social work and education.

A sort research has done on same; the findings to be explore and complied for documentation.

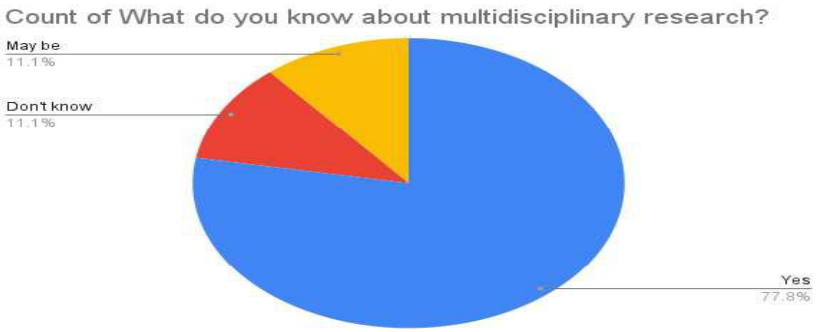
In this short research 9 B.Ed. students have been participated. Researcher has been collected data done through online mode by the. The students provided their valuable feedbacks on many questions. The detailed feedback is -

- Do you know about multidisciplinary research?



33.3% students are know something about multidisciplinary research and rest 66.7% students know verywell about multidisciplinary research.

- What do you know about multidisciplinary research?



77.8% students have enough knowledge about multidisciplinary research and rest 22.2% students are confuse about multidisciplinary research. They said that they hear something about this but not so much aware.

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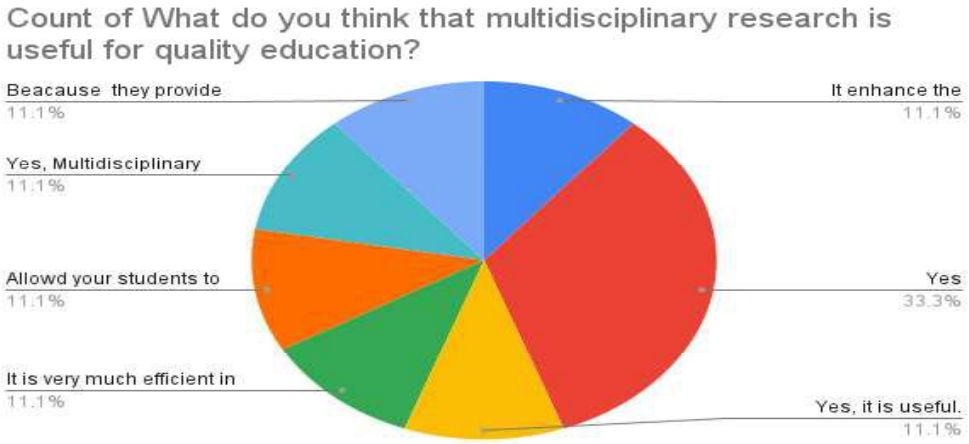
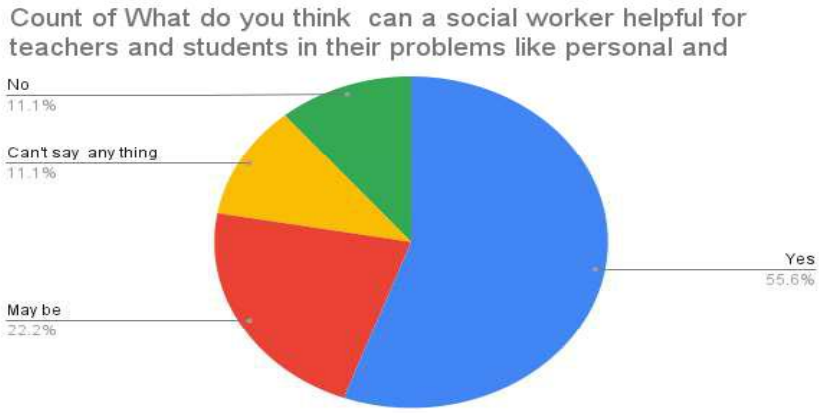
- What do you think that multidisciplinary research is useful for quality education?



When talked about the importance of multidisciplinary research in education the students have more mix responses, like it is very much effective for quality education. It is useful, it enhance the teaching learning process.

- What do you think can a social worker helpful for teachers and students in their problems like personal and professional?



- If we talked about social worker roll in multidisciplinary research the students have mix thoughts about them. Some 22.2% said that there are “no” role for a social worker and “can’t say anything” about that. Other 55.6% said yes to social worker role as problem solver. They do agree with social workers role to solve problems of teachers and students in personal and professional manner.

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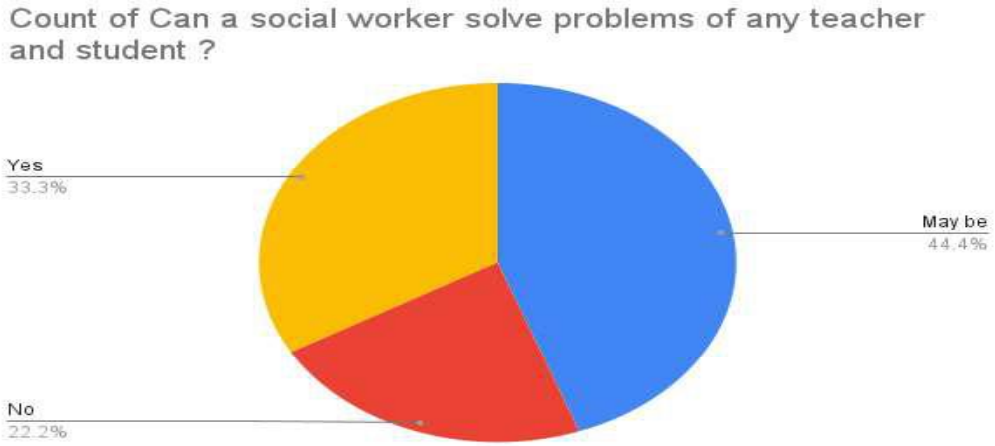
- Can a social worker solve problems of any teacher and student?



The 33.3% students think that a social worker solves the problems of any teachers and students. 44.4% students are having confusion about social worker role in problem solving. Rest 22.2% students denied the role of a social worker in problem solving.

On the bases of their knowledge on multidisciplinary research the students provide feedbacks about collaboration of Social work and education as multidisciplinary research approach for problem solving to enhance our education system and teaching learning process.

A complied detailed suggestions of students on "collaboration of Social work and education as multidisciplinary research approach for problem solving to enhance our education system and teaching learning process" are given below as it is-

Give your suggestions for Social work and education collaboration to improve quality education.

- Education in the village area or in the slums to motivate the children of slums and village and educate them for free.
- Without any discrimination there will be inclusive and skills based learning
- Extracurricular activities and pedagogy skills
- Social worker use education as a key tool inclined and community interaction
- Collaboration education for all students
- Spread Knowledge to them and guide for better education for bright future

Conclusion:

A social worker can do better to improve any situation or problem because a social worker is well trained in assessment of any individuals, groups and Communities. A social worker helps a lot to teachers in need assessment for students and as well as in teaching learning process and techniques. A social worker can be a link or bridge for the students, parents and teachers. There are many more lacks of information and knowledge about a social worker's role and responsibilities as a problem solver in education. Many students as B.Ed. student are not aware about social work and their importance in society. Whenever A B.Ed. student will be becomes a teacher he/she also faces issues in their personal

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and professional life. That time this collaboration would help them in problem solving and also helps them to improve quality education and their performance.

Suggestions: There are copious scope for study and programs to build a knowledge and understanding about multidisciplinary research. If B.Ed. students are aware about multidisciplinary research and social work then they can assess their services, whenever they become a teacher. Teacher and their students would take help from a social worker in their personal as well as professional life issues. This multidisciplinary research will be a game changer or bridge for students and teachers in quality education.

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Yogic Lifestyle and Mental Well Being

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Abstract

Yoga is a positive and normative science. Besides analysing human personality and its development, it also establishes normative standards and suggests methods for achieving these goals. The main goal of yoga psychology is to expand awareness and become the master of one's own mind. Yoga literature dating back thousands of years contains extensive descriptions of the topological elements of the mind as Freud described it in terms of subconscious, conscious and unconscious levels. A healthy yoga practice enables one to have a disease-free body and a sharp mind. Children and teens can build resilience and mental toughness by incorporating yoga and positive psychology principles into their daily routine. The benefits of such measures can be determined by further research with reliable study designs. This study shows the benefits of yoga.

ISBN: 978-93-5912-962-4

CHAPTER 5

Reflections on Female Madness in Literature

Dr. Priya Raghav and *Ms. Sarita*

Abstract

Throughout history women who have transgressed the boundaries assigned to them have been labelled as monsters, madwomen or witches. Moreover, the representations of such women in literature has been controlled by men. It is through male eyes that we see women who have become hysterical, insane or suicidal. In fact, madness was considered as a disease which was inherently feminine. It was not until the advent of psychiatry in the 19th century that a more humane approach was taken towards women who suffered from mental illnesses. How does literature reflect such women? Moreover, what is the relationship between women and madness? In this paper I will look at some of the most prominent literary instances of women who suffer from mental illness. We need to look deeper into such instances of mental health if we are to gain any concrete understanding on the subject. Today mental health is no longer a taboo subject. People are openly acknowledging their personal narratives in dealing with mental health issues. Since the outbreak of Covid issues surrounding mental health have once again been brought out of the closet. Dealing with instances of anxiety, depression, suicidal thoughts and loss have more support as such instances have become widespread during the pande

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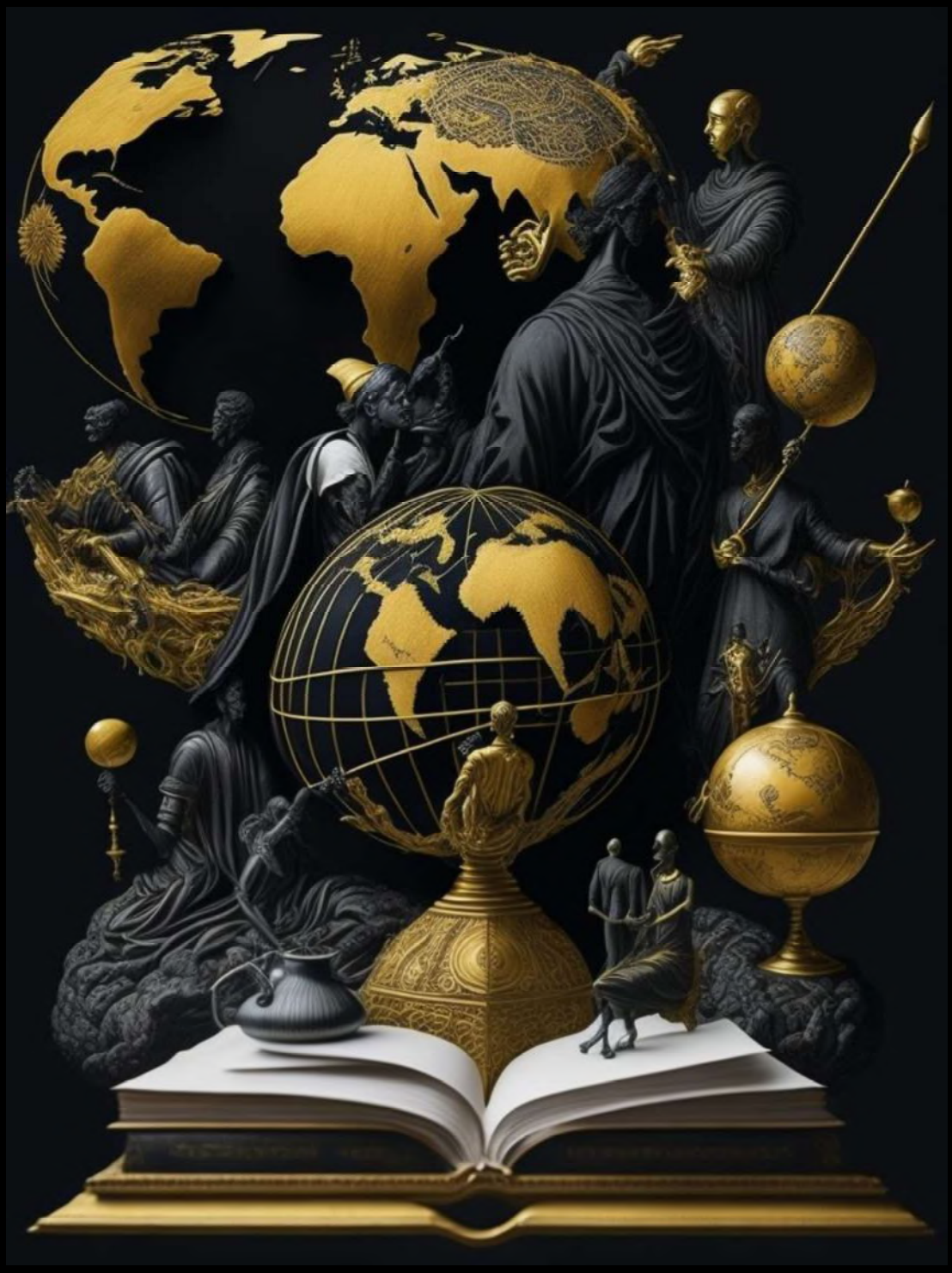

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Conference Monograph

ISBN: 978-93-5912-962-4

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Published by:

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Vill.- Bhadrail, Post- Gurail, Dakshin Dinajpur, West Bengal, Pin- 733142

Phone: 91-9775859039

E-mail: sohelranasarkareducation@gmail.com

Cover design: Dr. Soumya M. Ghosh

Printed at Dhar Brothers, 4, Rammohan Roy Rd, Yogi Para, Garpar, Machuabazar, Kolkata, West Bengal 700009

Shoukat, et al., (2015). Perception of teachers and students towards the functionality of semester system at university level in the context of Pakistani social and administrative set-ups. *International Journal of Teaching and Education.* III. 68-80. 10.20472/TE.2015.3.4.006.

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An exploratory study on Multidisciplinary dimension of social worker role in education to Improve the Quality Education in India

Dr. Pallavi Gangwar

Lingaya's Vidyapeeth
NSS Programme coordinator

Abstract

Education, directly and indirectly, gives learners or young people the opportunity to develop their social skills at school or in after-school level, learners interact with other learners/people, building their relationships with friends, teachers and other students of different ages and cultures, and help them to improving their lives.

Education refers to the discipline that is concerned with methods of teaching and learning in schools or school-like environments, as opposed to various non-formal and informal means of socialization. If we

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can talk about socialization then there is scope to improve quality education techniques in India with the help of social work.

We can define that Social work is a profession in which trained professionals are devoted to helping vulnerable people and communities work through challenges they face in everyday life. Social workers as a professional worker have commitment to advocating Individual, group and communities for improving the lives as individuals, families, groups and societies.

We can improve the quality of teacher education in India with some techniques.

Need-based training: Every teacher has unique skill sets and might face different challenges in each classroom.

Collaboration and involvement of teachers: Collaboration is very important for high-quality teacher training.

Continuous professional development.

A social worker can do better to improve these qualities because a social worker is well trained in assessment of any individuals, groups and Communities. A social worker helps a lot to teachers in need assessment for students and as well as in teaching learning process and techniques.

AS a social worker it's easy to gage out the problems in teaching process because a teacher can have some problems at inter personal level and that effects his/her teaching techniques. We can use social work techniques and methods to resolve his/her problems and motivate them to fulfill their professional responsibilities.

Key Words: Need assessment, teaching techniques, quality education and scope of improvement at individual and group level.

Introduction:

Education is a systematic process by which a person is able to understand anything in scientific way and have skills and knowledge to perform her/his role in society. The literacy rate is 77.70%, with literate males at 84.70% and literate females at 70.30%, according to the National Family Health Survey (NFHS-5) and National Statistical Office: NSO (2021 and 2022).

Education, directly and indirectly, gives learners or young people the opportunity to develop their social skills at school or in after-school level, learners interact with other learners/people, building their relationships with friends, teachers and other students of different ages and cultures, and help them to improving their lives. In ancient time there was a system for education that called Gurukuls. Now a days there are many more schools and institutes for education and knowledge. According to the first Public Report on Basic Education **(PROBE),** this report is written from the perspective of those who despite yearning for good quality education find themselves excluded from learning and acquiring decent education. The data is based on the findings of a survey conducted in 2006, along the lines of an earlier survey conducted by PROBE in 1996 - it 'revisited' the same sample villages covering schools and households, with some modifications. Apart from basic and primary education, this report looks at upper-primary schooling in Bihar, Madhya Pradesh, Uttar Pradesh, and Rajasthan, and in Himachal Pradesh. It highlights major progress in areas such as schooling facilities

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and enrolment rates. At the same time, it finds that fundamental problems remain, such as low classroom activity, poor quality of education, and discrimination due to social disparities in schooling opportunities. It is an indispensible tool for educationists, planners and policymakers, funding agencies, NGOs, and researchers across the social sciences and all those concerned with elementary education in India.

Objectives of the research:

- Identified the scope of social work to help out and resolves the issues of education.
- Need assessment for quality education.
- Assure things for the fruitful quality education in India.
- To make a bridge between education and social work for quality education.

Methodology: An exploratory research done to fulfill the requirement of this research. Exploratory research gives chance to understand the existing researches and records and after the exploring studies to gage out the needs and to do a research for betterment of that topic. So to gage out the gapes and needs an exploratory research to be done by the researcher.

A Good Teacher: A good teacher to be a good friend, guide, supervisor, guardian, leader and mentor. A good teacher has also some qualities like-

Quality of a Good Teacher:

A good teacher should have several qualities and some of them are-

Quality education is supported by three main pillars: availability to qualified teachers, the utilization of quality learning resources and professional development, and the creation of safe and supportive learning environments.

- A good teacher should be a good communicator and must know not only how to communicate with the students but also with the other teachers and school authorities especially when it comes to sharing the problems of the students as well.
- A good teacher is a good listener and must know to listen to the students and know their needs
- Adaptability is a crucial value of a good teacher, especially in these times as schools are moving online
- Good teachers are empathetic and patient with their students and understand what they are feeling and need.

Education: Education refers to the discipline that is concerned with methods of teaching and learning in schools or school-like environments, as opposed to various non-formal and informal means of socialization.

If we can talk about socialization then there is scope to improve quality education techniques in India with the help of social work. A person as a student or as a teacher has to a human being firstly and as a human being they have socio economic or personal problems in their lives. The problems of any student and teacher may affect their performance and their learning process also. We can explain their problems as-

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1. **Personal problem:** A student or a teacher has personal problems like family's issues problem in interaction with group or particular person at workplace or institute, psychological issues, health issues etc.
2. **Social problem:** There are many more social problems like neighborhood problem, school friends' problem, peer pressure and group teasing problem etc.
3. **Economical problem:** this common problem faces by the most of Indians as a teacher or as a student. We can say that economic problem is the most important problem in present scenario. If an economic issue affects teacher's life then there are possibility that it affects their teaching performance and also effect quality education.

These problems may affect their teaching performance and also affects the quality education. There is scope for a social worker to help out them to resolves their issues. Because poor quality education is leading to poor learning outcomes in India, ultimately pushing children out of the education system and leaving them vulnerable to child labor, abuse and violence.

A social worker can use their scientific methods and techniques to help them. AS a social worker it's easy to gage out the problems in teaching process because a teacher can have some problems at inter personal level and that effects his/her teaching techniques. We can use social work techniques and methods to resolve his/her problems and motivate them to fulfill their professional responsibilities.

Social work: Social work is a profession in which trained professionals are devoted to helping vulnerable people and communities work through challenges they face in everyday life. Social workers as a professional worker have commitment to advocating Individual, group and communities for improving the lives as individuals, families, groups and societies. Social workers assist people by helping them cope with issues in their everyday lives, deal with their relationships, and solve personal and family problems. The functions of social work are to change individuals and institutions with respect to individual social welfare. Social development focuses on the institutions of society.

We can improve the quality of teacher education in India with some techniques.

i) Need-based training: Every teacher has unique skill sets and might face different challenges in each classroom.

ii) Collaboration and involvement of teachers: Collaboration is very important for high-quality teacher training.

iii) Continuous professional development.

Many identified tools provided by the School of Social Work include finding their own learning style, how to develop effective lesson plans, reflective teaching and professional development, resources by subject, and effortless teaching among others. The educator role involves giving information to group members and teaching them new skills. To become an effective educator, the social worker should be knowledgeable about all situations and problem solving techniques. In addition she or he should have to be a good communicator so that information is clearly conveyed and readily understood by the receiver.

There is a strong correlation between social change and education since sometimes education may be the cause of social change and at other times there will be changes in education due to social change. The need for literate and educated people is a prerequisite for the development of a society. Society plays a significant role in education. It can influence it both ways, positively and negatively. The values, morals, and principles of a society will create an education system that upholds the same values, morals,

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and principles. A social worker continues work on societies so they can easily gauge out the problems about any socio personal problems.

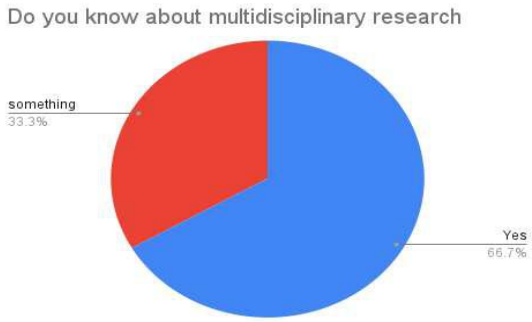
Healthy social enrichment allows us to establish positive relationships with family, friends, teachers, and other people in our lives. Social enrichment involves learning the values, knowledge, and skills of social interaction. As we can say, learners will learn communication and interaction with teachers, other learners, and friends in a school environment. Social and emotional skills are passed on to children directly by those who care for and teach them, as well as indirectly through social relationships within the family or with friends.

An exploratory research has done with B.Ed. students by the researcher. The researcher wants to know that what perspective have the B.Ed. students about multidisciplinary research and collaboration of social work and education.

A sort research has done on same; the findings to be explore and complied for documentation.

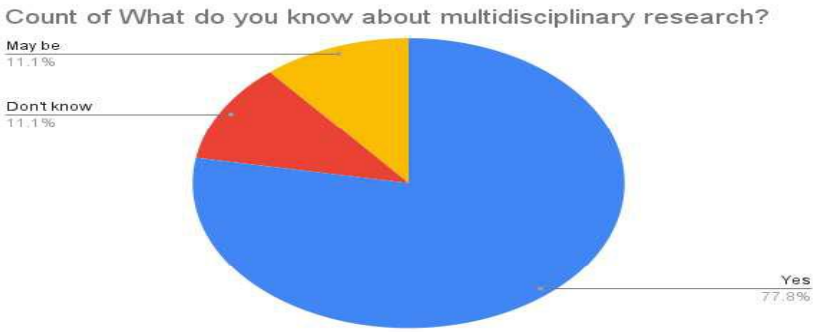
In this short research 9 B.Ed. students have been participated. Researcher has been collected data done through online mode by the. The students provided their valuable feedbacks on many questions. The detailed feedback is -

- Do you know about multidisciplinary research?



33.3% students are know something about multidisciplinary research and rest 66.7% students know verywell about multidisciplinary research.

- What do you know about multidisciplinary research?



77.8% students have enough knowledge about multidisciplinary research and rest 22.2% students are confuse about multidisciplinary research. They said that they hear something about this but not so much aware.

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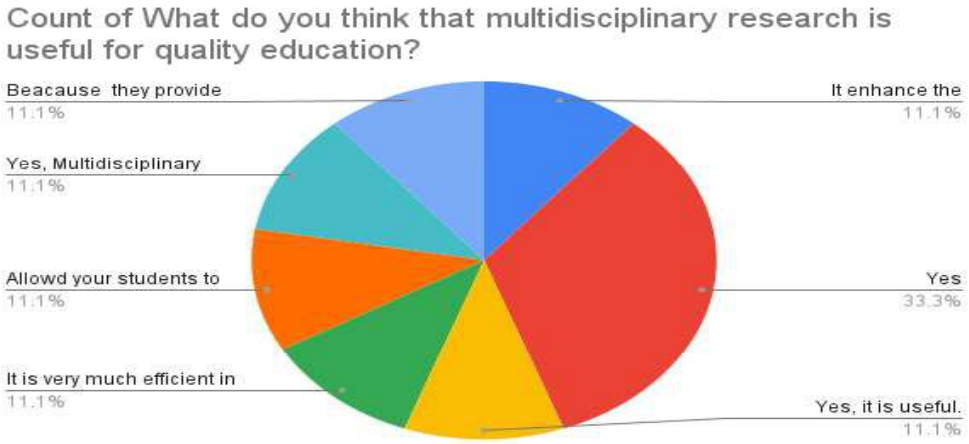
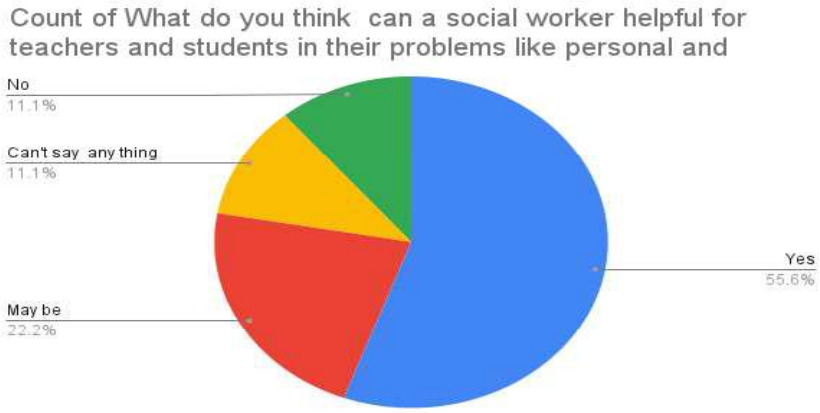
- What do you think that multidisciplinary research is useful for quality education?



When talked about the importance of multidisciplinary research in education the students have more mix responses, like it is very much effective for quality education. It is useful, it enhance the teaching learning process.

- What do you think can a social worker helpful for teachers and students in their problems like personal and professional?



- If we talked about social worker roll in multidisciplinary research the students have mix thoughts about them. Some 22.2% said that there are “no” role for a social worker and “can’t say anything” about that. Other 55.6% said yes to social worker role as problem solver. They do agree with social workers role to solve problems of teachers and students in personal and professional manner.

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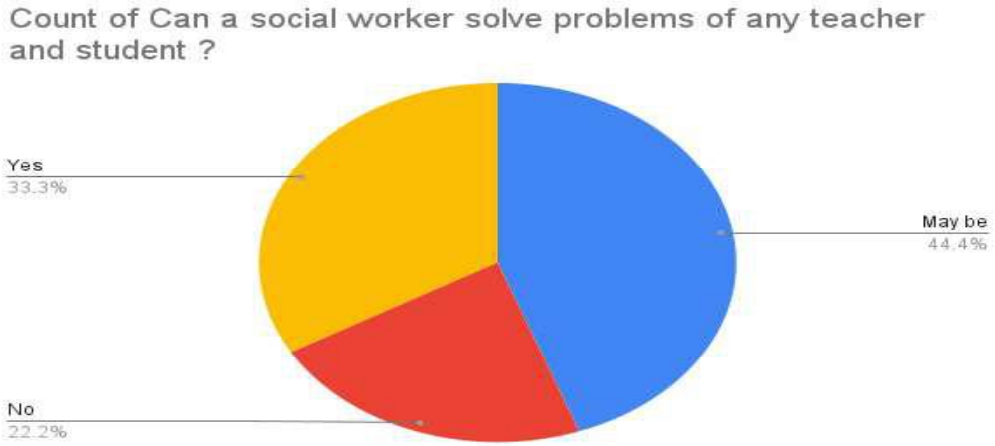
- Can a social worker solve problems of any teacher and student?



The 33.3% students think that a social worker solves the problems of any teachers and students. 44.4% students are having confusion about social worker role in problem solving. Rest 22.2% students denied the role of a social worker in problem solving.

On the bases of their knowledge on multidisciplinary research the students provide feedbacks about collaboration of Social work and education as multidisciplinary research approach for problem solving to enhance our education system and teaching learning process.

A complied detailed suggestions of students on "collaboration of Social work and education as multidisciplinary research approach for problem solving to enhance our education system and teaching learning process" are given below as it is-

Give your suggestions for Social work and education collaboration to improve quality education.

- Education in the village area or in the slums to motivate the children of slums and village and educate them for free.
- Without any discrimination there will be inclusive and skills based learning
- Extracurricular activities and pedagogy skills
- Social worker use education as a key tool inclined and community interaction
- Collaboration education for all students
- Spread Knowledge to them and guide for better education for bright future

Conclusion:

A social worker can do better to improve any situation or problem because a social worker is well trained in assessment of any individuals, groups and Communities. A social worker helps a lot to teachers in need assessment for students and as well as in teaching learning process and techniques. A social worker can be a link or bridge for the students, parents and teachers. There are many more lacks of information and knowledge about a social worker's role and responsibilities as a problem solver in education. Many students as B.Ed. student are not aware about social work and their importance in society. Whenever A B.Ed. student will be becomes a teacher he/she also faces issues in their personal

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and professional life. That time this collaboration would help them in problem solving and also helps them to improve quality education and their performance.

Suggestions: There are copious scope for study and programs to build a knowledge and understanding about multidisciplinary research. If B.Ed. students are aware about multidisciplinary research and social work then they can assess their services, whenever they become a teacher. Teacher and their students would take help from a social worker in their personal as well as professional life issues. This multidisciplinary research will be a game changer or bridge for students and teachers in quality education.

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Yogic Lifestyle and Mental Well Being

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Abstract

Yoga is a positive and normative science. Besides analysing human personality and its development, it also establishes normative standards and suggests methods for achieving these goals. The main goal of yoga psychology is to expand awareness and become the master of one's own mind. Yoga literature dating back thousands of years contains extensive descriptions of the topological elements of the mind as Freud described it in terms of subconscious, conscious and unconscious levels. A healthy yoga practice enables one to have a disease-free body and a sharp mind. Children and teens can build resilience and mental toughness by incorporating yoga and positive psychology principles into their daily routine. The benefits of such measures can be determined by further research with reliable study designs. This study shows the benefits of yoga.

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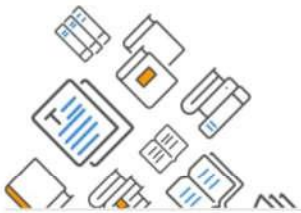

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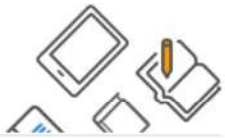

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Position Control Using a Physics-Based Model for Biomimetic Underwater Propulsor Actuated by IPMC

Ankur Gupta, Satyendra K. Prajapati & Sujoy Mukherjee

Conference paper | First Online: 04 October 2022

Part of the Lecture Notes in Mechanical Engineering book series (LNME)

Abstract

In this paper, an effort is made to provide a better position control model using the physics-based model for biomimetic underwater propulsor actuated by ionic polymer-metal composite (IPMC). The biomimetic underwater propulsor considering the body caudal fin-type locomotion is undertaken where the oscillating fin tail of the original fish is

replaced by a fin tail comprising an active IPMC beam. The supported cantilevered IPMC beam model is analyzed and the relations for displacement and velocity are studied using physics-based modeling in a fluidic environment. The robotic swimming velocity response due to the active IPMC tail fin deflection under applied electric potential has been observed. Considering the Laplace transform of the mathematical model, the transfer function relating the tail tip deflection and input voltage has been generated and proportional, integral and derivative (PID) closed-loop controller has been developed to control the deflection from IPMC in an underwater environment. The controlled and efficient desired displacement response of 1 mm through simulations was achieved. The PID gains are tuned using the Ziegler–Nichols tuning method to make the output response quick and robust.

Keywords

Position control **Physics-based model** **PID control** **IPMC** **Underwater propulsor**

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About this paper

Cite this paper

Gupta, A., Prajapati, S.K., Mukherjee, S. (2023). **Position Control Using a Physics-Based Model for Biomimetic Underwater Propulsor A**ctuated by IPMC. In: Gupta, V.K., Amarnath, C., Tandon, P., Ansari, M.Z. (eds) Recent Advances in Machines and Mechanisms. Lecture Notes in Mechanical Engineering. Springer, Singapore. https://doi.org/10.1007/978-981-19-3716-3_53

.RIS .ENW .BIB

DOI	Published	Publisher Name
https://doi.org/10.1007/978-981-19-3716-3_53	04 October 2022	Springer, Singapore

Print ISBN	Online ISBN	eBook Packages
978-981-19-3715-6	978-981-19-3716-3	Engineering Engineering (R0)

CHAPTER 5

Reflections on Female Madness in Literature

Dr. Priya Raghav and *Ms. Sarita*

Abstract

Throughout history women who have transgressed the boundaries assigned to them have been labelled as monsters, madwomen or witches. Moreover, the representations of such women in literature has been controlled by men. It is through male eyes that we see women who have become hysterical, insane or suicidal. In fact, madness was considered as a disease which was inherently feminine. It was not until the advent of psychiatry in the 19th century that a more humane approach was taken towards women who suffered from mental illnesses. How does literature reflect such women? Moreover, what is the relationship between women and madness? In this paper I will look at some of the most prominent literary instances of women who suffer from mental illness. We need to look deeper into such instances of mental health if we are to gain any concrete understanding on the subject. Today mental health is no longer a taboo subject. People are openly acknowledging their personal narratives in dealing with mental health issues. Since the outbreak of Covid issues surrounding mental health have once again been brought out of the closet. Dealing with instances of anxiety, depression, suicidal thoughts and loss have more support as such instances have become widespread during the pande

eywords: madness, hysteria, melancholy.

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A Multidisciplinary Approach in Innovation Paradigm

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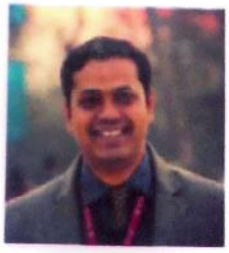

Prof. Ramesh Chandra Panda
Chief Scientist
Wegrow Private Limited
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CONTENT

CHAPTER - 11

Effect of Augmented Reality on Online Beauty Accessory Purchase during Covid 19 Pandemic: A study of L'Oréal Paris Makeup Section

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Abstract:

The COVID-19 pandemic that happened in the course of 2020 affects the financial area in the cosmetic Industry. Shoppers can general lyutilize on-line channels to diminish eye to eye contact with consumers. This examination expects to interrupt down the result of Augmented Reality during COVID-19 pandemic on retail customer conduct. This research utilizes subjective ways with auxiliary data sources non heritable from Delhi NCR working professionals and University students were taken. For this research qualitative analytical technique have been used with the help of questionnaire and data has been collected with the help of online voice records through social media, so this research is an exploratory cum descriptive research the outcomes show that the patterns during the COVID-19 pandemic are internet rooming and pure web primarily based shopping. This exploration is needed to be valuable for advertisers however Augmented Reality helps in rising retail showcasing procedures throughout the COVID-19 pandemic and increase a superior agreement and a lot of in-depth viewpoints how this new innovation (AR) creates interest in web based looking and make it more powerful for the corrective business.

Paradigm Shift in Business and Management

OUTCOME BASED STRATEGIC PERFORMANCE MANAGEMENT SYSTEM WITH STAKEHOLDERS' PERSPECTIVE

Shashank Chaudhary
Dr. Mona Sahay • Dr. Suruchi Satsangi

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Emerging Technologies in Education

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RED'SHINE PUBLICATION
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Stockholm, Sweden
Call: +46 761508180
Email: info.redshine.se@europe.com
Website: www.redshine.se
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ISBN: 978-91-987980-4-3
ISBN-10: 91-987980-4-9
DOI: 10.25215/9198798049
DIP: 18.10.9198798014
Price: kr 100
First Edition: August, 2022

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www.redshine.se | info.redshine.se@europe.com
Printed in Stockholm | Title ID: 9198783041

INDEX

ISBN: 978-91-987980-4-3

DIP: 18.10.9198798014.004

ICT AND INCLUSION – SAMR MODEL

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❖ ABSTRACT:

Usage of Information and communication technology (ICT) as a subject in general and as a necessity in particular, has become imperative in schools and colleges. Assistive technology, used for inclusive classroom, is a big help in reducing the big chasm between what people can do and what needs to be done by them. This technology helps to bring special people at par with those in the mainstream. Understanding the use of technology in language learning, in particular, has helped to arouse the curiosity of both educators and their charges. The current paper describes an attempt to teach English language through an inclusive pedagogical perspective by combining ICT and Special Education. Besides ICT, it shall also discuss the need of Assistive Technology in the classroom. It investigates how a creative application of information and communication technology can aid in the creation of inclusive web environments. The study specifically focuses on how students respond to diversity and e-inclusion using the SAMR model. SAMR, a model designed to assist educators in embedding technology skills into the classroom learning process, is one of the language learning technologies.

Keywords: *ICT, Inclusive Classroom, SAMR Model*

ISBN: 978-91-987980-4-3

❖ INCLUSIVE CLASSROOMS AND THE ROLE OF ICT:

The term 'Inclusion' encompasses the acceptance that all students, regardless of their labels, should be a part of the general education community. The inclusion philosophy advocates for the abolition of the dual- special and general education systems, in favour of a merged system that is responsive to the needs of all students. Generally, inclusive classrooms include only students with special needs, impairments, or disabilities. However, there is a recent shift toward inclusivity that includes more people than just those with special needs. Sometimes, inclusive classrooms refer to taking the initiative to ensure that the classroom includes students of various races, socioeconomic backgrounds, cultures, and sexual orientations. Its purpose is to ensure that all of these students are treated fairly and that they have access to technology and general education. Inclusive classrooms seek to bridge the gap between the haves and have-nots, as well as any prejudices we may harbour toward one another.

The International policy and legislation on the rights of people with disabilities strongly favours children with disabilities receiving an inclusive, rather than a segregated, education. Children with special needs, including those with disabilities, are valued members of the school community. It is the responsibility of the teachers to help create a positive school environment that values inclusion and provides equal opportunities for children with special abilities, from diverse social backgrounds, and with diverse learning needs. As a result, an inclusive classroom promotes learning for all children, including those with special abilities, from diverse social backgrounds, and with a wide range of learning needs. The Information and Communication Technologies (ICT) can provide good opportunities to spread and create inclusion processes: bringing together different people and subjects moving from an informal to a formal dimension and vice versa, during the learning process can enhance and develop a common background dimension to meet people's diverse educational needs [Della Volpe, V. (2012)]. In an inclusive context, we can provide more learning opportunities by encouraging knowledge development and enhancing the process of developing competencies in relation to everyone's potential.

ICT is an abbreviation for information and communication technology. According to Daniels (2002), ICT is regarded as one of the vital structure of modern society. Many countries now consider understanding ICT,

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mastering its fundamental skills and concepts and introducing ICT as the heart of Education system. Today, technology has brought entire mankind together and transformed the earth into a global village. The previous two decades have witnessed a sea change in all business and governance practices around the world due to the presence of digital media and technological advancement. Not to be left behind, even the sphere of education has become more learner-centric. It is at such a juncture that ICT has gained prominence in education.

❖ ASSISTIVE TECHNOLOGY IN THE INCLUSIVE CLASSROOM:

When it comes to the use of ICT for SEN students, it is critical to ensure that the technology does not prove a major obstacle in their path, it ought to be usable by them, it must be easily accessible. The term "accessible ICTs" refers to a comprehensive array of assistive and conventional technologies and set-ups that can allow students with disabilities to receive an inclusive education. Assistive technology (AT) is another type of accessible ICT. It includes those products, equipment and systems or any service that augment the learning of people with disabilities and also provide ease in their day to day life. The adaptability of a person towards technology may be repressed by a variety of disabilities viz. physical, sensory, emotional, or cognitive. ICTs that can be easily handled, help students with disabilities to receive an education and become self-sufficient socially as well as economically. They promote unbiased learning opportunities by allowing students to communicate with each other and with the teachers. Through ICT, learning materials are easily available to the students with various physical, sensory, emotional, or cognitive disabilities so that they can complete course work, assignments, and take exams.

❖ CHALLENGE OF TEACHING-LEARNING ENGLISH LANGUAGE:

'Assistive Technology' helps SEN students to enhance their participation and achievement in their educational programs. Academic Learning aids for reading, writing of English language are easily available to assist students with learning disabilities. In India, English language is a foreign language for most of the students. Learning English is imperative since it is the main medium of instruction in most of the educational institutions. Even if one follows primary education in one's own mother

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tongue, the key terms used are usually given in English language. Thus, learning English language becomes imperative. Moreover, English forms a binding factor, a sort of cementing factor, for students when they step out in the society to make a mark of their own. The challenge of teaching-learning of English language in an inclusive classroom has been simplified to a certain extent with the use of ICT.

According to Jeremy Harmer, (The Practice of English Language Teaching, 4th edition, 2007), "the word innovation means something new, which means new ideas to change things for better." He claims that all the tools used for teaching language around the world are not absolutely fruitful. There is still a need to search and develop new methods to improve the teaching-learning process.

Technology plays a major role, when teachers need to cover a wide range of content in a short period of time by reducing the need to take curriculum at a slower pace. Students with special needs may benefit from assistive technology that allows them to keep up with their peers. For example, students with Dyslexia can benefit from audio-books or e-books, students with learning disabilities can access 'Screen Reading Software' to help them in their studies. The CAST UDL Book Builder(http://bookbuilder.cast.org/),a free digital book database and book , developed and hosted by the Centre for Applied Special Technology (CAST), helps educators "create, share, publish, and read digital books that support diverse learners according to their individual needs, interests, and skills." Digital Posters are a blessing to both creative students and those with learning disabilities, where students get full creative freedom and play with their imagination. s (http://www.learnnc.org/lp/pages/6542)

❖ SAMR MODEL:

The list of smart innovative ICT Assistive Technologies is endless. As students become more techno- savvy, educators must persevere with advancement in technology and have the skillset to integrate them into the classroom teaching.

According to Tapscott (2009), "…the 'Net Generation' expects and even demands innovation in all aspects of their lives, including education."

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The number of innovations in technology in the field of education has an upward graph but one needs to gauge and judge the quality of integration into the classroom. The SAMR model is a tool that educators can use to determine not only how many technologies are being used, but also check the level of integration they are being used. The SAMR model was developed by Dr. Ruben Puentedura, recipient of a Phi Beta Kappa teaching award, to be used by teachers to evaluate how they incorporate technology into their instructional practice. This model helps to create the curriculum in such a way that students also learn the technological skills needed in the 21st century (Hilton, 2016).

The objective of the SAMR model is to aid in the planning and assessment of the levels of technologies used in the classroom (Jacobs-Israel, & Moorefield-Lang, 2013). This model works towards helping the teachers, administrators, and educators in examining the use of technology in the classroom (Jacobs-Israel et al., 2013). The SAMR model helps the educator to evaluate the level at which the students are using technology and "…become creators of their own knowledge" (Green, 2014, p.18).

The role of the educator is, to connect Bloom's Taxonomy with SAMR steps so that the as the lesson plan's objectives move from lower to the upper level of Bloom's Taxonomy concurrently with the SAMR levels. The three lower levels of Bloom's Taxonomy ((Remember, Understand, Apply) are associated with the two Enhancement levels of SAMR (Substitution, Augmentation), while the two Transformation levels of SAMR (Modification, Redefinition) are associated with the upper levels of Bloom (Analyze, Evaluate, Create). There is a simple ordering system within each grouping, Remember-type tasks are primarily associated with S-level uses of the technology, Understand-type tasks are associated with either S- or A-level uses of the technology etc. The diagram below depicts this relationship.

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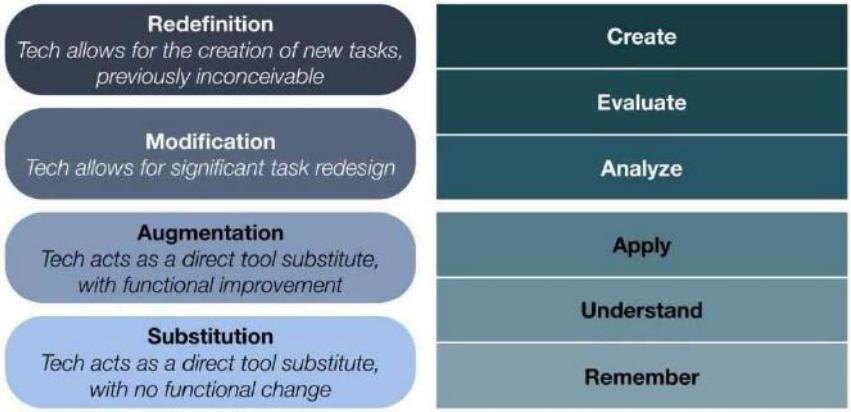

Citing the example of digital story-telling, which is a very creative form used by faculty and students and loved by those with special needs, where users create and share collaborative stories, one can align the levels of Bloom's Taxonomy with the SAMR model. From writing a story through the SAMR model, (Substitution level) to writing the story on the Story telling tool or app, progressing further to the augmentation level by making it three dimensional, to the modification level of collaboration, to making something new where students share their stories with each other, add a new aspect in the story and collaborate with each other creating another threads where other students can begin or end a story of their own, which was something inconceivable in a real life story telling class, especially in an inclusive classroom.

SAMR is an acronym for the 4 levels of technology integration: *Substitution, Augmentation, Modification and Redefinition*. It aims at helping the educators to pick and choose the right strategy to effectively teach the lesson at hand.

Substitution Level: Basically, at this level, technology is used as a mere well-thought-out ancillary with no purposeful change. The process used at this level is up gradation of tools, without changing its functional use. The mantra used is to 'substitute' traditional classroom teaching activities with digital versions. Educators can deliver both synchronous and asynchronous versions of their lectures or instructional videos so that students can see them at their own pace. Flash cards Deluxe, Easy Word Count, Franklin Speller etc. are those applications which help students

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with learning disabilities to understand the written word properly and use the same in their assignments.

Citing the example of writing assignments, earlier one used to rely on pen-paper tools to complete their assignments. This has been replaced with applications like Microsoft Word, Google Docs etc. to write and submit the assignments. These applications are a big help to students with learning disabilities

Augmentation Level: At this level too, technology is just a tool substitute with a few useful improvements. Educators research and apply interactive digital enhancements like comments, hyperlinks etc. to the technology that they are using, in this level. There is no change in the content, at the same time, the students can take advantage of the digital features to enrich their understanding. Dyslexic students can also write with their voice using Dictation tools. Text to Speech readout has been made possible through applications like 'NaturalReader' which helps students who cannot decipher the written word properly.

For example students use the various functions provided by Microsoft Word like spell check, grammar check, Thesaurus etc. while writing their assignments through the application, in fact students with dyslexia truly benefit from these. Another example is that instead of giving paper quizzes, the teachers can give quiz through Kahoot or Gamify etc.

Modification Level: It is in this level that educators use technology as an instrument to make major remodeling of entire lessons or even small portions to enhance student learning. For example, students with physical disabilities can use a voice-to-text application for writing and submitting an assignment. Also, the 'share and comment' features of Google Docs help the students to work on the rough drafts of feedbacks and assignments before submission.

Redefinition Level: At this level teachers create new activities which were hitherto unheard of in traditional classrooms. This infuses a new energy in the teaching-learning process. For example, the students can be asked to create multimedia presentations with the help of various applications and tools. Applications like 'Virtual Pen Pals', 'Virtual Field Trips' helps students with disabilities to connect with their counterparts

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around the world and visit places that they would have read in books. In this level, students learn to create their own blogs, even if they are differently abled.

To summarize, the SAMR Model for technology integration proves a big help to teachers while evaluating the suitability and effectiveness of technology for their classrooms, simplifying the process of selection and implementation of that technology. SAMR is just a tool-box and the objective over here is not to use this so called erudite box but to use the one most suited for the task at hand.

❖ CONCLUSION:

Through the study one can come to the conclusion that all students can benefit through the use of ICT. In this way, students, in an inclusive classroom, will get engaged in the teaching-learning process as well as in the development of the course through the various topics. The cognitive, meta-cognitive, and social skills of the students will be enhanced due to working in online groups. ICT aids in advancing the inclusion processes and students need such experiences for their academic progress. The use and testing of methods and practices of inclusive education, helps strengthen the self-esteem of students and create a sense of belonging to a learning community where every student gets equal opportunity and a positive atmosphere to interact and collaborate with others. Students will develop a sense of individual responsibility while doing justice to the task at hand.

This study proposes further research to take place in the area of inclusive education at the university level using the SAMR model. More research is required on the model itself and also on the application of the model. Using this model, research can be carried out to demonstrate the level of technological integration occurring within a given institution. The findings of that study can help to allocate resources to support further technological integration in the classroom.

- Through the study one can come to the conclusion that all students can benefit through the use of ICT. Students, including disabled ones, will get involved in the learning process and in the construction of the course through the various topics.

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- Working in online groups will help to develop cognitive, meta-cognitive, and social skills of the students.
- ICT can advance the inclusion processes and they need such experiences for their academic progress.
- Use and testing of methods and practices of inclusive education, will help strengthen their self-esteem, create a sense of belonging to a learning community where every student gets the same educational opportunities and a positive atmosphere to interact and collaborate with others.
- Students will have a sense of individual responsibility in their performance of assigned tasks.

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ISBN: 978-91-987980-4-3

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ISBN: 978-91-987980-4-3

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A Multidisciplinary Approach in Innovation Paradigm

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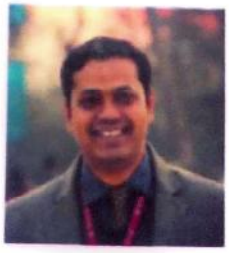

Prof. Ramesh Chandra Panda
Chief Scientist
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CONTENT

CHAPTER – 12

...vation and Future Trends in Corporate Cultures

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Dr. Samriti Mahajan

...iate Professor & Head of Department, School of Commerce & Management (Lingaya's Vidyapeeth Faridabad, Haryana)

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...on is a generic term, and this can happen on various levels and ...point of time. It is the term that involves modernization, ...n and development. Innovations in the corporate work ...ents are essential in developing new types of employment ...ities that eventually enhance the growth of individuals besides ...any.

...ment cultures in corporate set-ups pioneers eventually to lend ...ort to the already unconventional reasoning and its application. ... environments that encourage a culture of advancement by and ...y into the conviction that development isn't the region of top ... however can emerge out of anybody and in any department ... company.

...s and corporate cultures that are innovative and advancing ...ly measure representatives in light of measurements like worth

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ISBN: 978-93-5812-990-8

March 02-04, 2023

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A Multidisciplinary Approach in Innovation Paradigm

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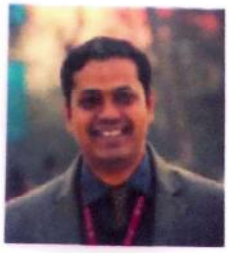

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CHAPTER - 11

Effect of Augmented Reality on Online Beauty Accessory Purchase during Covid 19 Pandemic: A study of L'Oréal Paris Makeup Section

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Abstract:

The COVID-19 pandemic that happened in the course of 2020 affects the financial area in the cosmetic Industry. Shoppers can general lyutilize on-line channels to diminish eye to eye contact with consumers. This examination expects to interrupt down the result of Augmented Reality during COVID-19 pandemic on retail customer conduct. This research utilizes subjective ways with auxiliary data sources non heritable from Delhi NCR working professionals and University students were taken. For this research qualitative analytical technique have been used with the help of questionnaire and data has been collected with the help of online voice records through social media, so this research is an exploratory cum descriptive research the outcomes show that the patterns during the COVID-19 pandemic are internet rooming and pure web primarily based shopping. This exploration is needed to be valuable for advertisers however Augmented Reality helps in rising retail showcasing procedures throughout the COVID-19 pandemic and increase a superior agreement and a lot of in-depth viewpoints how this new innovation (AR) creates interest in web based looking and make it more powerful for the corrective business.

Paradigm Shift in Business and Management

OUTCOME BASED STRATEGIC PERFORMANCE MANAGEMENT SYSTEM WITH STAKEHOLDERS' PERSPECTIVE

Shashank Chaudhary
Dr. Mona Sahay • Dr. Suruchi Satsangi

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Emerging Technologies in Education

Edited by: *Dr.Dilipkumar A. Ode, Madan Mohan Laddunuri, Dr. Nana N Shejwal, Prof. M Devendra, Bijoy Sarak, Dr.T.Milton, Dr. Pavankumar R. Sonawane & Pragati Singh*

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Stockholm, Sweden
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ISBN: 978-91-987980-4-3
ISBN-10: 91-987980-4-9
DOI: 10.25215/9198798049
DIP: 18.10.9198798014
Price: kr 100
First Edition: August, 2022

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www.redshine.se | info.redshine.se@europe.com
Printed in Stockholm | Title ID: 9198783041

INDEX

ISBN: 978-91-987980-4-3

DIP: 18.10.9198798014.004

ICT AND INCLUSION – SAMR MODEL

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❖ ABSTRACT:

Usage of Information and communication technology (ICT) as a subject in general and as a necessity in particular, has become imperative in schools and colleges. Assistive technology, used for inclusive classroom, is a big help in reducing the big chasm between what people can do and what needs to be done by them. This technology helps to bring special people at par with those in the mainstream. Understanding the use of technology in language learning, in particular, has helped to arouse the curiosity of both educators and their charges. The current paper describes an attempt to teach English language through an inclusive pedagogical perspective by combining ICT and Special Education. Besides ICT, it shall also discuss the need of Assistive Technology in the classroom. It investigates how a creative application of information and communication technology can aid in the creation of inclusive web environments. The study specifically focuses on how students respond to diversity and e-inclusion using the SAMR model. SAMR, a model designed to assist educators in embedding technology skills into the classroom learning process, is one of the language learning technologies.

Keywords: *ICT, Inclusive Classroom, SAMR Model*

ISBN: 978-91-987980-4-3

❖ INCLUSIVE CLASSROOMS AND THE ROLE OF ICT:

The term 'Inclusion' encompasses the acceptance that all students, regardless of their labels, should be a part of the general education community. The inclusion philosophy advocates for the abolition of the dual- special and general education systems, in favour of a merged system that is responsive to the needs of all students. Generally, inclusive classrooms include only students with special needs, impairments, or disabilities. However, there is a recent shift toward inclusivity that includes more people than just those with special needs. Sometimes, inclusive classrooms refer to taking the initiative to ensure that the classroom includes students of various races, socioeconomic backgrounds, cultures, and sexual orientations. Its purpose is to ensure that all of these students are treated fairly and that they have access to technology and general education. Inclusive classrooms seek to bridge the gap between the haves and have-nots, as well as any prejudices we may harbour toward one another.

The International policy and legislation on the rights of people with disabilities strongly favours children with disabilities receiving an inclusive, rather than a segregated, education. Children with special needs, including those with disabilities, are valued members of the school community. It is the responsibility of the teachers to help create a positive school environment that values inclusion and provides equal opportunities for children with special abilities, from diverse social backgrounds, and with diverse learning needs. As a result, an inclusive classroom promotes learning for all children, including those with special abilities, from diverse social backgrounds, and with a wide range of learning needs. The Information and Communication Technologies (ICT) can provide good opportunities to spread and create inclusion processes: bringing together different people and subjects moving from an informal to a formal dimension and vice versa, during the learning process can enhance and develop a common background dimension to meet people's diverse educational needs [Della Volpe, V. (2012)]. In an inclusive context, we can provide more learning opportunities by encouraging knowledge development and enhancing the process of developing competencies in relation to everyone's potential.

ICT is an abbreviation for information and communication technology. According to Daniels (2002), ICT is regarded as one of the vital structure of modern society. Many countries now consider understanding ICT,

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mastering its fundamental skills and concepts and introducing ICT as the heart of Education system. Today, technology has brought entire mankind together and transformed the earth into a global village. The previous two decades have witnessed a sea change in all business and governance practices around the world due to the presence of digital media and technological advancement. Not to be left behind, even the sphere of education has become more learner-centric. It is at such a juncture that ICT has gained prominence in education.

❖ ASSISTIVE TECHNOLOGY IN THE INCLUSIVE CLASSROOM:

When it comes to the use of ICT for SEN students, it is critical to ensure that the technology does not prove a major obstacle in their path, it ought to be usable by them, it must be easily accessible. The term "accessible ICTs" refers to a comprehensive array of assistive and conventional technologies and set-ups that can allow students with disabilities to receive an inclusive education. Assistive technology (AT) is another type of accessible ICT. It includes those products, equipment and systems or any service that augment the learning of people with disabilities and also provide ease in their day to day life. The adaptability of a person towards technology may be repressed by a variety of disabilities viz. physical, sensory, emotional, or cognitive. ICTs that can be easily handled, help students with disabilities to receive an education and become self-sufficient socially as well as economically. They promote unbiased learning opportunities by allowing students to communicate with each other and with the teachers. Through ICT, learning materials are easily available to the students with various physical, sensory, emotional, or cognitive disabilities so that they can complete course work, assignments, and take exams.

❖ CHALLENGE OF TEACHING-LEARNING ENGLISH LANGUAGE:

'Assistive Technology' helps SEN students to enhance their participation and achievement in their educational programs. Academic Learning aids for reading, writing of English language are easily available to assist students with learning disabilities. In India, English language is a foreign language for most of the students. Learning English is imperative since it is the main medium of instruction in most of the educational institutions. Even if one follows primary education in one's own mother

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tongue, the key terms used are usually given in English language. Thus, learning English language becomes imperative. Moreover, English forms a binding factor, a sort of cementing factor, for students when they step out in the society to make a mark of their own. The challenge of teaching-learning of English language in an inclusive classroom has been simplified to a certain extent with the use of ICT.

According to Jeremy Harmer, (The Practice of English Language Teaching, 4th edition, 2007), "the word innovation means something new, which means new ideas to change things for better." He claims that all the tools used for teaching language around the world are not absolutely fruitful. There is still a need to search and develop new methods to improve the teaching-learning process.

Technology plays a major role, when teachers need to cover a wide range of content in a short period of time by reducing the need to take curriculum at a slower pace. Students with special needs may benefit from assistive technology that allows them to keep up with their peers. For example, students with Dyslexia can benefit from audio-books or e-books, students with learning disabilities can access 'Screen Reading Software' to help them in their studies. The CAST UDL Book Builder(http://bookbuilder.cast.org/),a free digital book database and book , developed and hosted by the Centre for Applied Special Technology (CAST), helps educators "create, share, publish, and read digital books that support diverse learners according to their individual needs, interests, and skills." Digital Posters are a blessing to both creative students and those with learning disabilities, where students get full creative freedom and play with their imagination. s (http://www.learnnc.org/lp/pages/6542)

❖ SAMR MODEL:

The list of smart innovative ICT Assistive Technologies is endless. As students become more techno- savvy, educators must persevere with advancement in technology and have the skillset to integrate them into the classroom teaching.

According to Tapscott (2009), "…the 'Net Generation' expects and even demands innovation in all aspects of their lives, including education."

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The number of innovations in technology in the field of education has an upward graph but one needs to gauge and judge the quality of integration into the classroom. The SAMR model is a tool that educators can use to determine not only how many technologies are being used, but also check the level of integration they are being used. The SAMR model was developed by Dr. Ruben Puentedura, recipient of a Phi Beta Kappa teaching award, to be used by teachers to evaluate how they incorporate technology into their instructional practice. This model helps to create the curriculum in such a way that students also learn the technological skills needed in the 21st century (Hilton, 2016).

The objective of the SAMR model is to aid in the planning and assessment of the levels of technologies used in the classroom (Jacobs-Israel, & Moorefield-Lang, 2013). This model works towards helping the teachers, administrators, and educators in examining the use of technology in the classroom (Jacobs-Israel et al., 2013). The SAMR model helps the educator to evaluate the level at which the students are using technology and "…become creators of their own knowledge" (Green, 2014, p.18).

The role of the educator is, to connect Bloom's Taxonomy with SAMR steps so that the as the lesson plan's objectives move from lower to the upper level of Bloom's Taxonomy concurrently with the SAMR levels. The three lower levels of Bloom's Taxonomy ((Remember, Understand, Apply) are associated with the two Enhancement levels of SAMR (Substitution, Augmentation), while the two Transformation levels of SAMR (Modification, Redefinition) are associated with the upper levels of Bloom (Analyze, Evaluate, Create). There is a simple ordering system within each grouping, Remember-type tasks are primarily associated with S-level uses of the technology, Understand-type tasks are associated with either S- or A-level uses of the technology etc. The diagram below depicts this relationship.

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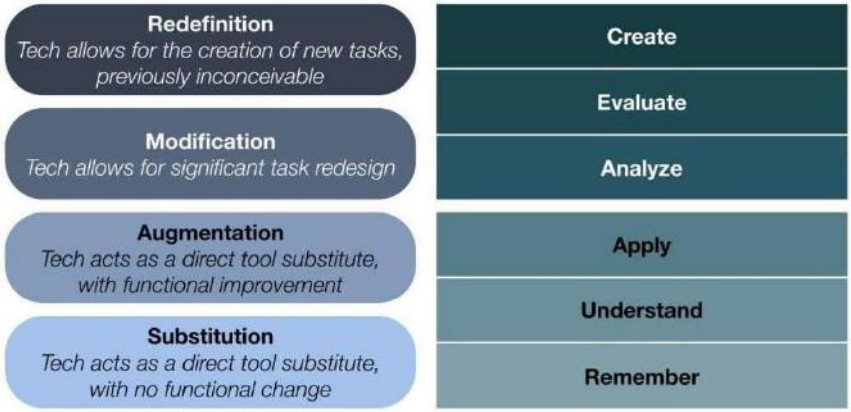

Citing the example of digital story-telling, which is a very creative form used by faculty and students and loved by those with special needs, where users create and share collaborative stories, one can align the levels of Bloom's Taxonomy with the SAMR model. From writing a story through the SAMR model, (Substitution level) to writing the story on the Story telling tool or app, progressing further to the augmentation level by making it three dimensional, to the modification level of collaboration, to making something new where students share their stories with each other, add a new aspect in the story and collaborate with each other creating another threads where other students can begin or end a story of their own, which was something inconceivable in a real life story telling class, especially in an inclusive classroom.

SAMR is an acronym for the 4 levels of technology integration: *Substitution, Augmentation, Modification and Redefinition*. It aims at helping the educators to pick and choose the right strategy to effectively teach the lesson at hand.

Substitution Level: Basically, at this level, technology is used as a mere well-thought-out ancillary with no purposeful change. The process used at this level is up gradation of tools, without changing its functional use. The mantra used is to 'substitute' traditional classroom teaching activities with digital versions. Educators can deliver both synchronous and asynchronous versions of their lectures or instructional videos so that students can see them at their own pace. Flash cards Deluxe, Easy Word Count, Franklin Speller etc. are those applications which help students

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with learning disabilities to understand the written word properly and use the same in their assignments.

Citing the example of writing assignments, earlier one used to rely on pen-paper tools to complete their assignments. This has been replaced with applications like Microsoft Word, Google Docs etc. to write and submit the assignments. These applications are a big help to students with learning disabilities

Augmentation Level: At this level too, technology is just a tool substitute with a few useful improvements. Educators research and apply interactive digital enhancements like comments, hyperlinks etc. to the technology that they are using, in this level. There is no change in the content, at the same time, the students can take advantage of the digital features to enrich their understanding. Dyslexic students can also write with their voice using Dictation tools. Text to Speech readout has been made possible through applications like 'NaturalReader' which helps students who cannot decipher the written word properly.

For example students use the various functions provided by Microsoft Word like spell check, grammar check, Thesaurus etc. while writing their assignments through the application, in fact students with dyslexia truly benefit from these. Another example is that instead of giving paper quizzes, the teachers can give quiz through Kahoot or Gamify etc.

Modification Level: It is in this level that educators use technology as an instrument to make major remodeling of entire lessons or even small portions to enhance student learning. For example, students with physical disabilities can use a voice-to-text application for writing and submitting an assignment. Also, the 'share and comment' features of Google Docs help the students to work on the rough drafts of feedbacks and assignments before submission.

Redefinition Level: At this level teachers create new activities which were hitherto unheard of in traditional classrooms. This infuses a new energy in the teaching-learning process. For example, the students can be asked to create multimedia presentations with the help of various applications and tools. Applications like 'Virtual Pen Pals', 'Virtual Field Trips' helps students with disabilities to connect with their counterparts

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around the world and visit places that they would have read in books. In this level, students learn to create their own blogs, even if they are differently abled.

To summarize, the SAMR Model for technology integration proves a big help to teachers while evaluating the suitability and effectiveness of technology for their classrooms, simplifying the process of selection and implementation of that technology. SAMR is just a tool-box and the objective over here is not to use this so called erudite box but to use the one most suited for the task at hand.

❖ CONCLUSION:

Through the study one can come to the conclusion that all students can benefit through the use of ICT. In this way, students, in an inclusive classroom, will get engaged in the teaching-learning process as well as in the development of the course through the various topics. The cognitive, meta-cognitive, and social skills of the students will be enhanced due to working in online groups. ICT aids in advancing the inclusion processes and students need such experiences for their academic progress. The use and testing of methods and practices of inclusive education, helps strengthen the self-esteem of students and create a sense of belonging to a learning community where every student gets equal opportunity and a positive atmosphere to interact and collaborate with others. Students will develop a sense of individual responsibility while doing justice to the task at hand.

This study proposes further research to take place in the area of inclusive education at the university level using the SAMR model. More research is required on the model itself and also on the application of the model. Using this model, research can be carried out to demonstrate the level of technological integration occurring within a given institution. The findings of that study can help to allocate resources to support further technological integration in the classroom.

- Through the study one can come to the conclusion that all students can benefit through the use of ICT. Students, including disabled ones, will get involved in the learning process and in the construction of the course through the various topics.

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- Working in online groups will help to develop cognitive, meta-cognitive, and social skills of the students.
- ICT can advance the inclusion processes and they need such experiences for their academic progress.
- Use and testing of methods and practices of inclusive education, will help strengthen their self-esteem, create a sense of belonging to a learning community where every student gets the same educational opportunities and a positive atmosphere to interact and collaborate with others.
- Students will have a sense of individual responsibility in their performance of assigned tasks.

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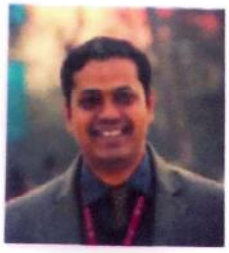

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ISBN: 978-93-5812-990-8

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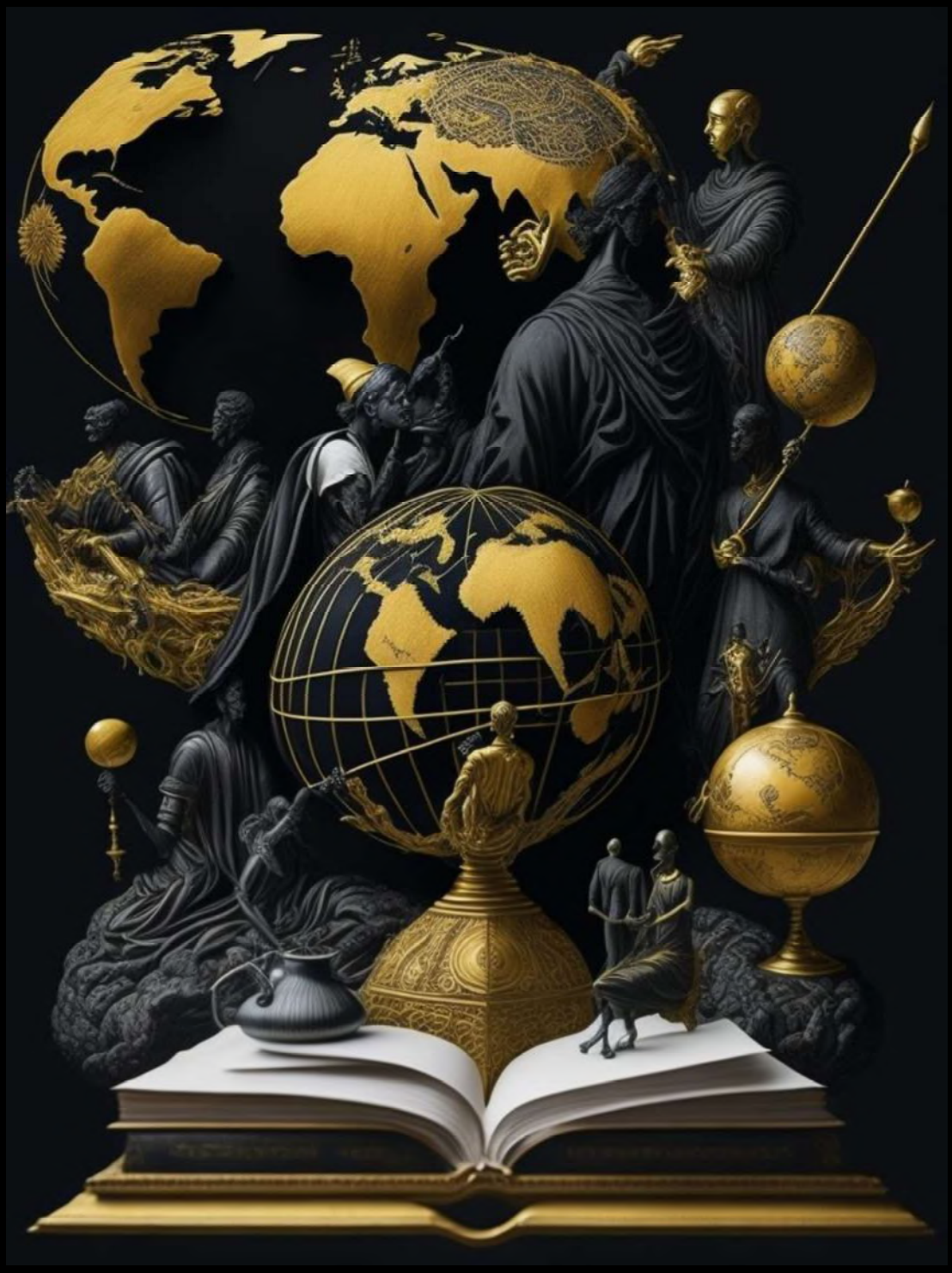

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International Conference on Multidisciplinary Research ICMR- 2023

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International Conference on Multidisciplinary Research

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Conference Monograph

ISBN: 978-93-5912-962-4

Price: 700/-

Published by:

Dr. Sohel Rana Sarkar

Vill.- Bhadrail, Post- Gurail, Dakshin Dinajpur, West Bengal, Pin- 733142

Phone: 91-9775859039

E-mail: sohelranasarkareducation@gmail.com

Cover design: Dr. Soumya M. Ghosh

Printed at Dhar Brothers, 4, Rammohan Roy Rd, Yogi Para, Garpar, Machuabazar, Kolkata, West Bengal 700009

Shoukat, et al., (2015). Perception of teachers and students towards the functionality of semester system at university level in the context of Pakistani social and administrative set-ups. *International Journal of Teaching and Education.* III. 68-80. 10.20472/TE.2015.3.4.006.

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An exploratory study on Multidisciplinary dimension of social worker role in education to Improve the Quality Education in India

Dr. Pallavi Gangwar

Lingaya's Vidyapeeth
NSS Programme coordinator

Abstract

Education, directly and indirectly, gives learners or young people the opportunity to develop their social skills at school or in after-school level, learners interact with other learners/people, building their relationships with friends, teachers and other students of different ages and cultures, and help them to improving their lives.

Education refers to the discipline that is concerned with methods of teaching and learning in schools or school-like environments, as opposed to various non-formal and informal means of socialization. If we

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can talk about socialization then there is scope to improve quality education techniques in India with the help of social work.

We can define that Social work is a profession in which trained professionals are devoted to helping vulnerable people and communities work through challenges they face in everyday life. Social workers as a professional worker have commitment to advocating Individual, group and communities for improving the lives as individuals, families, groups and societies.

We can improve the quality of teacher education in India with some techniques.

Need-based training: Every teacher has unique skill sets and might face different challenges in each classroom.

Collaboration and involvement of teachers: Collaboration is very important for high-quality teacher training.

Continuous professional development.

A social worker can do better to improve these qualities because a social worker is well trained in assessment of any individuals, groups and Communities. A social worker helps a lot to teachers in need assessment for students and as well as in teaching learning process and techniques.

AS a social worker it's easy to gage out the problems in teaching process because a teacher can have some problems at inter personal level and that effects his/her teaching techniques. We can use social work techniques and methods to resolve his/her problems and motivate them to fulfill their professional responsibilities.

Key Words: Need assessment, teaching techniques, quality education and scope of improvement at individual and group level.

Introduction:

Education is a systematic process by which a person is able to understand anything in scientific way and have skills and knowledge to perform her/his role in society. The literacy rate is 77.70%, with literate males at 84.70% and literate females at 70.30%, according to the National Family Health Survey (NFHS-5) and National Statistical Office: NSO (2021 and 2022).

Education, directly and indirectly, gives learners or young people the opportunity to develop their social skills at school or in after-school level, learners interact with other learners/people, building their relationships with friends, teachers and other students of different ages and cultures, and help them to improving their lives. In ancient time there was a system for education that called Gurukuls. Now a days there are many more schools and institutes for education and knowledge. According to the first Public Report on Basic Education **(PROBE),** this report is written from the perspective of those who despite yearning for good quality education find themselves excluded from learning and acquiring decent education. The data is based on the findings of a survey conducted in 2006, along the lines of an earlier survey conducted by PROBE in 1996 - it 'revisited' the same sample villages covering schools and households, with some modifications. Apart from basic and primary education, this report looks at upper-primary schooling in Bihar, Madhya Pradesh, Uttar Pradesh, and Rajasthan, and in Himachal Pradesh. It highlights major progress in areas such as schooling facilities

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and enrolment rates. At the same time, it finds that fundamental problems remain, such as low classroom activity, poor quality of education, and discrimination due to social disparities in schooling opportunities. It is an indispensible tool for educationists, planners and policymakers, funding agencies, NGOs, and researchers across the social sciences and all those concerned with elementary education in India.

Objectives of the research:

- Identified the scope of social work to help out and resolves the issues of education.
- Need assessment for quality education.
- Assure things for the fruitful quality education in India.
- To make a bridge between education and social work for quality education.

Methodology: An exploratory research done to fulfill the requirement of this research. Exploratory research gives chance to understand the existing researches and records and after the exploring studies to gage out the needs and to do a research for betterment of that topic. So to gage out the gapes and needs an exploratory research to be done by the researcher.

A Good Teacher: A good teacher to be a good friend, guide, supervisor, guardian, leader and mentor. A good teacher has also some qualities like-

Quality of a Good Teacher:

A good teacher should have several qualities and some of them are-

Quality education is supported by three main pillars: availability to qualified teachers, the utilization of quality learning resources and professional development, and the creation of safe and supportive learning environments.

- A good teacher should be a good communicator and must know not only how to communicate with the students but also with the other teachers and school authorities especially when it comes to sharing the problems of the students as well.
- A good teacher is a good listener and must know to listen to the students and know their needs
- Adaptability is a crucial value of a good teacher, especially in these times as schools are moving online
- Good teachers are empathetic and patient with their students and understand what they are feeling and need.

Education: Education refers to the discipline that is concerned with methods of teaching and learning in schools or school-like environments, as opposed to various non-formal and informal means of socialization.

If we can talk about socialization then there is scope to improve quality education techniques in India with the help of social work. A person as a student or as a teacher has to a human being firstly and as a human being they have socio economic or personal problems in their lives. The problems of any student and teacher may affect their performance and their learning process also. We can explain their problems as-

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1. **Personal problem:** A student or a teacher has personal problems like family's issues problem in interaction with group or particular person at workplace or institute, psychological issues, health issues etc.
2. **Social problem:** There are many more social problems like neighborhood problem, school friends' problem, peer pressure and group teasing problem etc.
3. **Economical problem:** this common problem faces by the most of Indians as a teacher or as a student. We can say that economic problem is the most important problem in present scenario. If an economic issue affects teacher's life then there are possibility that it affects their teaching performance and also effect quality education.

These problems may affect their teaching performance and also affects the quality education. There is scope for a social worker to help out them to resolves their issues. Because poor quality education is leading to poor learning outcomes in India, ultimately pushing children out of the education system and leaving them vulnerable to child labor, abuse and violence.

A social worker can use their scientific methods and techniques to help them. AS a social worker it's easy to gage out the problems in teaching process because a teacher can have some problems at inter personal level and that effects his/her teaching techniques. We can use social work techniques and methods to resolve his/her problems and motivate them to fulfill their professional responsibilities.

Social work: Social work is a profession in which trained professionals are devoted to helping vulnerable people and communities work through challenges they face in everyday life. Social workers as a professional worker have commitment to advocating Individual, group and communities for improving the lives as individuals, families, groups and societies. Social workers assist people by helping them cope with issues in their everyday lives, deal with their relationships, and solve personal and family problems. The functions of social work are to change individuals and institutions with respect to individual social welfare. Social development focuses on the institutions of society.

We can improve the quality of teacher education in India with some techniques.

i) Need-based training: Every teacher has unique skill sets and might face different challenges in each classroom.

ii) Collaboration and involvement of teachers: Collaboration is very important for high-quality teacher training.

iii) Continuous professional development.

Many identified tools provided by the School of Social Work include finding their own learning style, how to develop effective lesson plans, reflective teaching and professional development, resources by subject, and effortless teaching among others. The educator role involves giving information to group members and teaching them new skills. To become an effective educator, the social worker should be knowledgeable about all situations and problem solving techniques. In addition she or he should have to be a good communicator so that information is clearly conveyed and readily understood by the receiver.

There is a strong correlation between social change and education since sometimes education may be the cause of social change and at other times there will be changes in education due to social change. The need for literate and educated people is a prerequisite for the development of a society. Society plays a significant role in education. It can influence it both ways, positively and negatively. The values, morals, and principles of a society will create an education system that upholds the same values, morals,

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and principles. A social worker continues work on societies so they can easily gauge out the problems about any socio personal problems.

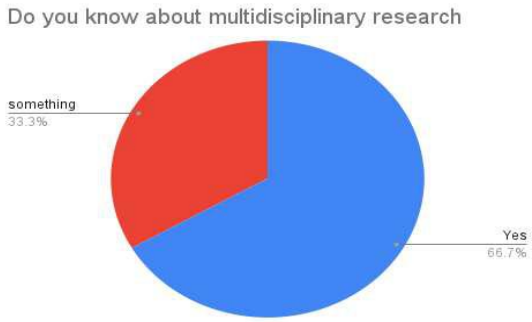
Healthy social enrichment allows us to establish positive relationships with family, friends, teachers, and other people in our lives. Social enrichment involves learning the values, knowledge, and skills of social interaction. As we can say, learners will learn communication and interaction with teachers, other learners, and friends in a school environment. Social and emotional skills are passed on to children directly by those who care for and teach them, as well as indirectly through social relationships within the family or with friends.

An exploratory research has done with B.Ed. students by the researcher. The researcher wants to know that what perspective have the B.Ed. students about multidisciplinary research and collaboration of social work and education.

A sort research has done on same; the findings to be explore and complied for documentation.

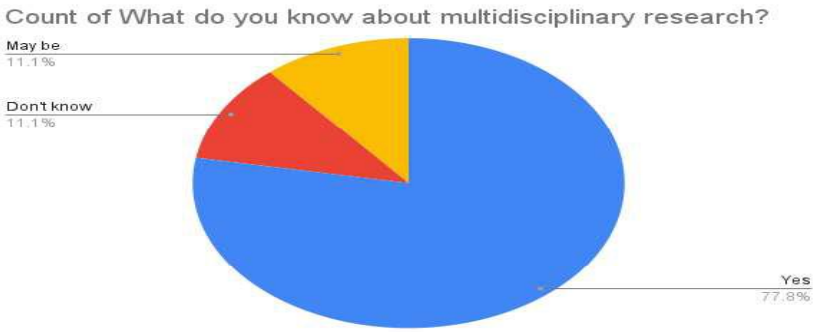
In this short research 9 B.Ed. students have been participated. Researcher has been collected data done through online mode by the. The students provided their valuable feedbacks on many questions. The detailed feedback is -

- Do you know about multidisciplinary research?



33.3% students are know something about multidisciplinary research and rest 66.7% students know verywell about multidisciplinary research.

- What do you know about multidisciplinary research?



77.8% students have enough knowledge about multidisciplinary research and rest 22.2% students are confuse about multidisciplinary research. They said that they hear something about this but not so much aware.

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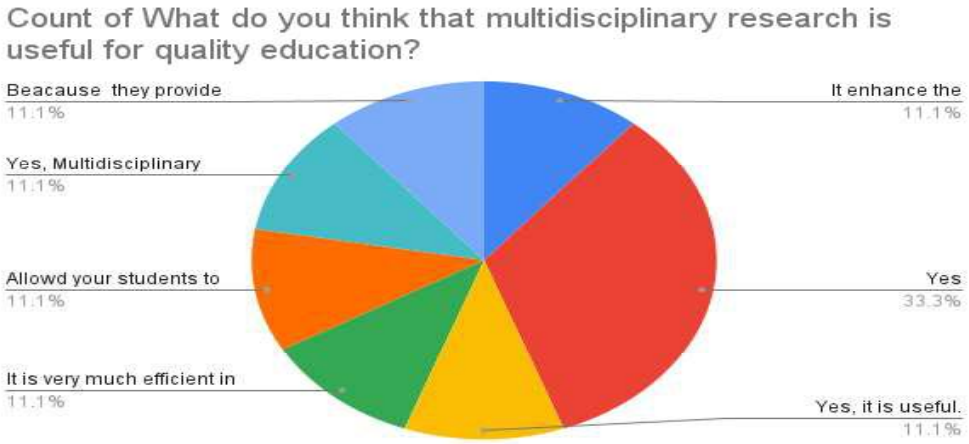
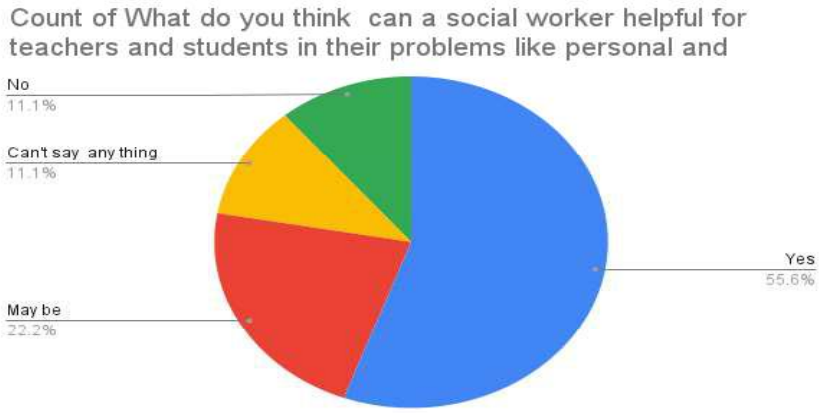
- What do you think that multidisciplinary research is useful for quality education?



When talked about the importance of multidisciplinary research in education the students have more mix responses, like it is very much effective for quality education. It is useful, it enhance the teaching learning process.

- What do you think can a social worker helpful for teachers and students in their problems like personal and professional?



- If we talked about social worker roll in multidisciplinary research the students have mix thoughts about them. Some 22.2% said that there are “no” role for a social worker and “can’t say anything” about that. Other 55.6% said yes to social worker role as problem solver. They do agree with social workers role to solve problems of teachers and students in personal and professional manner.

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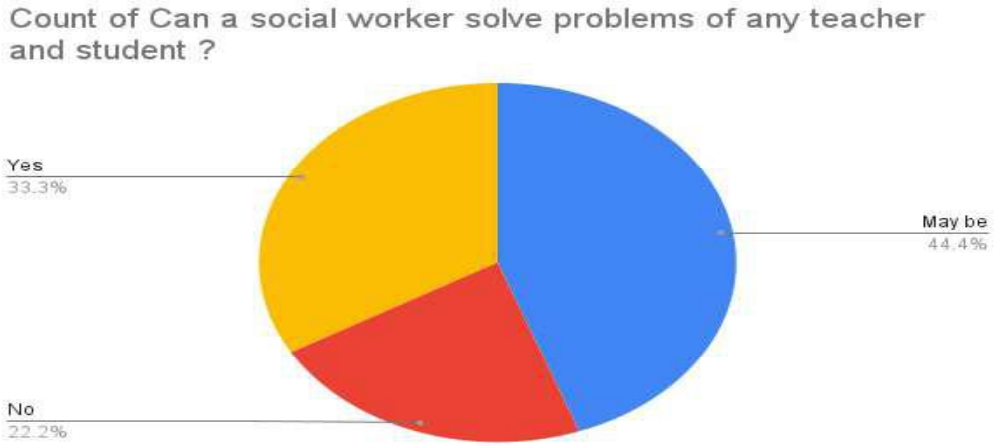
- Can a social worker solve problems of any teacher and student?



The 33.3% students think that a social worker solves the problems of any teachers and students. 44.4% students are having confusion about social worker role in problem solving. Rest 22.2% students denied the role of a social worker in problem solving.

On the bases of their knowledge on multidisciplinary research the students provide feedbacks about collaboration of Social work and education as multidisciplinary research approach for problem solving to enhance our education system and teaching learning process.

A complied detailed suggestions of students on "collaboration of Social work and education as multidisciplinary research approach for problem solving to enhance our education system and teaching learning process" are given below as it is-

Give your suggestions for Social work and education collaboration to improve quality education.

- Education in the village area or in the slums to motivate the children of slums and village and educate them for free.
- Without any discrimination there will be inclusive and skills based learning
- Extracurricular activities and pedagogy skills
- Social worker use education as a key tool inclined and community interaction
- Collaboration education for all students
- Spread Knowledge to them and guide for better education for bright future

Conclusion:

A social worker can do better to improve any situation or problem because a social worker is well trained in assessment of any individuals, groups and Communities. A social worker helps a lot to teachers in need assessment for students and as well as in teaching learning process and techniques. A social worker can be a link or bridge for the students, parents and teachers. There are many more lacks of information and knowledge about a social worker's role and responsibilities as a problem solver in education. Many students as B.Ed. student are not aware about social work and their importance in society. Whenever A B.Ed. student will be becomes a teacher he/she also faces issues in their personal

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and professional life. That time this collaboration would help them in problem solving and also helps them to improve quality education and their performance.

Suggestions: There are copious scope for study and programs to build a knowledge and understanding about multidisciplinary research. If B.Ed. students are aware about multidisciplinary research and social work then they can assess their services, whenever they become a teacher. Teacher and their students would take help from a social worker in their personal as well as professional life issues. This multidisciplinary research will be a game changer or bridge for students and teachers in quality education.

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Yogic Lifestyle and Mental Well Being

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Abstract

Yoga is a positive and normative science. Besides analysing human personality and its development, it also establishes normative standards and suggests methods for achieving these goals. The main goal of yoga psychology is to expand awareness and become the master of one's own mind. Yoga literature dating back thousands of years contains extensive descriptions of the topological elements of the mind as Freud described it in terms of subconscious, conscious and unconscious levels. A healthy yoga practice enables one to have a disease-free body and a sharp mind. Children and teens can build resilience and mental toughness by incorporating yoga and positive psychology principles into their daily routine. The benefits of such measures can be determined by further research with reliable study designs. This study shows the benefits of yoga.

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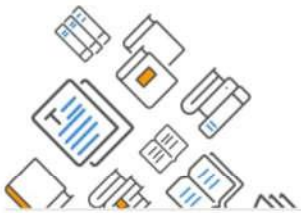

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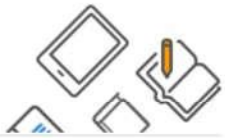

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Position Control Using a Physics-Based Model for Biomimetic Underwater Propulsor Actuated by IPMC

Ankur Gupta, Satyendra K. Prajapati & Sujoy Mukherjee

Conference paper | First Online: 04 October 2022

Part of the Lecture Notes in Mechanical Engineering book series (LNME)

Abstract

In this paper, an effort is made to provide a better position control model using the physics-based model for biomimetic underwater propulsor actuated by ionic polymer-metal composite (IPMC). The biomimetic underwater propulsor considering the body caudal fin-type locomotion is undertaken where the oscillating fin tail of the original fish is

replaced by a fin tail comprising an active IPMC beam. The supported cantilevered IPMC beam model is analyzed and the relations for displacement and velocity are studied using physics-based modeling in a fluidic environment. The robotic swimming velocity response due to the active IPMC tail fin deflection under applied electric potential has been observed. Considering the Laplace transform of the mathematical model, the transfer function relating the tail tip deflection and input voltage has been generated and proportional, integral and derivative (PID) closed-loop controller has been developed to control the deflection from IPMC in an underwater environment. The controlled and efficient desired displacement response of 1 mm through simulations was achieved. The PID gains are tuned using the Ziegler–Nichols tuning method to make the output response quick and robust.

Keywords

Position control **Physics-based model** **PID control** **IPMC** **Underwater propulsor**

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About this paper

Cite this paper

Gupta, A., Prajapati, S.K., Mukherjee, S. (2023). **Position Control Using a Physics-Based Model for Biomimetic Underwater Propulsor A**ctuated by IPMC. In: Gupta, V.K., Amarnath, C., Tandon, P., Ansari, M.Z. (eds) Recent Advances in Machines and Mechanisms. Lecture Notes in Mechanical Engineering. Springer, Singapore. https://doi.org/10.1007/978-981-19-3716-3_53

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DOI	Published	Publisher Name
https://doi.org/10.1007/978-981-19-3716-3_53	04 October 2022	Springer, Singapore

Print ISBN	Online ISBN	eBook Packages
978-981-19-3715-6	978-981-19-3716-3	Engineering Engineering (R0)

Pollution from Building Construction

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Abstract

It is common knowledge that development of any city strengthens the economic infrastructure of the country, across all regions. Among the various urban sectors, the construction sector gives maximum employment with a varied job diversity.

Air pollution from the construction sector is responsible for increasing ambient air pollution. As per a report from Delhi Pollution Control Committee (DPCC), the pollution and dust emanating from the construction sector is 30 percent of the air pollution that is generated from the construction sectors. Due to the proximity of construction sites and the materials used, construction sector can generate domestic pollution.

This includes soil, water, air and noise pollution. In addition, construction can also reveal pollution on the existing subsurface due to which the construction workers are also exposed to pollution. The paper explores the various implications of the construction sector in relation to environmental conditions, including air, water, soil, and noise pollution, as well as suggestions and measures to prevent and combat pollution from the construction sector.

1. Introduction

Due to proximity to construction sites and substance used in building, construction sites can generate domestic pollution. This includes soil, air, water, and noise pollution. ... In addition to noise pollution and poor air quality and ground water are the most affected pollution. You can experience by visiting or staying at a construction site yourself.

Construction sites that harm the environment globally, and also affect the local community. In fact, construction can lead to soil erosion and problems with water quality and flow.

Additionally may be pollute the existing subsurface of construction work. In such a situation, the construction work is stopped and the work needs to be improved. Thus construction work poses construction pollution problems affecting the site owners nearby. In addition workers engaged in construction (especially in the past) may have been exposed to pollution. So, let's discuss these aspects in more detail below.

2. Source of Pollution

- Construction dust: Construction and demolition operations contribute to windblown dust problems—sometimes called fugitive dust—onto nearby roadways which can remain in the air for days or even weeks.

- Significant source of PM 2.5 on construction sites comes from the diesel engine exhausts of diesel generators, vehicles and heavy equipment's.

- Harmful and dangerous vapors from thinners, oils, glues, treated woods, paints, plastics, cleaners and other many more hazardous chemicals that are widely and maximum used on building construction sites, these are also contribute to air pollution

- C&D Waste: The waste comprising of building materials, debris and rubble resulting from construction, re-modeling, repair and demolition of any civil structure. Construction industry in India generates about 11-12 million tons of waste annually.

3. Air Pollution

Pollution during construction work makes the air polluted. In addition to noise, poor air quality is the most effective pollution effect you can experience from a building site. This means that air hauled pollution, including contaminated particles and inconstant compounds, is spreading to the surrounding neighborhood (mostly from the air) (the main wind direction will affect the area most affected by air pollution around a construction site). Air-circulating components can travel large distances in a short period of time. The main building pollutants circulating around the air include particles such as PM10 (contaminated material with a diameter of less than 10 mm), PAH particulate matter, VOC (volatile organic compound), mica, carbon monoxide, carbon dioxide, and nitrogen oxide.

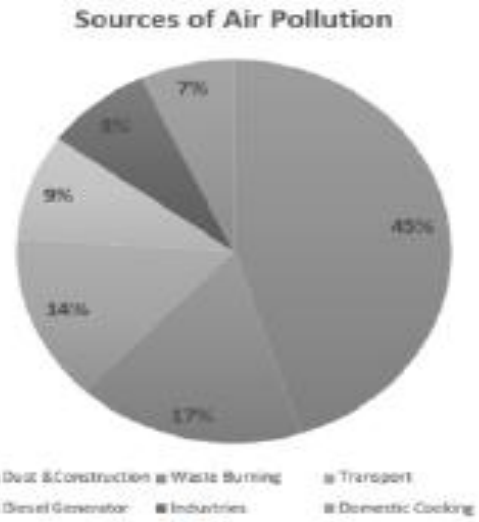


Figure 1: (Air Pollution Chart-i)

Figure 2: (Air Pollution-ii)

3.1 PM-10

These large quantities of construction, such as cement, concrete, silica, paint and wood, at very large levels, are collectively classified as PM10. (PM10 is particulate matter less than or equal to 10 micrometers in diameter that is invisible to the naked eye) Diesel engine emitting smoke from plants and other vehicles on the construction site is a major contributor to the emitted PM10. Diesel smoke in particular pollutes the atmosphere, referred to as diesel particulate matter (DPM), and the smoke emanating from an engine or machine contains sulfates and silicates that add pollutants to the atmosphere.

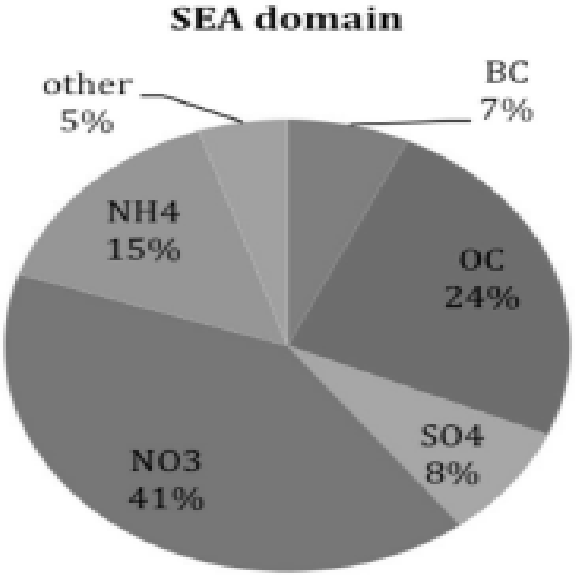
A research in PM10 has shown that people living on nearby building construction sites can understand deep in the lungs, which is due to polluted air. Damage to engineers and workers who regularly work on building construction sites, resulting in an high risk of physical and health complications. Many health problems arise due to air pollution:

- Difficulties in breathing,
- Cough and wheezing.
- Respiratory disease and cardiac arrest.
- Lung cancer.
- Strokes.
- Acuteness of Asthma.

It is believed that 56% of men effected with cancer from building construction industry are responsible. This includes diseases such as mesothelioma, this type of cancer that develops on the lining of the lungs and chest and the only cause of which is asbestos exposure. Dust and gas fibers, such as silica and asbestos, as well as continuous exposure to fumes and gases emitted by vehicles and machinery used on construction sites, cause lung cancer especially among workers engaged in construction. Indeed, workers working in the building construction industry are

potentially exposed to between 16 and 20 carcinogens as a result of common work activities. People living around building construction sites also have the effects of air pollution that they may experience.

Site workers have to work on foot on site who will not be so close to pollutants as dirty air can experience the effects of poor air quality long after the project is completed. PM10 and other air pollutants are spread by air to the surrounding area and can then settle down. Residents living nearby often inhale inadvertently through polluted air and may then develop a cough or shortness of breath as a short-term result.



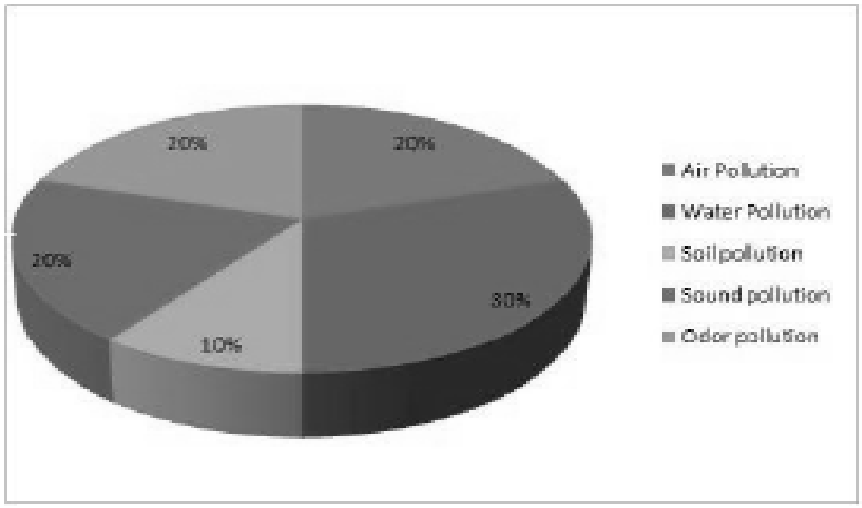


Figure 3: (Environmental Pollution Chart-1) Figure 4 (Environmental Pollution Chart)

Types construction sites are responsible for 14.6% PM 2.5 (particulate matter which is 2.50 micrometers in diameter) and 8.5% PM10 emissions. Most of it comes from using generators and construction machinery running on diesel, representing 1.2% of dust from construction sites activities such as excavation, moving vehicle on site and demolition. Plants, hedge and animals both are also effected and struggle to life has to struggle to flourish as a result of pollution, causing loss of biodiversity, farming and affecting the food chain.

4. Water Pollution

The surface water runoff and the groundwater close to a construction site become polluted with various materials used in the construction sites work. The following construction sites contaminants can be pollute the water: VOCs, Oils, paints, glues, diesel, other toxic materials and chemicals, and cement. The immediate effect is creating turbidity in the runoff water and affected surface groundwater (since some of the runoff water may infiltrate in the subsurface reaching the groundwater. In fact, residential area are effected by both surface and ground water contamination.

Domestic animals and pets may drink contaminated water and soil may become contaminated too. Additionally, the groundwater, it may affect the pollution in the following ways: through direct consumption if you use water from a property well, and indirectly by affecting the quality is used indoor air (vapor intrusion of the volatile contaminants from water). Overall, water pollution from construction sites is underestimated and has potential to generate severe environmental problems. Construction activities often involve the use of toxic chemicals and pollutants that can end up in the water table if not managed well.

Common construction sources that contribute to air pollution include:

4.1 Diesel and oil.
4.2 Cement.
4.3 Glues.
4.4 Paints.
4.5 Other toxic chemicals.
4.6 All of these contaminants have the potential to end up in water as a result of runoff from construction work. Pollutants can enter the water system in a number of ways, such as through drains, seeping into soil, or runoff directly into rivers or lakes.

4.7 Impact of water pollution - Pollutants from construction sites can soak into the groundwater. It is to treat much harder to treat groundwater than it is surface water and so, as a source of human drinking water, there is a risk that some chemicals may end up being consumed. Chemical pollutants such as arsenic and mercury can cause serious health issues, including cancer, if ingested through contaminated water supplies.

4.8 Environmental -- Water contaminated by pollutants produced by the construction industry poses a serious danger to the Environment. Once pollution has entered the water system, it can harm or kill fish and animals living in it or drinking from it. This can disrupt the entire ecosystem of animals, plants, bacteria and fungi, causing many species to suffer as a result.

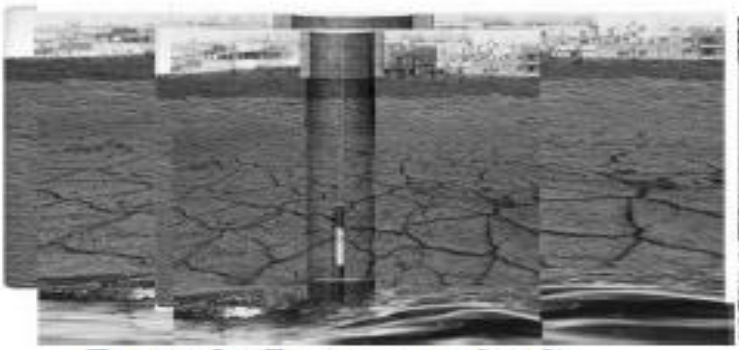


Figure 5: (Down water level)

Figure 6: (Water Pollution)

5. Soil / Dust Pollution

Soil at and around a construction site may become contaminated due to air transport followed by deposition of construction contaminants (listed at air pollution) as well as water runoff of construction contaminants (as listed for water pollution). Soil may constitute a sink for pollutants and some of those may accumulate in soil and persist over longer periods of time.

5.1 Dust Pollution

Dust Particles, also known as particle pollution (or PM), are made up of a number of components Including nitrates and sulfates, organic chemicals, metals and soil or dust particles. Some particles such as dust, dirt, soot or smoke, are large or dark enough to be seen by the naked eye.

5.2 Airborne dust functions in a manner similar to the greenhouse effect: it absorbs and scatters solar radiation entering Earth's atmosphere, reducing the amount reaching the surface, and absorbs long-wave radiation bouncing back up from the surface, re-emitting it in all directions.

Figure 7: (Excavated Earth Covering)

Figure 8: (Truck Sprinkler System)

6. Noise Pollution

Noise is usually associated with construction work although modern preventive measures may substantially reduce the amount of noise (in the neighboring community). Noise may adversely affect health, including effects such as stress, sleep disturbance, high blood pressure and even also consider the effects of noise pollution on the construction workers themselves. Additionally, if employees use equipment that is particularly loud, they may even Experience hearing loss.

6.1 Construction Pollution

Construction pollution involves the following main types of construction work:

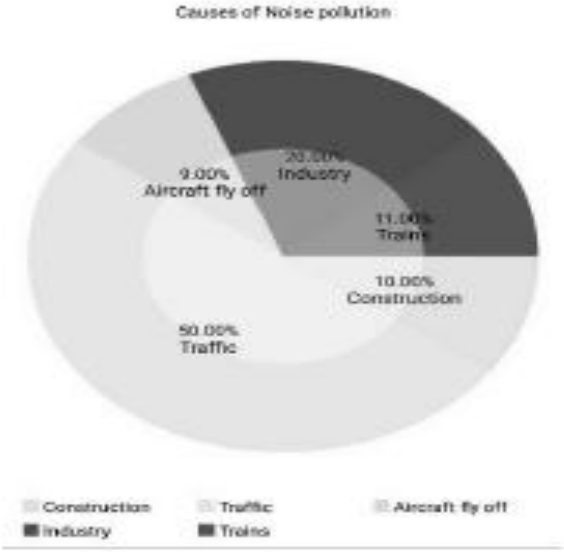


Figure 9

Figure 10 (Noise Pollution)
(Noise & Dust Pollution by Construction Machinery)

i- Building construction pollution - represents the generation of construction contamination at sites where buildings are constructed which may involve also a demolition phase (if the construction site has an existing building)

ii- Road construction pollution - represents the generation of construction contamination at sites where roads are built Construction Pollution Prevention and Cost Recovery

7. Impact of Construction Pollution

i- Personal damage. From the perspective of the public, the best prevention is to spend as little time as possible outside (e.g., in your yard or balcony) close to a construction site during operation time. Additionally, having a rich vegetation around houses (and between them and the construction site) will act as a natural filter for the generated pollution, reducing the amount of pollution one may come in contact with. So, planting in yards or even potted plants in a balcony can help. The greener the better. Also, regular spraying of water around the home will reduce the amount of dust and exposure through inhalation, although the soil and water pollution may increase (but these are affecting less directly than air!).

ii- Property damage. From the perspective of the construction site owner / developer, you may be faced with building on polluted land (pollution could be discovered during construction excavation work). To prevent such situation, you should order a full land quality survey before starting any construction work. However, if this is not possible and you are faced with building on polluted land, you may be able to recover remediation costs from

iii- the original polluters. In this situation, specialized forensic investigations and legal advice (using top specialized legal firms) are recommended.

Figure 11: (Noise from Construction Site)

8. Conclusions

I believe that proper enforcement, incentives and education, strong citizen participation and strict adherence to national green building regulations can significantly reduce pollution from construction. It is our duty to strictly follow it while constructing buildings and saving lives. We as individuals and the government can transform the development of construction and infrastructure into a non-polluting source.

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Solid Waste Management In Smart Cities

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Abstract

Solid waste management is a biggest threat faced by the developed, under developed and developing countries like India. Day by day solid waste generation levels are increasing significantly because of population explosion, lifestyle habits, urbanization etc. Thus growing number of cities and rapid growth in population demands higher efficiency in terms of resources to keep their cities clean. Waste management is a fundamental pillar of a smart city, within the public services.

The aim of this article is to evaluate the role of solid waste management in the development of smart cities. The waste management concept followed by smart cities is to curtail the large amount of waste production by creating awareness amongst people to follow the 4 R's rule- rethink, reduce, reuse and recycle. This will help in waste production curtailment at the source. Management of urban waste is composed of different stages from collection, transportation, treatment and finally disposal. Out of these the collection of waste is the key factor to achieve efficient waste management system because of two reasons- cost and logistic development. The smart city concept integrates information and communication technology and various physical devices connected to the IOT network to optimize the efficiency of city operations and services and connect to the citizens.

ICT is used to enhance quality performance and interactivity of urban services to reduce costs and resource consumption and to increase contact between citizens and government. Smart city Technology has evolved together with the help of the Internet of Things (IOT) and Wireless Sensor Networks (WSN). The current state of Technology in the field of smart waste management involves the use of sensors that measure the fill level of trash bin.

The paper is based on the case studies of two smart cities of India and abroad. At the end in the discussion the comparisons of waste management is done to derive how waste can be managed efficiently.

Keywords: *Solid waste management, Smart cities, ICT, Internet of Things (IOT),*

1. Introduction

Around the globe, waste generation rates are increasing rapidly. In 2016, 2.01 billion tonnes of solid waste was generated all over the world, amounting to 0.74 kilograms waste per person per day. (Silpa Kaza, 2018)

The majority of waste is discarded or disposed of in landfills around the world. About 37% of waste is disposed of in a landfill, with 8% of that going to sanitary landfills with landfill gas collection systems. Around 31% of waste is dumped openly, while by recycling and composting 19% is recovered and for final disposal, 11% is incinerated. As compared to 2 % in high income countries, 93% of waste in low-income countries is disposed in dumps. The amount of waste dumped in the landfill sites in the upper middle-income countries and high income countries is 54% and 39% respectively. (Silpa Kaza, 2018) The world's oceans are contaminated, clogged, flooded because of the poor management of waste.

High-income countries tend to produce fewer food and green waste, which accounts for 32 percent of total waste, and 51 percent of total dry waste that can be recycled, such as plastic, paper, cardboard, metal, glass etc. Food and green waste produced in middle-income countries is 53 percent and low-income countries is 56 percent respectively, with the proportion of organic waste rising as economic development levels fall. (Silpa Kaza, 2018)

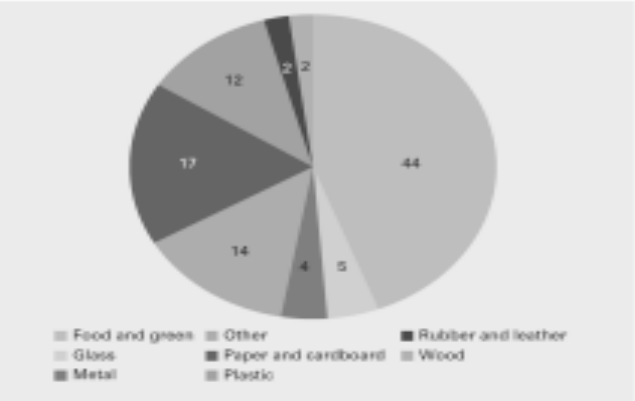

Figure 1: Waste composition in world (Silpa Kaza, 2018)

India's 1.33 billion population is the second highest in the world, which contributes to 17.86 % of the total world's population. Urban population has a share of 32.8 percent of country's total population. According to projections, by 2050 nearly half of the total population will live in urban areas. Rapid industrialization and population growth have resulted in migration of people from villages to towns,

resulting in the generation of thousands of tonnes of MSW every day. Other factors that contribute to waste generation include changing lifestyles, eating patterns, changing living standards, rapid economic growth, urbanization, and the rising tourism industry. Thus significant rise in waste management is a serious issue as it not only affects the aesthetic aspect of the country but also has severe environmental impact. (Praneetha Surapaneni, 2018)

According to the Union Ministry of State for Environment, Forests and Climate Change, the country generates 62 million tonnes of waste annually, with 5.6 million tonnes of plastic waste, 0.17 million tonnes of biomedical waste, 7.9 million tonnes of hazardous waste, and 15 lakh tonnes of e-waste. 75-80 percent of municipal waste is collected, with the remaining 22-28 percent being processed and handled. (Government notifies new solid waste management rules, 2016).

Waste accumulation is caused by insufficient storage and transportation. Due to lack of adequate facilities to process and dispose of the largest amount of MSW produced daily in metropolitan cities, MSW management is in a critical phase. In general, urban solid waste is disposed of in low-lying areas with no safeguards or organizational controls in place. Some waste may rot eventually, but not all and it can smell or produce explosive methane gas, which contributes to the greenhouse effect. Nearly 5% global emissions took place because of solid waste in 2016. (Silpa Kaza, 2018) Landfills that aren't well-managed can attract vermin and litter. As a result, MSWM is the most serious environmental problem. Reduced waste has a lower environmental impact, uses less water and energy, and saves money. SWM is in control of activation.

Reduced waste has a lower environmental impact and thus saves money. SWM encompasses all aspects of solid waste processing, storage, collection, transportation, treatment, and disposal. However, only four operations, namely processing, collection, transportation, and waste disposal are carried out in the current scenario. Municipal solid waste disposal necessitates proper facilities, maintenance and upgrading.

There are eight different types of urban solid waste:

1. Materials that can be recycled which include glass, bottles, cans, paper, metals, and plastic etc.
2. Composite wastes such as Tetra packs and waste plastics from toys, clothing, and other items.
3. Biodegradable wastes include paper (which can also be recycled), food and kitchen waste, and green waste (flowers, vegetables, fruits, leaves)
4. Inert waste (dirt, rocks, etc.)
5. Light bulbs, fluorescent tubes, washing machines, TVs, monitors, screens, alarm clocks, watches, and other electrical and electronic waste.
6. Hazardous waste which includes paints, additives, batteries, spray cans, fertilizers, and pesticide containers, among other things.
7. Toxic waste such as pesticides, herbicides, and fungicides, among other things
8. Biomedical waste (expired pharmaceuticals, human body parts)

The smart cities mission is a welcome move that aims to boost economic growth and enhance people's quality of life by facilitating local development and leveraging technology to achieve smart outcomes for residents. One of the key challenges those cities face, particularly due to population growth is improving the urban waste collection service and in general achieving a more effective waste management.

As a result, smart waste management is an essential aspect of smart cities. Fortunately, the new digital era offers tremendous opportunities for smart waste management, allowing us to implement sustainable policies in this crucial area and create an environment friendly city concept. As a result, smart waste management is an essential aspect of smart cities.

The smart city concept combines information and communication technology with a variety of physical devices linked to the Internet of Things (IoT) network to improve the city operations efficiency and services while also connecting to people.

2. Methodology

The research work is carried out from the details published in different journals, newspapers, websites, articles, reports and videos related to this topic. One foreign city and two Indian cities are reviewed to analyze the best practices to deal with the challenging solid waste management aspect of the smart cities.

3. Case Studies

Case studies of three different cities are carried out to understand the various aspects of solid waste management of smart cities. Various aspects of solid waste management are the composition of solid waste, waste collection mechanism, transportation and finally management of solid waste i.e treatment and disposal of waste.

A. Case Study - Indore

It is ranked number one smart city of India. As the city's economy is growing at a very fast pace and due to population explosion the city generates tons of municipal solid waste on daily basis. Indore generates almost 1.2MT of garbage daily which comes either from households, industries or commercial establishments.

To collect the garbage from every nook and corner, door to door collection service was started in January 2016 and to achieve 100% it took almost a year. It is the collective effort of citizens and authorities who played a significant role in making the city clean. The municipal corporation has played a vital role in the educating citizens to segregate the waste at source thereby considerably reducing the waste dumped in open areas. (Solid waste management- smart city Indore)

Composition

The major composition of MSW in Indore is biodegradable waste, Industrial waste, commercial and garbage waste, institutional waste, constructional and demolition waste.

Waste composition is:

Wet or organic waste	-	58.25%
Dry waste	-	41.75%
Hazardous waste	-	0.5%

To meet this challenging task of achieving 100% door to door collection identification was carried out to figure out the population and waste generation at each ward. Indore city has 85 wards and 19 zones for the waste management. For the optimization of the collection process a spatial geodatabase was constructed, in a standard commercial GIS environment (ArcGIS). This ensures compatibility with available data from municipality and many network routes. A detailed route plan was choked out to Cover all the wards of city.

Partitioned vehicles known as tippers along with staff were deployed on a specific route plan in order to meet the waste collection demand. Wet, dry and domestic hazardous waste was collected in these three separate collection bins. The vehicular route is monitored by the monitoring cell by a GPS enabled tracking system.

In Indore every smart bin is equipped with ultrasonic sensors which measure the fill up levels of each dustbin. Each container has three levels, a camera is placed at each can for capturing the images and the data is viewed, saved and sent on the other network using internet. The waste collected by tippers is transported to garbage transfer stations for secondary collection. Every time the garbage crosses a level the sensor receives the data of filled level which is further sent to garbage analyzer as instant message using GSM module. Out of the total waste generation of 1115 MTPD, wet waste is approx 650 MTPD and dry waste is approx 465 MTPD respectively. (Solid waste management- smart city Indore)

Gasification, Incineration, composting, recycling etc processes are followed to treat the municipal waste. The untreated waste is disposed off in a landfill site of Devgurada which is 15 km away from the Indore's city centre. It is the oldest and economical method to treat the solid waste. Although the gases like methane produced from waste is a big threat to the environment. Thus, for the treatment of MSW, the Indore Municipal Corporation (IMC) primarily employs landfill and composting methods. Since it is a renewable energy source for electricity production, IMC also uses various treatments for MSW treatment, such as gasification technology. (Agrawal, 2017)

B. Case Study - Kochi

Kochi is the industrial and commercial capital of Kerala state. The population of Kochi is 12, 52,000 spread over an area of 330 sq.km. (Chedambath). Due to migration there is a rapid surge in the solid waste generation in the city. Waste generation of the city amounts to 180 to 250 MTPD. River Kadambrayar and surrounding water bodies in the city are getting polluted and affecting the water life considerably. (Hridya K K1, 2016)

The most common practice of dealing waste management in majority of Indian cities is dumping in open areas, which is practically not feasible in congested and populated city like Kochi. Only for the dumping of waste Kochi cannot spare its valuable land. Kochi Corporation's health department and Engineering department bears the responsibility of cities solid waste management. Health department bears the collection, transportation and disposal responsibility whereas planning, choking of programs, procurement of vehicles, equipment etc. are borne by the Engineering department. (Hridya K K1, 2016)

Kochi has 74 wards for governance and administrative purpose. (Administration of Kochi) Household waste is collected by Kudamba Sree workers on daily basis. Tippers, auto rickshaws, handcarts are used for waste collection. 75% of waste is collected through door to door collection and is finally loaded to larger tipper and compactor trucks to transport them for treatment 20 km away from the city at Brahmapuram solid waste treatment plant. (Project – IUC: Sustainable and innovative cities and region)

Table 1: Quantity of MSW in the city

MSW Generation sources	Quantity
Domestic sources	134.70
Commercial establishments	32.99
Marriage and community halls	4.75
Hotel and Restaurants	29.90
Markets	20.39
Institutions / Schools, offices	14.75
Street sweepings	31.30
Hospitals (Non infectious)	4.22
Slaughter house	5.26
Construction and Demolition	17.00
Total	295.26
Per capita generation(g/day/head)	482.00

source: (Hridya K K1, 2016)

From the total waste generation of 305 TPD- 230 TPD is collected from door to door collection. Out of which 130 TPD is sent for processing and 100 TPD is dumped at the landfill site. Kochi Municipal Corporation (KMC) transports waste to the

Brahmapuram plant having an area of 110 acres, from waste collection points for processing and treatment, using 83 vehicles owned by the company as well as by the 500 handcarts. (Project – IUC: Sustainable and innovative cities and region)

Brahmapuram plant treats biodegradable waste only and plastic, sanitary along with other hazardous wastes are disposed off outside the plant which has resulted in environmental issues. On an average 220 tonnes and 72 tonnes biodegradable and non biodegradable waste respectively is received by the plant on daily basis. Although the plant is in dilapidated state, it treats organic waste using Inoculum bacteria by aerobic decomposition. Situated on the shores of Kadambrayar River, the plant affects the water life to a great extent as it contaminates the water bodies. The other drawback is the odour nuisance. Brahmapuram requires a new waste treatment unit as the available treatment facility is not sustainable. (Hridya K K1, 2016).

The waste management issue of the city can be resolved by adopting a solution comprising of the following four methods namely 4R's (Rethink, Reduce, Recycle and Reuse), Gasification, composting and land filling.

I Rethink- Before deciding to buy any product, think that no residue is left behind.

II Reduce- it helps in regulating the waste product e.g. instead of using polythene one can use paper /jute bag.

III Recycle- the leftover material is used as a raw material for other product after recycling. Like Plastic after shredding can be used for road construction or for brick manufacturing

IV Reuse- to use the products again after using once like cans, bottles etc, refill it again and reuse it.
The people of Kochi should be made aware of these 4R's to achieve maximum success following the example of Indore where the citizens have set an outstanding example of collaboration of public and Municipal Corporation .

Gasification -It is a preferred process as compared to the traditional combustion in which gas is achieved as a byproduct by converting solid or liquid waste material. Further the energy recovered is used for plant operation and will benefit Kochi Municipal Corporation economically. To prevent the accumulation of dioxins and a significant amount of Sulphur Oxide and Nitrogen Oxide, a low oxygen atmosphere is used.

Composting -By product fertilizer is achieved after decomposition of organic matter. At present this technology is practiced at the plant.

Landfill - The leftover waste after composting and gasification is dumped in the land fill areas. Its main aim is to isolate it from the surrounding environment. It is one of the most conventional methods.

Kochi city has witnessed consecutive floods in 2018 and 2019 because of global warming and solid waste is one of the factors contributing to it. Thus above methods are proposed to be adopted to resolve the waste management issues in Kochi. Public participation at a large scale is required to resolve the issues related to solid waste management.

C. Case Study – Singapore

Singapore is home to nearly 5.5 million people and spans over 700 square kilometres of area, which is mostly surrounded by water. The rising economy of Singapore has resulted in a rise in waste generation, with about 7.23 million tonnes of solid waste produced in 2019. (Five facts about unsustainable waste management in Singapore)

National Environment Agency administers the waste management in Singapore. The agency also recognizes the value of waste reuse and disposal due to land constraints. The NEA, which is in charge of waste management, sends the collected waste to be incinerated, with over 40% of it being incinerated. Incineration eliminates waste by up to 90%, allowing landfill space to be saved. (How will Singapore defuse a 16 year waste timebomb?)

As Singapore is a small Island only one landfill site is available so land filling is not preferred to a large extent. Priority is given to incineration and presently Singapore has four plants available for incineration. Dioxins produced due to excessive waste burning poses threat to environment. Modern incinerators in Singapore is provided to control 90% of nitrogen oxides and 99% toxic acid gases. (Khoo, 2006) Singapore has only one landfill site for disposal of waste -Semakau landfill. Only 10% of solid waste is dumped in this landfill site. Due to the outbreak of covid-19 pandemic, leading to the increase in waste generation, it is projected that the only landfill in the city- Semakau Landfill will reach its capacity by 2035 only. (How will Singapore defuse a 16 year waste timebomb?) Despite the fact that the amount of waste produced in 2018 was 9,000 tonnes less than in 2017, recycling rates have also decreased. The recycling rate dropped by 5% in 2019 as compared to 2018. Government programmes such as "the circular economy" and the "Zero Waste" vision, on the other hand, emphasise keeping for longer periods the resources in use through increased recycling and reusing. (Smart Waste Management: How iZeeM is helping environmental service providers in Singapore (Part 1), 2019)

Recycling of waste saves energy and reduces the emission of carbon dioxide. Singapore aims for zero landfill because the overuse of land causes threat to the society. Recycling of waste was targeted which comprises of the following:

1. Recycling of ferrous metals, woods, tyres, plastic etc
2. Construction waste is converted into aggregates for example mixture of cement, steel, aluminum wood, sand etc.
3. Food waste is converted into animal food.

Few waste materials for processing and recycling are sent overseas such as glass, paper, textile, non ferrous metals etc. Singapore aimed for increase of recycling rate in year 2004 from 48 % to 60% by the year 2012. (Khoo, 2006) Major portion of Singapore's recycling waste is exported abroad. National recycling program of Singapore gave access to recycling bins to all households, wastes such as glass, plastic, paper, metal etc. if not recycled correctly poses the risk of contamination. Biological treatment of horticulture waste is adopted to decompose biodegradable wastes. This process involves decomposition of biodegradable wastes by microorganisms occurring naturally. Garden compost is formed from leaves and pruned tree trunks. (Khoo, 2006)

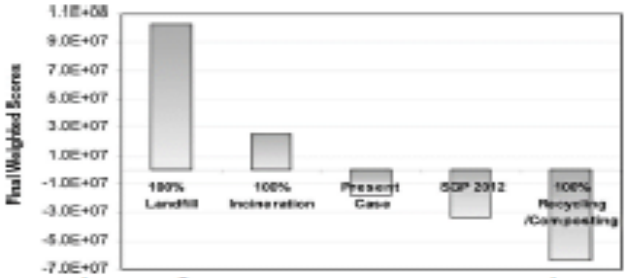

Figure 2: Overall Comparison of waste management options source: (Khoo, 2006)

Waste management system of Singapore comprises of collection of waste, transportation, treatment involving incineration and recycling and finally disposal to Semakau landfill by truck and barge.

Greenhouse gases are emitted in large amounts by the landfills but in Singapore due to restriction of organic wastes sent to the landfill it does not pose threat to the environment. The ability to generate electricity by the Incineration plant helps the public to get 80% of the electricity generated. (Khoo, 2006)

Singapore has started the construction of its first integrated water and solid waste treatment facility next to a water reclamation plant which will work on the system of food waste digestion and water sludge to increase the output of electricity. It will annually treat solid waste of approx 2.5 million tonnes. It will be amongst the world's largest plant. (How will Singapore defuse a 16 year waste timebomb?)

By maintaining efforts to reduce waste and increase recycling at work, Singapore is aiming to achieve:

a. **Zero landfill**
b. **Zero waste**

By doing this lifespan of Semakau landfill can be extended. By 2030, Singapore targets to achieve 70% recycling rate. (Lee, 2010)

4. Results

After observing the solid waste management of the above mentioned smart cities, it is observed clearly that solid waste collection and management at the source plays a vital role in the waste management of any city. Maintaining efforts to reduce waste and the treatment method helps in the restriction of the amount of waste to be sent to the landfill site.

Sr. No	City	Waste collection	Waste generated	Treatment method	Remarks
1	Indore	100% door to door collection.	1115 MTPD	100% door to door waste collection. Gasification, composting, incineration and recycling methods are adopted. The untreated waste is disposed off in a landfill site of Devgurada which is 15 km away from the Indore's city centre.	Waste is segregated at the source with the help of partitioned vehicles.
2	Kochi	75% door to door collection	180-250 MTPD	75 % door to door waste Collection, Composting and finally dumping in the landfill site. Brahmapuram plant treats biodegradable waste only using Inoculum bacteria by aerobic decomposition and plastic, sanitary along with other hazardous wastes are disposed off outside the plant.	Waste transported to treatment plant through trucks and vehicles owned by the company as well as by the handcarts.
3	Singapore	Public recycling bins provided at source	7.23 Million tonnes in 2019.	Collection of waste, transportation, treatment involving incineration and recycling. Biological treatment of horticulture waste is adopted to decompose biodegradable wastes.	Restriction of organic wastes sent to the landfill, does not pose threat to the environment.

5. Conclusions

Cleanliness and hygiene are the key factors contributing to the success of smart cities. Public participation along with the municipal corporations plays a significant role in achieving a clean city. Door to door collection of waste is the foremost step along with the effective segregation of waste at the source. 4R's namely (Rethink, Reduce, Recycle and Reuse) can play an effective role in checking the solid waste production. Processes such as Gasification, composting, setting up of incineration plants can considerably help in reducing the amount of waste sent to the landfill site for dumping. Great emphasis should be laid on integrated solid waste management system. Restriction of disposing of organic wastes to the landfill leads to less environmental impact as it keeps a check on emission of greenhouse gases. By striving to achieve zero waste and zero landfill the solid waste management system can be a great success in smart cities. The success of any smart city depends largely on solid waste management system.

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Dedicated Freight Corridor: Policy and Impact

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Abstract

India is a growing economy and Indian railways plays an important and crucial role in this growth. Need of time and technology has led to requirement of dedicated fright corridors to enable a continuous and efficient fright movement. Planning of dedicated freight corridor along Golden Quadrilateral rail route amplify this economic and spatial growth of the entire region. Dedicated freight corridor is targeted to meet demand, supply, need so as to improve the supply chain not just at national level but also internationally. The paper is an attempt to explore the changes in Indian railway infrastructure system and its impact on transportation network system and development. The research includes a study of the requirements of various ancillary activities and built environment along with a focus on the planning guidelines and development norms for such spaces around the industrial corridors. The paper reviews the present policies and planning guidelines in India and identifies the gap in the same. Indian railway shift towards great autonomy of making Indian Railway sole owner and customer. This has opened up lot of opportunity for Indian railways and Indian economy.

Keywords – Fright Corridor, Economic Development, Planning Guidelines, Industrial Corridor

1. Introduction

1.1 Background

India is one of the fastest growing economy in the world. Growth in economy of a country is a reflection of not just increase in production of goods and services in all sectors but also the consumption of these. Transportation as a commercial activity drives economic benefits by attributes likes cost, efficiency, reliability, capacity, speed and competitiveness. Transportation is closely related to socioeconomic development and changes. 19th century globalization and 20-2st century of economic integration have opened gates for globalization. Transportation system- international, regional

and local is now one of the fundamental component of economic activities. The importance of freight services is also increasing with globalization as more multinational companies are growing and operating all over the world. This results in a demand of faster and more reliable transportation system. Different transportation model for goods and services exist in India. These transport model not just help in movement of people but also movies good that directly and indirectly impact economy of the country. Socio-economic development of a country depends on Policy plan and its emphasis on infrastructure development in all sectors. Transportation infrastructure is life line of any Economy, and Indian Railways plays an important part in that. Indian Railways world's second largest network is spread across 1,15,000 km and with track length of 68442 km. Indian Railways is also one of such transportation mode which is serving India from long way back. India railway (IR) has one of the largest railway network which spread 108706 km's in route length. It serves with 13,523 passenger and 9146 freight trains, daily plying 23 million passengers and about 3 million tons of fright (Indian Railways Industry, 2021). Based on concept of "Pacific Belt" (Tokaido Corridor- Japan) (Chaudhary, 2016) dedicated fright corridor was introduced in House of Parliament during presentation of Railway Budget for year 2005-06. Indians 11th five year plan (2007- 2012) introduced Dedicated Freight Corridor (DFC) by Ministry of Railways. Dedicated Freight Corridor Corporation of India Limited (DFCCIL). DFCCIL is designated as "Special Purpose Vehicle" for purpose of its planning and development, mobilization of financial resources, construction, operations and maintenance.

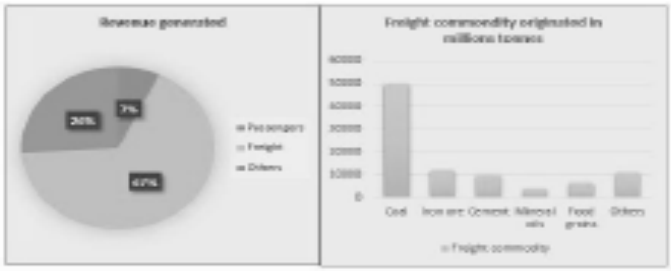
1.2 Need of DFC

1991 Economic liberalization, followed by Information Technology has placed India in leading development counties. 1990's reform reflected increase in private sector investment in major sectors specially targeting urban regions. Continuing with this trend and essential excellent development lead to specific development policy resulted emerging of different urban forms like Special Economic Zones, National Investment and Manufacturing Zones and adding new settlements towns around existing urban developments. In future also Indian economy is likely to show the same trajectory. Indian Railway has shown high cargo volumes with decrease in turn-around time, reduction in transportation cost and improved operations. With the course of time.

According to the Indian Railways Statistical Publications 2013-14, freight accounts for 67 percent of total revenue. As a result, rail infrastructure improvement has been long overdue.Besides, the saturation of existing railway lines has led to congestion and loss in the freight market share for Indian Railways. From the earlier 90 percent in 1950, the freight market share has dipped.

The Eastern Cargo Passage arm (1,839 km) begins from Ludhiana (Punjab) and passes through the states of Punjab, Haryana Uttar Pradesh, Bihar and Jharkhand, to end in Dankuni (West Bengal). The Western Cargo Hallway arm (almost 1,500 km) begins from Dadri in Uttar Pradesh and goes to Jawaharlal Nehru Harbour in

Mumbai, passing through UP, Haryana, Rajasthan, Gujarat and Maharashtra. The project's centrality lies within the truth that once completely operational, 70 per cent of the products trains will move to the DFC, subsequently liberating up the existing tracks totally for traveler trains. The Indian Railroads carries the fourth most noteworthy tonnage of cargo universally — at over 1,200 million tons — which incorporates coal, steel, petroleum items, press metal, cement, manures, foodgrains and containers. While there has been a hop of over 700 million tons of freight in India within the final decade and a half, there has not been a comparing increment within the stacking capacity of the trains.



Source: https://www.99acres.com/articles/what-is-a-dedicated-freight-corridor.html

2. Study

Study is based on one of the world's largest infrastructure project- Dedicated freight corridor, one of the critical driver of Indian economy that has a direct impact on socio- economic activity of each person leaving in this Country. The focus of study is not just to increase knowledge, but also to evaluate and understand its impact on society, economy, and environment. Study also includes dedicated freight Projects whether promotes sustainable development in country. Large projects of such type has a direct impact on development policy in long run.

3. Purpose

Broad purpose of this study is to understand and determine policy impact on factors like social and economic efficiency, sustainable growth and environment. The major goal that are aimed by Government and policy makers which lead to motivation behind purposing of Dedicated Freight Corridor project. Aim of study is to assess impacts from such type of transport infrastructure enhancement.

3.1 Scope

Broad study to access potential of dedicated freight corridor with respect to Social, economic and environmental. Ambitious project of Government of India with India Railways was primarily based on exploring potential of Indian Railway with respect to rising demand of freight transportation. This would lead in higher economic efficiency and significant environmental benefits. However, no explicit data or analysis related to these considerations is availed right now. A more elaborate study is required for understanding these elements.

The study compromises of following aspects of Dedicated Freight Corridor:

1. Overview of Project and its implementation strategy
2. Potential Economic development benefitted by this project
3. Potential regional / social development benefitted by this project
4. Potential environmental development benefitted by this project
5. Assessment of Economic and Environmental benefits

4. Overview: Freight Transportation in India

4.1 Past Trends and Future Projects

India's first railway proposal was made in Madras (Chennai) in year 1832. In 1837, Red Hill Railways ran it from Red Hill to Chintadripet Bridge in Madras to transport granite for road building. In 1947, at time of India's independence fairly a large railway network wa available. Indian Railways used to enjoy 90% share in Goods movement. With passage of time Indian Railway could not able to sustain this and showed a decline. In 1980's Indian Railways discontinued small and wagonload traffic.

Demand growth is limited in-between 0.8 to 1 in past decades. With India's future economic growth railways demand is expected to rise and to be 1.2 times GDP growth. With requirement of increase in capacity let to dedicated freight corridor requirement.

Japan International Cooperation Agency and World Bank with Indian Railways started this project with heavy investment.

4.2 Infrastructure gaps and future challenges

India's economy has seen uncommon development amid the final decade, averaging 7-8% per annum. While this has made a awesome bargain of openings, it has moreover come about in numerous challenges particularly for infrastructure required to maintain the rate of development. Transport is seen as one of the basic infrastructures for the economy. In national transport frameworks, cargo transport acts as the basic interface between ports, markets and fabricating centres. Concurring to an gauge by Indian Railroads, flexibility of transport demand to GDP is 1.25. Subsequently, GDP development of 9% would decipher into development in transport demand of more than 11% (MoR, 2009). On the other hand, it is additionally a truth that existing transport foundation has not kept pace with the growth in request. The thruway advancement ventures have moderated down and the railroad systems are highly congested. It is accepted that line capacity utilization on existing trunk courses is distant in abundance of saturation capacity. The same are

- Dedicated Freight trains modified dimensions. Length of freight trains modified to 1.5 km long, wit to be 3660 mm and clear height of 7.1 mts. This is one of its kind and first in World.
- Track Gauge of 1676 (5 ft 6 in) track that can easily run trains with speed of 100kmph have to be followed by all dedicated fright corridors.
- Double stack shaped containers to be standard and can be transported through electrical locomotives. These locomotives capable of handling load of 15000 ton with 400 containers. This is first and only in world.
- Bridges & formation to support 32.5 Ton axel. Track loading capacity 12t/m.
- High speed freight corridor capable of running trains with speed greater than 100km/h.
- GSM based tracking and Radio communication for all freight corridor.
- "No level Crossing" to reduce time and enhance safety in all respect.
- Increasing railway share in freight market through customized logistic services.
- Segregating infrastructure for both passengers and freight services.
- Introduction of latest and high end technology in transportation and services.
- "Guaranteed transit time" with accurate time tabled freight services.
- Reduction and promotion of Low carbon transport system in India
- Reduction in cost of transportation through dedicated corridor and speedy movement of freight trains. This will result in high productivity and economical savings.

5. Genesis of Dedicated Fright Corridor

A network of 68000kms and serving each nook and corner of India, it plays crucial role ofbalancing socio- economy development of India. Major core sectors – Coal, Mining, steel, petroleum, power, fertilizer cement and food grain heavily depends on Indian Railway. Serving with 1230 daily rake loading, 2815 indents a day, 302364 wagons, 13068 locomotives and 646 commodities Indian Railways define its extensions (About Us, n.d.).

1. Golden Quadrilateral Freight Corridor

GQFC has six DFCs, two of which are currently operational, and funding for the remaining four was approved in January 2018. The Golden Quadrilateral connects the four largest metropolitan cities of Delhi, Mumbai, Chennai, and Kolkata, as well as two diagonals, the North-South Dedicated Freight Corridor (Delhi-Chennai) and the East-West Dedicated Freight Corridor (Kolkata-Mumbai) (GQFC). These account for 55% of the total.

Source: https://en.wikipedia.org/

5.1.1 Eastern Dedicated Freight Corridor

The Eastern Dedicated Freight Corridor commences from Dankuni in West Bengal and passes through the States of Bihar, Jharkhand, Uttar Pradesh, Haryana, and finally terminates in Ludhiana, Punjab. It will be a 1,839-kilometer stretch with two electrified stretches. However, the track between Ludhiana and Khurja covering a distance of 400 km will be single electrified line owing to the lack of land.

5.1.2 Western Dedicated Freight Corridor

Dadri in the National Capital Region (NCR) is linked to Mumbai's Jawaharlal Nehru Port (JNPT) by the Western Dedicated Freight Corridor. It will take place in Uttar Pradesh, Delhi NCR, Haryana, Rajasthan, Maharashtra, and Gujarat, and will span six states. It would be a 1,500-kilometer rail line. Sections of the creation are expected to be announced by the government. Initially, 190 km of the stretch between Dadri (UP) and Phulera (Rajasthan) was closed.

6. Scope of DFC

The DFCs were launched to:

- "Reduce unit cost of transportation by speeding up freight train operations & higher productivity
- Increase rail share in freight market by providing customized logistic services
- Segregate freight infrastructure for focused approach on both passenger and freight business of Railways
- Create additional rail infrastructure to cater high levels of transport demand
- Introduce of high-end technology & IT packing of Freight Services
- Introduce time tabled freight services & guaranteed transit time".

6.1 Global experience of DFCs

Numerous nations around the world utilize rail foundation for "long pull operations", which is another term for cargo passages, particularly built for transportation of bulk cargo merchandise by railroads. Be that as it may, few countries have committed cargo passages. Among the ones that do, the foremost conspicuous are, Australia, South Africa, China, Netherlands and USA.

"Dedicated cargo lines are rail lines whose arranged utilize is confined to cargo trains as it were. A dedicated rail cargo arrange would comprise of an necessarily arrange of such lines, either recently built lines or existing lines changed over to devoted cargo utilize, with adjustment where necessary" (Dirand, 2007). Conventional lines, then again, work with traveler and cargo trains sharing the same infrastructure, which frequently comes about in clashing needs and decreased carrying capacity of the framework.

In South Africa, the 861 km long Sishen-Saldanha railroad line, known as the Mineral Trade Line, operates 4 km long trains carrying net stack of 41000 tons with 30T hub stack (Kuys, 2011). Cargo Railroads in America, which are totally secretly claimed, are among the cheapest within the world and one of the most efficient systems. Since its deregulation within the 1980s, the share of rail cargo activity within the USA has increased consistently. In spite of the fact that there are a few committed hallways, much of the arrange is simultaneously used by Amtrak traveler administrations as required beneath current directions. With future request for freight traffic anticipated to develop at exceptionally tall rates, the industry is stressed around inescapable struggle with intercity passenger rail administrations, which are too increasing rapidly (The Financial analyst, 2010). So also, DFCs in Europe, such as the Betuweroute within the Netherlands, are centering on genuine issues of financial viability and integration with blended activity at connecting hubs. The German DFC.

China has incredibly extended its rail arrange and modern DFCs are being built to interface hinterland regions with ports as well as to transport key assets between different generation centres within the northern and southern locales. Concurring to the "Medium and Long-Term Railroad Arrange Plan", traveler transport will be isolated from cargo transport on active trunk lines by 2020. In spite of the fact that current development of the rail organize in China is government financed, more prominent private segment support is expected in coming years. Similar to American Railroads, China is additionally confronting the troublesome approach choices and uncertainties associated with deregulation of this division for accomplishing advertise proficiency. Whereas China is committed to rapidly extending the rail cargo arrange, their involvement with DFCs has not been reported.

By and large, the worldwide encounter of DFCs appears that integration of DFCs with blended activity systems is problematic at the meeting focuses (hubs). These issues must be tended to with meticulous planning of systems and frameworks.

The other major challenge is that of choosing between tight regulations and state control on one hand, and deregulation and free showcase competition on the other.

7. Conclusion

DFCs display a critical opportunity for cargo coordinations in India. What is vital is to see how the increasingly optimistic activity projections will be realized. That depends upon the mechanical and exchange development in India, and the development of mechanical hallways and the feeder organize. In arrange to use the complete productivity of the DFC, we will too require rolling stock that can take advantage of the expanded pivot stacking capability. On the EDFC, the dependence on coal activity would be a concern since there may be troublesome changes on the sources of vitality in the long run. Encourage, the prospect of expanding holder activity can be influenced antagonistically since the EDFC would permit single stacking as it were. Another imperative concern would be the sole mediator part played by the Indian Railways, which needs to bring within the conclusion clients. Indian Railroads has not continuously been known for its client centricity. Overall, the DFCs have the potential to be a diversion changer for the Indian.

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Child Friendly Cities

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Abstract

It is common knowledge that majority of the population growth in the upcoming decades is going to happen in urban cities, it is important to have a clear roadmap and thought process to ensure that growth of the cities happens in a planned and projected manner instead of unplanned or haphazard way. There are multiple aspects of this including but not limited to Safe and healthy housing, Commercial activities, Transport, Energy, Water and Food. A lot of countries in the world are trying to address the same through the theme of 'City 2050'. There are no doubts about the fact however that, out of all the aspects mentioned above, the one relating to healthy and safe living is foremost and has to be considered at top priority. This paper intends to explore this aspect further and focus more on the concept of Child Friendly Cities (CFC) as envisaged by UNICEF in its declaration of 1996.The Child Friendly Cities Initiative (CFCI) is a UNICEF-led initiative that supports municipal governments in realizing the rights of children at the local level using the UN Convention on the Rights of the Child as its foundation. Not only that, it also provides a forum that brings together various constituents and stakeholders such as Governments, civil society organizations, the private sector, academia, media and, importantly children themselves who wish to make their cities and communities more child-friendly. Paper further explores the need of Child friendly cities in general, Guidelines of CFC framework, Trend setting cities across the globe, Challenges faced by them and CFC in India. Paper also discusses a few case studies from across the globe, gaps in implementation of the said projects, major lessons learnt and strategies to leverage the same to mitigate the challenges in pursuing CFC project in developing world.

Keywords: *Planning, Urban Area, City 2050, globalization*

1. Introduction

For the first time in human history, urban areas have more inhabitants than rural areas. It is estimated that around 68% of the population would dwell in urban areas by 2050 (NATIONS, 2018), 60% of this would be constituted by people under the age of 18 years. Many of these children benefit from the benefits of city life, such as greater educational and medical opportunities in addition to leisure facilities. Many children are denied such necessities where there isn't one. Children can travel safely and freely inside their neighborhoods thanks to good urban planning and design. As a result, it is critical that authorities design and create communities that are child-friendly and sensitive, co-creating healthy, inclusive, and accessible public spaces for and with children, especially the most vulnerable. In keeping with these observations UNICEF and UN-Habitat initiated the Child Friendly City(CFC) initiative in 1996 to implement a resolution passed during the second United Nations Conference on Human Settlements to make cities more livable for everyone. A few countries have started concerted efforts towards achieving the objective of Child friendly cities. Child friendly city is a city, town or community in which the voices, needs, priorities and rights of children are an integral part of public policies, programs and decisions.According to UNICEF, CFC is a city, town or community where children:

- Are protected from exploitation, violence and abuse.
- Have a good start in life and grow up healthy and cared for.
- Have access to quality social services.
- Experience quality, inclusive and participatory education and skills development.
- Express their opinions and influence decisions that affect them.
- Participate in family, cultural, city/community and social life.
- Live in a safe secure and clean environment with access to green spaces.
- Meet friends and have places to play and enjoy themselves.
- Have a fair chance in life regardless of their ethnic origin, religion, income, gender or ability.

Given below is a map which shows current status of the same across the globe – cities which are already CFC, cities which are in early stages of designs and also cities where action is yet to begin.

Figure 1:Location of CFC countries on world map
Source: (UNICEF, 2021)

2. Methodology

The research is based on information found in various journals, articles,research papers, and videos related to this topic. Later in this paper some observations from global case studies have been shared which can be considered as benchmark by these developing nations for taking ahead their program for widespread CFC development.

Case studies have been accessed against the 9 building blocks for CFC which are formulated by UNICEF and Sustainable Development Goals 2015._

2.1 Building Blocks for CFC: There are 9 building blocks which have been formulated to address the ongoing challenges.

Table 1:Nine Building Blocks for CFC

1.Children's Participation(B1): promoting children's active participation in topics that concern them; listening to and considering their opinions taken into account during the decision-making process.	**2. A Child Friendly Legal Framework(B2):** ensuring effective promotion and protection of rights by legislation, regulatory mechanisms, and procedures of all the kids.	**3. A city- wide children's rights strategy(B3):** Develop a comprehensive, detailed strategy or agenda Construction of the children's friendly city agreement.
4.A children's rights unit or coordinating mechanism(B4): Develop continuous local government structures to ensure priority consideration of the perspective of children.	**5.Child impact assessment and evaluation(B5)**: Ensure the systematic evaluation process for children during and after implementation of law, policy and practice.	**6.A children's budget (B6)**: Ensure adequate commitment to resources and child budget analysis
7. A regular state of the City's children Report(B7): ensure adequate surveillance and collection of data on the state and rights of children	**8.Making children's rights known(B8)**: Ensure awareness of adult and children's rights.	**9. Independent advocacy for children(B9)**: Support for the promotion of the rights of children by non-governmental organizations and the development of independent human rights institutions

Source: :(Unicef, 2004)

2.2 Sustainable Development Goals(SDG) for CFC: The 2030 Agenda for Sustainable Development was adopted by world leaders in September 2015. The

Agenda is a set of 17 Sustainable Development Goals (SDGs) and 169 targets. Out of the 17 SDG's there are 12 goals which are directly or indirectly concerned with CFC namely

Goal -1 No Poverty, Goal-2 Zero Hunger, Goal-3 Good Health and Well Being, Goal- 4 Quality Education, Goal-5 Gender Equality, Goal- 6 Clean Water and Sanitation, Goal-7 Affordable and Clean Energy, Goal-8 Decent Work and Economic Growth, Goal-10 Reduced Inequality, Goal-13 Climate Action, Goal-16 Peace and Justice Strong Institutions and Goal-17 Partnerships to achieve the Goal. (Unicef, Unicef, n.d.)

3. Research Context/Case Study

Many Cities have attempted to initiate child friendly planning in their cities and for the purpose of this research 4 cities were chosen for case studies i.e. Sharjah (U.A.E), Bogota(Columbia), Denver (Colorado, USA) and Barra Mansa (Rio de Janeiro, Brazil).

Figure 2:Location of Child Friendly Cities taken in case Studies
Source: (UNICEF, 2021)

3.1 Sharjah(UAE): Sharjah , with a population of around 1.4 m people is the third largest emirate of UAE. Under the directives of ruler of Sharjah , the emirate has taken definitive measures over last 4 decades to develop Sharjah into a city where children and young adults can live in a safe and healthy environment enjoying their rights and having access to platforms where their voices can be heard. UNICEF announced Sharjah to be a Child Friendly city in 2018 for its child friendly initiatives and with its concerted efforts on all fronts – legal, institutional, budgetary and planning- the city became first in the middle east region to become a CFC and also the first one in the whole world .

Main CFC Initiative of Sharjah: 'Baby friendly Cities'- The Project was started in 2011. After the successful introduction of four initiatives: Baby-Friendly Health Facilities, Mother-Friendly Workplaces, Mother and Baby-Friendly Public Areas, and Breastfeeding-Friendly Nurseries, the project was able to introduce the idea of a "child-friendly city." It focuses mainly on health of the children. The emirate has

designated 19 government and private health facilities as Baby-Friendly, 22 public places as Mother-Baby Friendly, 30 nurseries as Breastfeeding-Friendly, and 84 workplaces as Mother-Friendly since the project's inception. (NEWS, 2019)

3.2 Bogota(Columbia): Mayor Enrique Perialosa of Bogota initiated many projects to make it environment friendly and child friendly city.

Main CFC Initiatives of Bogota

1. **TransMilenio Project:** To develop a healthy and safe atmosphere for children, in 1999 Bogota started TransMilenio project to established dedicated cycling and pedestrian-only roads, banned cars from the city centre, and built a 700,000-person-per-day rapid transit bus system. As a result, traffic deaths decreased by 50%. The first phase of implementation was completed in 2002, the second in 2006, and by 2012, TransMilenio had 12 lines running across the region, making it the world's largest bus system. (UNICEF, childfriendlycities)

2. **Street Paintings Project:** To minimize traffic speeds and create new play space, street paintings and planters were used to mark a path between a kindergarten, school, and park, while buildings were painted in bright colours. (Laker, 2018)

3. **Camino Imaginado Project:** The third initiative undertaken by Bogota worth mentioning here is the project called 'Camino Imaginado'. Project aims at significantly improving upon social inclusion through safe access of schools to students and teachers and also rehabilitation of youth offenders by providing them job opportunities. Some 40,000 sq.m (Beverly Kingston, 2007). space has been recovered for former and around 1300 jobs for latter purposes. (Devashish Dhar, 2020)

3.3 Denver, Colorado(U.S.A.)

Denver is the number-1 ranked child friendly city of U.S.A.

Main CFC Initiative of Denver: In 2006 with a collaboration of mayor of Denver and children, youth and environment centre, Colorado initiated City Youth Friendly City Initiative (CYFC).

Name was chosen specifically to make it inclusive of a wider age group rather than limiting it to just the Children. Denver's CYFC program revolves mainly around two projects:

1. **Safe Routes to School:** This project by the Children, Youth and Environments Center (CYE) of Denver addresses the need for safe routes to walk and bike to school. It aims to provide children, parents, and other community stakeholders with a process for communicating neighborhood safety concerns and also in addressing these concerns through a community-based approach tailored to the

needs of specific neighborhoods. The said approach helps all the concerned stakeholders to evaluate and address the risks identified by children themselves. This is then followed up by a team representative of neighborhood stakeholders, who assist in implementing changes based on the priorities identified by children and other stakeholders. Project ensures that children can safely walk or ride to school using a variety of strategies including compliance, infrastructure improvements, safety education, and non-motorized transportation incentives. (Beverly Kingston, 2007)

2. **Learning Landscapes:** With a budget of $20m raised in pubic private partnership, this project has Department of Landscape Architecture work with School officials, teachers and students. Project aims at designing new multi generation spaces for outdoor use in the school yards to meet the requirements of different age groups of not only the students of the school but also of the local residents in before and after hours of schools. In nutshell, this program reconnects schools to the communities by allowing community use and as a result increases the sense of belongingness and ownership of the school yards.

3.4 Barra Mansa, Rio de Janeiro, Brazil

Main CFC Initiative of Barra Mansa: Barra Mansa's children's participatory budget council (CPBC) is a good example of combining children's involvement with genuine, budgeted resources for child-initiated projects. Local youngsters aged 9 to 15 and parents were the driving forces behind the formation of these councils. They then invited others to join in and offer their knowledge and abilities. The budgeting procedure is quite transparent because the government has allocated a tiny portion of its budget (about USD 125,000) to the council, with the elected children of the council being able to decide on the public works to which the budget should be given. Elected children also go on "citizenship trips" to various communities to examine the many problems at various geographic levels, allowing them to prioritize which issues should be addressed. The relative budgetary clarity allows children in Barra Mansa to launch projects such as health clinic renovations without risking proposing completely impossible plans. (Guerra, 2002)

The CPBC was founded in 1997 as a result of a municipal program called "Citizenship Knows No Age," which started the citizenship process for children and teenagers. The program established a Children's Secretariat, with the goal of having one child or adolescent participate in each municipal secretariat. Child Secretaries were chosen from a pool of five boys and seven girls aged 8–13. Barra Mansa City Council had been creating activities based on public participation and implementing innovative policies in the field of children's and young people's rights, thus the city consultation process was centered on the theme of "participatory governance and children's citizenship. (N.I.U.A, 2017)

3.5 Child Friendly Cities in India: India has the world's greatest number of children. Children (ages 0-18 years) make up 472 million of India's population (Census of

India, 2011) which is 39 percent of total population. Some of the most prominent issues which need to be kept in consideration while planning child friendly cities are as following:

1. **Vehicular density and congestion:** Given the traffic density on Indian roads and the time an average child spends on the commute to and from school, play areas and friendly meets - it is of utmost important to plan roads, footpaths and crossings safe and inclusive for children in India.

2. **Concrete jungles and limited access to green spaces:** This has led to the limited availability of open and green spaces for children to play and mix up with their peers. This problem has further accentuated itself during covid times and as a result of which children have remained confined to indoors. While considering planning Child Friendly Cities, it is important that there is sufficient green and open space in the neighborhood of all children for them to be able to happily and safely enjoy their childhood and develop into healthy adults. (Devashish Dhar, 2020)

In addition to the above slums, lack of health care centres, increase of crime rates in cities etc. are the main issues which have to be taken care by the government as well as by planners to make cities child friendly. Participation of children in making child friendly cities can play an important role towards this. Indian Government also started some policies and schemes for children such as

- National Education Policy2020 (NEP2020)-For Free Education to children
- Affordable Housing (PMAY)-For Affordable housing
- Mid-day meal scheme-To provide nutritious meal to poor children
- Sukanya Sammridhi yojna-To provide financial support to girl child
- AMRUT Yojna-To provide walkable Communities

The National Institute of Urban Affairs (NIUA), in collaboration with the Bernard Van Leer Foundation (BvLF) has undertaken a project to build Child Friendly Smart Cities (CFSC) in India within the urban agenda of building smart cities. The goal of this initiative is to bring focus to the needs of the children in the urban policy and planning framework. Two cities, namely Pune and Bhubaneswar, are the pioneers in India from CFC perspective. Officials in Bhubaneswar have started the "Socially Smart Bhubaneswar" program, which teaches adolescent girls self-defense tactics. The city has also joined the Bernard van Leer Foundation's Urban95 initiative, which strives to develop cities that meet the needs of a three-year-old (average height is 95 cm approx.). This effort focuses on bringing about changes in urban planning. (Devashish Dhar, 2020)

4. Findings

Through Comparative analysis it is found that out of 9 building blocks Child Participation, Legal framework, children's rights strategy and Children's budget are

the most widely strategies to make child friendly cities. The lowest covered building block is-Child impact assessment and evaluation(B5).

Table 3:Analysis of Case Studies on the basis of 9 Building Blocks

City	Child Participation	CFC legal framework	A city wide children's rights strategy	A children's coordinating mechanism	Child impact assessment and evaluation	A children's budget	A regular state of the city's children report	Making Children's rights known	Independent advocacy for children
Sharjah, U.A.E.	-	-	-			-		-	-
Bogota, Columbia			-				-		
Denver, U.S.A	-		-	-		-			-
Barra Mansa, Brazil	-			-		-			

Source: Compiled from literature

5. Conclusions

Child Friendly Cities is a great initiative towards finalizing master plan vision 2050 of cities. This will ensure that our cities are more environment friendly, sustainable and provide support to our children towards a healthy, safe and learning environment. Almost anywhere in the world, adult urban planners planned city while the end users are frequently teenagers, as is the case in parks, public spaces, and schools. Child Friendly Cities with children's innovative minds can create an environment for children to express their views and influence decisions that impact them, so that urban planners and decision-makers can provide a healthy, stable, and clean environment that takes children's perspectives into account.

To summarize the solution to this challenge lies in making our cities child-friendly through following means;

a) Participation of children in decision making through city parliaments to solicit their views on issues of importance
b) Dedicated corridors/cycle tracks for children to travel to the surrounding areas for attending schools, visiting playground and local markets
c) Creating self-sufficient societies with minimal vehicular movement inside with all the important buildings and areas like schools, markets, libraries and recreational spaces are available to them within the boundaries of that society
d) Formalizing rules to help sensitize the local law enforcement agencies to ensure safety and wellbeing of children
e) Establishment and strengthening of local Aanganwadi for ensuring compliance and adherence with all health and nutrition related matters
f) Formation of exclusive bodies for protection of child right in conjunction with judiciary and law enforcement agencies

g) Introduction of education related to child right at school level to increase awareness

Through the analysis of this research it is concluded that by following the above stated guidelines the cities can grow towards focusing on child centric development. When one looks at the growing population or the current composition of our country it is found that around 39%of the population is in young age so in the coming 10-20 years the concentration of the population would be more in young and child age. Hence our focus should be in the direction to make it useful for the users when they should start thinking on the lines of child centric development.

Given above, the need for a CFC is undeniably proven however, the concept itself is in infancy and as such it might take years, if not decades, before it starts gaining the attention it deserves.

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Review of Counter Magnet City Concept and Setting up Prameters for Future Consideration

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The Population in urban areas is increasing on a very rapid rate. In 1975 the urban population of entire world was 38 percent, in 2000 it increased to 47 percent and it is estimated to be 61 percent by 2030. Indian urban population is also increasing rapidly. The population of people living in urban areas of India, as per the 1901 census, was 11.4%, which increased to 28.53% in 2001 census, and to 34% in 2017 as per the World Bank. Delhi's population which was around 3.0 million in 1960, is estimated to be around 38 million by the year of 2030. The main reason of the fast increasing population in urban areas is migration. This escalating population growth has put a lot of pressure on the existing infrastructure of the Metropolitan cities. Hence to stimulate the process and to control the urban population the new growth concepts like new town, counter magnets, satellite towns and ring towns emerged widely. Out of these approaches concept of counter magnet city was to develop another city far from the origin city and to develop the infrastructure and employment opportunities within it to attract migration and ease out the pressure of the origin city. This paper discusses how the approach for a counter magnet city has been considered to control the migration of main cities via various case studies for Delhi NCR region and other international cities. Further the paper attempts to put forth a set of parameters that are a pre-requisite for counter magnet cities so as to achieve the overall aim of decreasing the pressure from the main city. Case study based approach along with a literature review to analyze and detail out the counter magnet city concept is being adopted.

***Keywords*: Urban Growth, Urbanization, Counter Magnet, Tier-II city, Balanced Development, Region Dynamics**

1. Introduction

Urbanization and migration are considered to be the key elements for rapidly growing mega cities in our country. This can be clearly understood in respect of world urbanization pattern. The urbanization was triggered by the industrial revolution which started in the 19th century In 1975 world urban population was 38% which increased to 47% in 2000 and is expected to be 61% by 2030 **(NCRPB, Introduction (Study on counter magnet areas to Delhi & NCR), January 2008)**.

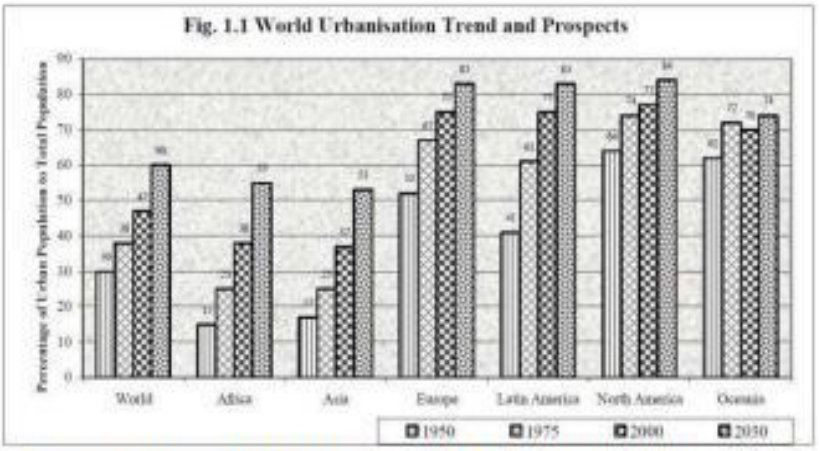


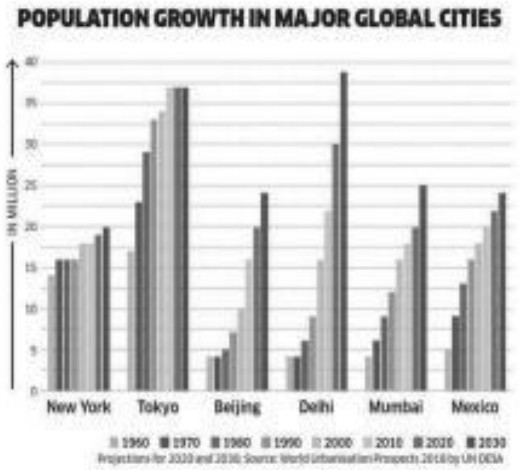
Figure 1 United Nations, World Urbanization Prospects

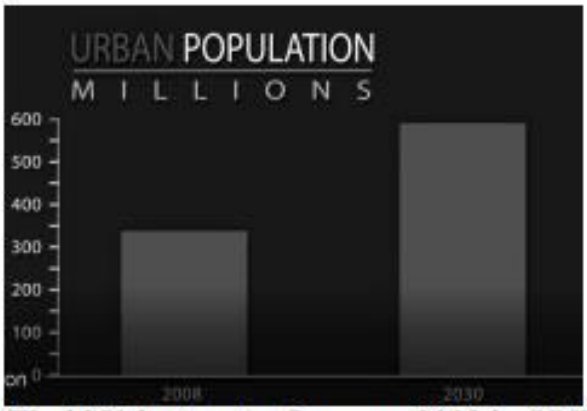
Table 1.1: Number of 10 million + Cities/Agglomerations in the world, more developed and less developed regions of the World

Description	World				Developed Regions				Less Developed Regions			
	1950	1975	2000	2015	1950	1975	2000	2015	1950	1975	2000	2015
No of Agglomerations	1	5	19	23	1	2	4	4	0	3	15	19
Total Population (in million)	12	68	263	375	12	36	67	69	0	33	195	306

Source: United Nations, World Urbanization Prospects

Urban India is also in the race of urbanization. As per Census of India 2011, 377.1 million people live in urban areas out of the entire population of 1210.2 million and this number is estimated to be around 600 million by the year of 2030 **(mckinsey global institute, n.d.)**National capital Delhi and its region (NCR) has grown by 33% to 36% decadal from the year of 1961 to 2001 **(India, Census of India, 2001)** and it's estimated to be 58.2 million by 2021 from 11.1 million in 1961.





Source: World Urbanization Prospect 2018 by UNDESA
Source: Meckinsey Global Institute

Metropolitan cities serve as the center of business development, trade and commerce and lots of different tertiary services. Because of this heavy urbanization the pressure on existing urban infrastructure, amenities and services increases heavily. Hence, the concept of counter magnet town or city came into existence to reduce the burden on existing infrastructure, and other services while giving or generating enough economic activities and a balanced growth to boost the zonal or regional economy. As per **(NCRPB, Migration Study of Delhi & NCR, 2008)** population of the NCR region has grown many folds over the years.

Population Growth in NCR			
Decades	NCR Population in Lakh	Decadal Increase in Population in Lakh	Population Growth rate (Decadal)
1961	111	-	-
1971	147	36	32.4
1981	199	52	35.4
1991	274	75	37.7
2001	371	97	35.4
2011	460	89	24.0

Table 1: Source Census of India 2011

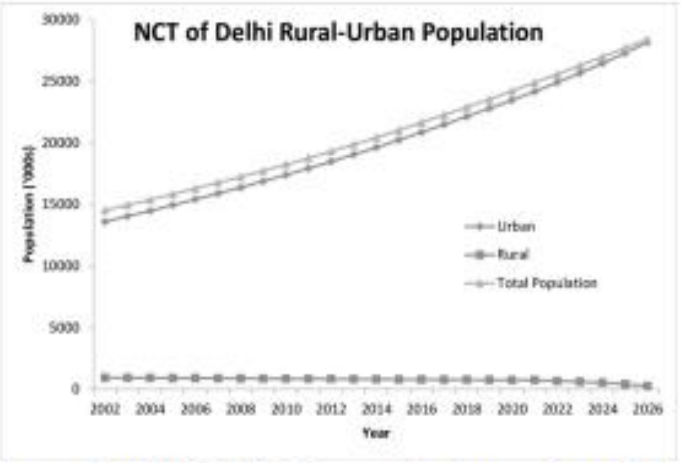


Figure 2: Source: NCT of Delhi Sustainability analysis & plan for the future (June 2015)

The table clearly reflects a serious need to establish the counter magnet areas by developing Tier-II cities, satellite cities, etc. for redistribution of population by reducing the population inflow in major cities enabling a balanced regional development As these tier II cities would function majorly for easing out pressure from megacities they need to be meticulously planned so that they serve their purpose and emerge as promising cities of future.

2. Management Strategies of Urbanization

People, move from rural areas to urban areas or urban areas to other urban areas due to many push and pull factors, better employment opportunities being one such factor. This is called migration and it leads to urbanization which is linked with urban growth. In order to manage such urban growth there are various strategies which can be adopted. These strategies can be divided in two categories namely external and internal **(Agarwal, 2020)**.

External

- New Towns
- Pole Development
- Counter Magnet
- Satellite Town

Internal

- Infill Development
- City Extension

The internal strategies are limited to within the city or by adding the adjoining areas or peripheral areas while in external strategies try to find out the solution beyond the city limit. The primary need to reduce the pressure of existing overexploited

infrastructure and amenities by making appropriate strategy One way for this can be to make the necessary changes in the existing policies by which underutilized potential can be identified and empower the urban area to cater the increasing population. The internal strategy includes the up gradation of current infrastructure, optimization of the existing utilities and services and up gradation of existing policies like FSI limits and vertical development to enhance the event of the internal ways. These include infill development, Brownfield development and city extension. All these strategies have their own limitations in terms of availability of land and provision of services as per the need and demand of the growing population.

The External strategies look for new dimensions of development which explore varied development approaches like satellite town, counter magnet city, new town and pole development etc. Since economic growth is the key factor in the development, 'employment generation' has been proven the key focus area. In Pole development as the name suggest the growth in population and the movement of people is limited to an anticipated area called as growth pole. In this concept growth is not uniform in the entire region but is concentrated to a particular region or area. At a later stage when first growth pole becomes inadequate to cater the needs of increasing population then emergence of 2nd growth pole is possible.

Satellite towns are town which have been developed near the main city or core city and they are neither fully independent of the mother city nor restricted in their function. These have been developed at the adjoining areas or in the suburban areas which are partially independent for its socially and economically growth **(Amit Chatterjee, 2015)**. But it is found that with due course of time these satellite town got merged with the main city due to continuous expansion of these town and main city and hence lose their charm and identity.

3. Magnet City

The city, which pulls individuals, brings investment, provides social amenities & infrastructure is known as a magnet city or town. In foreign countries also the concept got a lot of success. Basically a powerful magnet pulls the people and attracts the business, economic activities and give enough employment opportunities to people on a lower expenditure for living as compared to the metro city. If a counter city has not been planned adequately then it may push people away from the city and can become a negative magnet based on its characteristics. For a successful magnet city the aim should be to give identity to city and generate the opportunities to grow the economy and uplift the living standard of the residing people.

This counter magnet town or city basically acts as a substitute of its origin city and work to reduce the existing pressure of the metropolitan city. These cities or towns provide a better infrastructure and other social amenities as well as good connectivity with the other parts of the region.

Considering the above advantages, the counter magnet city or town acts like a barrier in migratory flows from the near about areas to the core city. Other than that the counter magnet city provides the enough opportunities for the employment and gives better services and stops local people to go out of their roots or their origin city due to these factors. Thus these cities act like an economy generator and help the country to grow equally.

3.1 Counter Magnet City concept

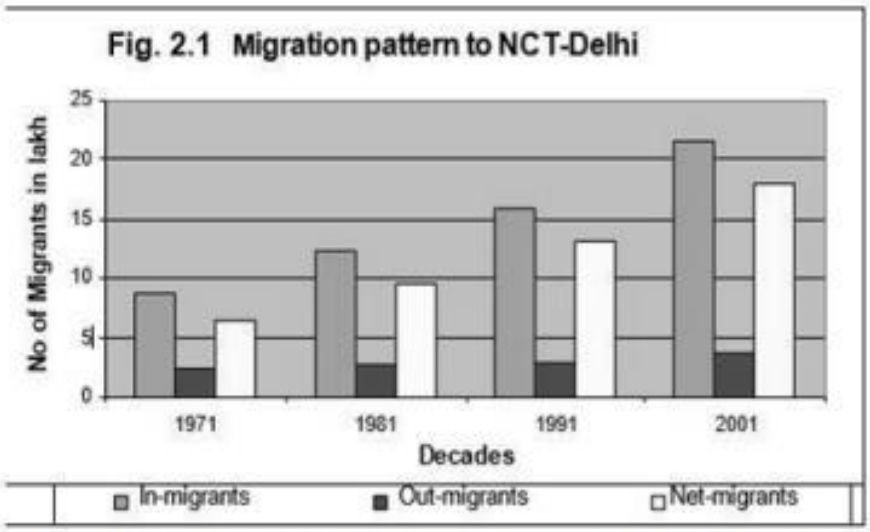


Figure 3: Source Study on counter magnet areas to Delhi-NCR by NCRPB

In the year 1985 the NCRPB (National capital region planning board) was formed to ease out the increasing migration in Delhi-NCR first. Board further studied the region in totality and gave the proposal of counter magnet cities for the balanced growth and to ease out the increasing urbanization and migration for the Delhi – NCR.

Figure 4: Source NCRPB -Counter Magnet Cities of India

The concept was to identify the few cities away from the NCR area which can be developed further and can attract the migration to release the Delhi – NCR migration pressure.

As per NCR plan 2001, first total 36 cities within the range of 100-400 km identified based on various parameters like their size, population growth, status, work participation ratio, population density and spatial parameters like accessibility, congruence with in migration corridors and proximity to other contenders in the region. In final analysis based on city profile, demographic changes, productive activity, finance & commercial services, Public and semipublic facilities, urban management, infrastructure (utilities and services) and growth impulse total 5 cities were identified as counter magnet cities.

1. Hissar (Haryana)
2. Gwalior (Madhya Pradesh)
3. Kota (Rajasthan)
4. Patiala (Punjab)
5. Bareilly (Uttar Pradesh)

Later on as per Regional Plan 2021 three more urban areas Ambala (Haryana), Kanpur (Uttar Pradesh) and Dehradun (Uttarakhand) have been added to these magnet cities by NCRPB in 2008.

3.2 Assigned role for Counter Magnets area

Regional set up 2001 appointed 2 distinctive and reciprocally complementary roles within the context of NCR (NCRPB, Study of existing counter magnet areas, january 2008):

1. As interceptors for the migration flowing in to NCR region, which can step up due to accelerated progress of NCR which can further pull migrants from the near about less developed region.
2. As these counter magnet cities will be growth centres hence the growth of urbanization in entire region should be balanced in an adequate time period.

As per policy guideline of 2001 regional plan, it was a combined duty of state government and NCRPB for the development of identified Counter magnet areas. The state government or the concerned agencies were given to prepare the overall strategic development program for the CMAs to uplift the physical and social infrastructure and economic based activities.

3.3 Development Strategy for CMA

a) General approach to development

The growth of these magnets has been considered in a larger prospect to get the balanced growth or development and equal growth in the neighbouring states as a

complimentary planning process for step by step growth of Delhi – NCR region as these towns or cities are the integral part of the strategy of decentralization of NCR area. Hence the priority has to be given to these towns.

As per suggestion NCR board has to make sure to provide the funds and guidance to the state government. At the same time state government has to make sure the development progress.

b) Area of Intervention

The identified cma had enough potential to grow and develop on their own by the help of state government and local agencies. Certain areas like regional connectivity, social and economic infrastructure were required immediate focus to promote so that development can be accelerated and these cities can function effectively as cma. The areas of intervention area:-

- Up gradation of Regional Linkage
- Improvement of Economic base viability
- Up gradation of infrastructure

4. Case Studies

1. Hisar (Haryana)

Hisar a very important urban center and a very fast growing region of Haryana. Hisar district is taking care of the needs of approx. 17.43 million people's (India, census of India, 2011). Hisar is located to 164 km to the west of New Delhi.Ithas links with other neighboring areas of Rajasthan and Punjab for trade purpose. In radius of 100 km of Hisar, there is no other major urban center. The district covers approx... 3983 sq.km. Area with four no of tehsils. Total density of the district in 2001 was 386 persons per sq.km which was 237 in 1981.

Hisar has a very good connectivity with other districts of Haryana and other neighboring states' districts by rail and road network both.

Basically Hisar is located on NH-10 & NH-65 which connects it with other urban region like Delhi, Sirsa and Rohtak. There are other state Highways as well for connecting hisar with Tohana- Chandigarh, Tohana – Bhiwani, Balsamand – Bhadra. Hisar has its own domestic airport which is situated at 5 km distance to the north east of the city.

Figure 5: map of India website- Hisar district map

Industrial growth inside the city and in the neighboring areas, Shifting of Electrical Board of Haryana State in Hisar, Administrative complex and other judicial complex made the city as a most growing center in the region.

Hisar city has grown with a decadal growth of 31.95% and 45.14% from 1981-1991 and 1991-2001 with population of 1,37,369 in 1981,1,81,255 in 1991, 263,070 in 2001. Once after declaring as counter magnet city growth was 17.54% from 2001-2011 with a population of and 3,09,210 in 2011 as per India census. As per NCRPB report total in migration in Hisar was 1,29,056 from 1991-2001 and on the other hand out migrated numbers to Delhi are 6,894.

Majorly economy of Hisar depends on Industries. Other sources are trade, commerce and education institutes as well. Hisar is known as "**City of Steel**" (saini, 2015) as well. Steel pipe manufacturing makes the Hisar as one of the largest pipe manufacture region the Haryana State. Hisar has the industries like Jindal Steel, Hisar textile mills and sister companies. The work force involvement has also grown up to 33.51% in 2001 from 28.74% of 1991. The total numbers has been increased to 88,145 from the 52,103 during this period. Being a counter magnet city, NCRPB has funded for the various project in Hisar like extension of water supply, Sewage treatment etc.

In conclusion Hisar city has a huge potential for a counter magnet city considering its connectivity with Delhi and other cities, Its own Airport, its industrial growth, job opportunities, its own fabric and socio culture. However city is not serving the purpose of selecting a counter magnet so far as still it is not able to pull mass migration and to decrease the load of the Capital city Delhi.

2. Patiala (Punjab)

Patiala With a population of 6.16 lac. Patiala is situated just off to the National highway-1 on Delhi – Amritsar. City is about 250km from National Capital Delhi. The nearby urban regions are Rajpura on 24km, Ambala on 50km and Chandigarh at 65 kms from the city. Patiala lies on the Ambala – Bhatinda railway corridor but it does not have direct connectivity with Punjab capital Chandigarh and other parts of the country.

Figure 6: Source - Map of India website- Patiala District map

The town lies 62 km SW of the Chandigarh city. Patiala is a very important region for the Agriculture produce and other goods. Patiala is having a good connectivity with Gobindgarh, Rajpura which are the growing industrial towns and it has connectivity with market towns like Samana, Sangrur, Patran and Nabha.

Regionally Patiala has Chandigarh, Rupnagar and Fatehgarh in North, Sangrur in the West, Ambala and Kurukshetra in the east and Kaithal in the south. The district level administrative headquarter is situated in Patiala. There are state and regional government offices like PSEB, Public health Dpt., Punjab state pollution control board, PWD, Excise and taxation Dpt., Income Tax commissioner, Water supply and Sewerage Board located in city. In Education field also there are institutions like Punjab University, Thapar Engineering College, Two dental colleges. It has second largest cantonment in Punjab. Due to these colleges and institutions Patiala has potential to be developed as Knowledge city. Its fertile hinterland may help to develop the various agro based industries.

Population growth of Patiala can be understand by below mentioned table. As per 2011 census Patiala population was 4.06 lac which was 2.06 lac in 1981.

Decades	Population	Increase in population	Decadal growth rate in %
1971	151041	-	-
1981	206254	55213	36.55
1991	253706	47452	23
2001	323884	70178	27.66
2011	406214	82330	21

Table 3: Patiala Decadal Growth

Total Migration from all other parts of India is 1,30,869 in last decade from 1991 to 2001 and out migration to National Capital is 3363 (Migration table).

Majorly Patiala's economy depends on the Institutions, Service, trade and commerce. Gobindgarh, prominent industrial town in Patiala's vicinity is also called as "Steel Town". Patiala is known for tractors wholesale business. Patiala is a fast growing Industrial region.

In 2001 census the nos of main workers is grown up to 5,89,015 in 2001 from 4,69,151 in 1981.

Patiala has huge potential for tourism sector because of many historical and religious points. Tourist spots like Bahadurgarh fort, Quila Mubarak, Maharani Club, Sheesh Mahal, Bara Dari garden and cricket Stadium are the major locations which can further be enhanced to attract people to visit the location to grow the tourism sector.

NCRPB is funding two major project in Patiala (a) integrated township project at Baran (b) Physical infrastructure project (Extension part).

The city does not have a direct railway connectivity with Delhi because of which the entire traffic has to depend up on road transport. Moreover as the city lies just off the excellent national highway -01 the city could not develop at the pace as envisaged by the NCR PB as a counter magnet.

3. Mysore (Karnataka)

Mysore city, the famous historical and tourist places in South India, is situated at a distance of about 145 Kms. South west of the state capital Bangalore city. Mysore city is geographically located between 12° 18′ 26″ north latitude and 76° 38′ 59″ east longitude. Mysore is located in the foothills of chamundi hills. . Mysore is connected with National Highway 212 to the Gundlupet which is on the state border and it further connects the kerala and Tamilnadu states. Mysore is connected with Banglore via state highway no 217 which is a four lane highway. Mysore connects the H D Kote and Mangalore city via State – Highway 33 and national highway 275 respectively. Mysore has implemented the smart transport system to manage the buses and ferrying (Gupta, 2017). Mysore has three railway line which connects the city with Mangalore, Bengaluru and Chamarajanagar. Mysore has domestic airport which is situated at 10 km in south of the city's center. Mysore known as **"cultural capital"** of state is drained by the two river Cauvery and Kabini (Bharath H. Aithal). Mysore covers the area of 286.05 sq.km and as per 2011 census of India total population of city is 9.21 lac.

Mysore also has the centuries-old Devaraja Market, filled with spices, silk and sandalwood. As per State government Mysore has been proven as the destination for the investment in Industrial, Education, Tourism sector and IT.

Figure 7: Source - Map of India website- Mysore district map

Mysore as per history is considered as home for the traditional industries like Weaving, Sandal wood carving, Oil crushing, Production of salt, Lime and Bronze work. By learning from these traditional industries Mysore has transformed itself as the center for the IT industries (Khan, 2007), Manufacturing, Service sector. Infosys Technologies, TVS Motor Company, Reid & Taylor, Raman Boards, Vikram Hospitals, N. Ranga Rao & Sons and Jubilant Organosys are some of them. Currently in and around the city there are 100 large – mid scale and 10000 small scale industries are under operation. These industries are producing products like automobile spares, pharmaceuticals, electrical goods, engineering and machine components, rubber, textiles, chemicals, processed foods, plastics, defence-related goods, Information Technology products and incense sticks. Mysore is also rich in educational institutions, right from kindergarten schools to professional colleges. From the resident point of view also Mysore has many advantages like quality life on lower cost, Salubrious climate and location of the city. The city is second best when it comes to emerging as the second largest software exporter in Karnataka. It contributed Rs. 1363 Cr. To Karnataka IT exports. City provides a very good climate for living conditions. City has good connectivity via rail and road with other cities and even expansion is under progress for road network. Mysore is one of the most prominent tourist destinations in Southern India. This has also helped it emerge as the startup hub. Sound infrastructure and lower **living** cost makes this city a great attraction for the people who are looking an alternate option of Bengaluru. Land price costs less than one-sixth of that in Bangalore. Mysore has been proved a good option to its origin city Bengaluru considering its cheaper land prize, IT industries and people are preferring the city.

4. Gwalior (Madhya Pradesh)

Gwalior district is situated in the Madhya Pradesh state. It is situated at a distance of 319 kms from the national capital Delhi. Gwalior has a very good connectivity with other nearby cities by roads, Rail and air. The city lies on Delhi –

Agra – Mumbai national highway NH-3. Gwalior is also connected via rail network with Delhi – Agra – Mumbai railway line. Nearby cities like Bhind and Shivpuri are connected via rail network. City is situated on North-South corridor and 50 km from East – West corridor. These two corridor creates so many business and trade opportunities for city. Strategically also city lies in the center portion of the state.

Figure 8: Source map of India website- Gwalior District map

Gwalior was identified as a counter magnet city for the NCR in 1985 as it clears all the parameters like distance, size, population density, work force ratio and status. Gwalior is one of the largest urban region in the state. Gwalior has its own history and urban fabric leading to recognition as a historical town. Total population of the Gwalior as per 2011 census is 10.69 lac approx. which was 8.26 lac in 2001 with a decadal growth of 29.53%. Total migration as as per (Migration table) 2001 from all over the India is 1s, 13,587 and total outmigration to the National Capital from Gwalior is 4,692.

Gwalior's major economy is generated by the services sector, Trade and commerce. City has various industries related to manufacturing of chemicals, Paints, Leather, ceramics, Textile, food processing and carpets. In education field also Gwalior has many colleges and institution which are working in the field of Management, Tourism, Technology, Science and agriculture. As per 2001 census work force participation in Gwalior city was 32.54% as compare to 26% in 1991. The district is spread in an area of 4565 sq.km. The district population in 2001 was 16.32 lac from 12.93 lac in 1991. As a counter magnet city NCRPB has funded the projects like 84 km total atrial and sub atrial road, 20 MLD capacity WTP, 33KVA and 11 KVA substation, 2 ohts, Land allocation for SEZ , Forest scheme with 60,000 trees plantation and 5000 residential plots and 1000 acre institutional land.

Overall in spite of so much potential Gwalior could not be developed as counter magnet city for the National Capital Delhi. Still it lacks at so many fronts to

be called a good example of counter magnet city. City could not grow as per the potential and expectation.

4.5 Milton Keynes (U.K.)

In 1965 UK government found that there is serous need of a counter magnet town in south east of England as London was getting more and more congested day by day. There was a huge housing demand in the London city and which was making city very congested. In 1960 Government has identified the north Buckinghamshire a potential site to develop a large town or a new town. The target population for which the city had to be planned was 2.50 lac. The total area for the new town or city was finalized 8855 hectare and the name was given as "**Milton Keynes**". The name was taken from one of the existing town of the site.

Milton Keynes is considered as one of the largest town of the Buckinghamshire, England. The city is situated in north - west of London at a distance of 50 miles. The nearby towns of the city are Northampton, Luton, Bedford and Aylesbury. The nearest major cities are Leicester, Coventry, Cambridge, London and Oxford. As per 2011 census total population of the city was almost 2.30 lac. After reviewing the existing town road situation the city has been planned with open grid pattern road and in each grid square amenities has been designed balanced for retail, Leisure and social. The city has total seven railway stations which serves the urban areas. Three railway station Wolverton, Milton Keynes central and Bletchley serves the local commuter on west coarse between London and Birmingham. Fenny Stratford, Bow Brickhill, Woburn Sands and Aspley Guise railway station are on the Marston Vale line to Bedford. The nearest airport is London Luton and easily approachable. Every year almost 31 million shoppers comes to use these facilities. Major population is young as more than 45% people are of the age of around 30. In 1997 given job opportunities by the city was 1.08 lac approx. which is estimated 1.30 lac in 2015. The unemployment rate of the city is very low as less than 2% (Nikki

Flanagan). It is a important location for the Business activities and almost 25 million people live at a distance of 2 hour drive and the city has a very good road network as well the railway connectivity. The city has more open and green spaces as compare to other nearby cities. It was considered as Future City as it is less congested and less populated while having the high class services at the same time.

Milton Keynes has been proven as one of the most successful economy of UK. It is center for various national and international companies. In the city 90% economy has been generated by the service sector and 9% by the Manufacturing units. 75% people are economically active and 8.3% population is self-employed. Major contribution in the business sector are from the scientist and Technical sector. City has the largest numbers of start-ups in Britain. The contribution in the employment from the public administration, health and education is largest but still comparatively very less to south east or England. The city is known for the wide range of industries and different style of housing. Community facilities like theatre, art galleries, football stadium (30,500 capacity), central church, Concert hall, Teaching hospital make the city a happening city. Milton Keynes has been proved a good example for the counter magnet city to the main city London in terms of all the magnet city parameters like attract the people, to provide employment, to grow equally and to release the stress of the main city. Milton Keynes provide the economical prize housing, business opportunities and employment.

5. Principles for an Ideal Magnet City

A city act like a magnet which either attracts something or repels. A city which has potential, pulls or attracts people as new residents, for business activities, for visiting purpose, for setting up industries for manufacturing, for tourism, for social network. Visitors come to the city which help the city to grow and to develop its infrastructure. By new business and investments jobs are created. Thus a city grows with its economy. Based on the assessment conducted in this research, principals for an ideal magnet city are as follows:

a. **Young Generation:** A magnet city always focus to attract young generation who can create wealth and by which job creation can take place in the city to boost the economy and people's attraction to migrate to the magnet city. If we take example of Mark Zuckerberg, Evan Williams, Sergey and Larry they are the people who did not establish their business in their born cities. They basically moved to other cities and started their startups and businesses which further created thousands of jobs and helped the second city to grow more. When Facebook shifted to Menlo Park in California it created 10,000 jobs and **(Robinson, August 2011)** there was a specific relationship of the city and these young people and that's why these people moved there. These cities provided the required facilities like infrastructure, Transportation, Housing, Social network, Hotels, Restaurants to these young people to start their business. Further a city can work up on its special feature which may be its historical part or present by which it can attract a specific kind of people to migrate to the city and start working there. In Changwon city when

industries and factory workers started to out migrate then city administration went back to the city's history and took reference from there (It was a birth place to the famous Korean artist and poets) and started to attract the people like painters, poets, sculptors. Today city is doing very well and a house for these type of profession's people.

b. **Physical Renewal:** Physical renewal like new buildings, innovative infrastructure keeps cities new and interesting. All the global cities follow this principle and that's why those are successful. Housing part of the city plays a very important role as some time people prefer to have it around the urban core with easy and quick transport and sometime people prefer it should be in mixed use which has bars, offices, restaurants, studios. Also in many cities so much energy has been put to redesign their downtown which gives new life to the city and it starts attracting people. Denver is now reinitiated is union street railway station which is situated in the middle of the city and now many restaurants, Housing apartments, bars are under development to make the center portion more happening which was nothing one time. In Malmo, on the western Harbour one old industrial docs was redesigned and highly sustainable houses has been built for approx. 5000 people **(E., 2013)**.

c. **Defined identity of City:** A magnet city should have its own clear identity like Global cities to draw more attention for investments, Businesses and residents. Global cities like New York, London and Hong Kong are known for their own identity. New York is city which never sleeps **(KPMG, 2014)**and Berlin is a city known for social experimentation and innovation. Similarly these magnet can have strong identities like sustainability, creativity, equality etc. When people of Oklahoma started out migrating from the city, Administration took a bold step by creating many sports facilities like Football stadium, River rafting, basketball team etc. as citizens were sports lover. As a result people started coming back to the city and now Oklahoma comes in US top 10 cities for living and business.

d. **Well connected with other urban regions:** A magnet city have very good connectivity with other nearby cities and other big cities for various reasons. A good connectivity not only make the transportation easy and cheaper but it saves lot of time, people come easily for meeting and other business activities which help to grow the business activities, Labour pooling is also easier, Import of row material and export of final product is easier and cheaper. It is important for a city to have the economical transport system which should be quick as well like high speed trains, metro trains, airports etc. but at the same time to attract the new generation to go out and in should also be easier and economical for a city to grow.

e. **Open to Innovative and New Ideas:** A magnet city which is targeting new generation and young professional people should always be open to new and innovative ideas. City's culture and its heritage, Type of residents, its creative sector like arts and music, Business community, its education system and physical cityscape all contribute in new and innovative ideas. For example cities like

Boston and San Francisco attracts top inventors, Investors and Researchers. Today both the city are in top 5 in entire world for Patent applications as per population ratio.

f. **City as Fund generator:** City's role is just not to distribute the funds but also it also has a significant financial role as well. City works to get the public and private investment. Sometime city puts it capital in risk to get more investment and funds. That's how magnet city reduce its dependency on the national scheme or state government for the funds. This principle of becoming self-dependent makes the city a magnet city. A city can generate the funds by selling its own land, commercial and residential buildings to invest in new infrastructure. For example Malmo city borrowed the money to install the highly sustainable infrastructure in its western Harbour brownfield land. The city first sold the land to developers to develop and later on city made the enough profit to cover up the capital cost and interest payment. As per other studies it's very clear that city cannot transform itself by using only its fund and they need to join with public and private funds as well. It is possible when city itself put its assets on stake and share the revenue. There are many example in various cities of this kind of model.

g. **Strong Leadership** – To make a magnet city a successful city it is very essential for the city to have the strong leadership. Some times while implementing some policies major businesses or central portion activities gets disturbed and starts out migrating but a strong leadership, city's mayor takes bold step and do the required reforms which give very good results later on. So strong leadership for these new cities is very essential.

6. Conclusion

Overall having a counter magnet city to manage the urban growth of any major city or region is a very good concept. But while implementing the concept right sprit is required.

While developing a second city in to a magnet city it is important to understand the city's identity and its inherent potential. A magnet city will not give good results if the transportation is not up to the mark and if the city's connection with other urban regions and major cities is not well defined. The major focus should be given on economic growth which will help to generate the job opportunities and business activities to attract the young generation for migration to the city.

It is imperative to understand a city's strengths like what kind of industries will work in that region. In spite of having so much potential all the Delhi NCR magnet cities are not doing up to the mark. For instance Patiala case, the city does not have a good transport system and even the city is not well connected with other major city or urban region and that's why is not fulfilling the expected result so far and does not attracts the people to migrate. If we take the example of Gwalior, it is connected with north-south, east-west corridor and big cities like Agra and Mumbai but still does not

provide that employment opportunities and get failed as a counter magnet city expectation.

At the other hand we look at the example like Mysore and Milton Keynes, both are doing well as a counter magnet city as both the city worked on the principles of the magnet city. Both the city have good connectivity with major city like Bengaluru and London. Even internal transport is also good. Both cities provides the enough opportunities for the employment and in job creation. In Milton Keynes case the unemployment rate is even less than 2%.

Natural factors play a significant role in city's development. In case of Gwalior city is covered with forest, hills and dam which affected the connectivity of the city with other regional areas. So these factors also play a significant roles and should be considered which planning. Proper budgeting and allocation of funds to complete any project with in the city is very essential. It has been noticed that many time projects do not get completed on time and loose its importance later on. To avoid such situation a city should be self-dependent to bear the cost in case of facing problem the get the funds from state or central government.

A lot of efforts need to be done to make this concept successful in India. Government should take the learnings from foreign magnet cities and implement in India to make the city a successful magnet city.

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Affordable housing for migrants

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ABSTRACT

In high growth economies continuous rural to urban migration has placed forth an oversized challenge for the housing planners in developing countries. India is witnessing a high rate of rural to urban migration. The term migrant worker typically refers to inter-state labor migrants who move to different areas away from their birth places with the aim of employment. These include a good variety of trained and unskilled staff along with the street vendors. Rural to urban migrants are at a disadvantage with relevant housing and access to basic services. In India, urban planning policies and master plans fail to mention the land reserve for migrant housing in cities. Due to this policy level gap, cities never accept the migrants as their permanent residents and the migrant population forever feels neglected in the development journey of cities. This often leads to the development of slums and squatters in the cities. The study through best practices tries to explore options for accommodating the migrants and refugees in urban areas by mainstreaming them through planning and development policies. Moreover, the study highlights the key role of cities and native administrations in housing provision.

Keywords: Urban migrants, Affordable Migrant Housing, Rental Housing for Migrants, Housing policies.

1. Introduction

The high rate of urbanization experienced by India brings immediately to the fore the issue of housing of the recent low-income migrants to the cities. A study lays out before us the whole gamut of the policies related to urbanization as well as on well-being of the most vulnerable population of the society. India the fastest growing economy, but also because, embarked on different policy regimes and development paths and increasing inequalities within the urban areas.

Further, cities are facing real estate boom and severe housing price increase leading to marginalization of a very large section of the urban poor and certainly the recent low-income migrants from the housing market, a realization that has dawned in the national policy making circles. This study presents a brief comparative perspective of this aspect of the urban social policy. Housing for rural migrants and the urban poor is a policy challenge for all governments in India. During the last half a century, various policies have been promoted and implemented by governments around the world. Housing for migrants and therefore the urban poor remains an unsolved problem. Large areas of slum settlements can be found around or within developed cities.

Low-income migrants tend to measure especially locations like urban villages, construction sites or industrial factory dormitories. Urban villages were originally rural settlements located in suburban areas. Because of urban expansion the agricultural land owned by these villages was gradually developed, and these traditional villages became incorporated into the built-up area. Due to their unique locations and the collective ownership of land (non-state ownership), cheaper private rental housing in those villages become the main source of accommodation for poor migrants. For an extended time, researchers and policy makers around the world are founding out answers to the unanswered questions of how the urban poor should be housed in developing countries.

The capacity of the state to provide low-cost housing in urban areas through housing project and self-build methods proved limited. They produced a minimal number of housing units in reference to rapidly growing need, and exacerbated the housing situation through the continued eradication of slums and squatter settlements. In addition, both forms of

housing were too expensive for the vast majority of the population, but in fact tended to benefit the growing number of middle classes (Jenkins et al., 2007).

2. Materials and Methodology

The Methodology adopted to write this research paper was collecting the secondary data available in form of literature, published articles and study of the existing policies on affordable housing for migrants. After collecting the secondary data, than analyze existing policy framework in context with existing problem, identify policy limitations and put the conclusion on the subject.

2.1. Secondary data & analysis

2.1.1. Literature review

Migrants and their Housing Options
In India, there are three sorts of rural-urban migrants: (i) long-term or permanent migrants with the intention of settling down in the urban areas, many getting into regular employment but keeping strong links with the native village/town.

(ii) Seasonal migrants, defined as those who stay in the urban areas for more than 60 days in a year but returning back for some period, mainly returning back during monsoon and going to cities to tide over lean agricultural seasons.

(iii) Migrants tied to the employers, who move from one place of employment to other, and about who no estimates are available. Almost all rural urban migrants in India would like to settle down in the cities if possible.

Three categories of migrants in urban India, discussed above, face different types of challenges. The permanent migrants, those who eventually settle down in the urban areas, enter the urban labor market at the lower end as temporary workers, eventually working their way up into the system through improving their employment situation and through that the housing. Many a permanent migrants come to the urban areas as single male migrants, at young age, and then call their families, once they are reasonably financially, socially and shelter-wise secure. This process is incremental, at the initiative of the migrants themselves in general. Migrants from some states, in particular from Uttar Pradesh and Bihar, do not settle down and would like to return back to their native villages and hence do not bring their spouse or family to the cities. The chances of most migrants returning back to their native villages is rare except under specific circumstances, such as urban violence emanating from communal polity and regional chauvinism and also slum demolition (Mahadevia & Narayanan, Shanghaing Mumbai - Politics, 2008).

The migrants when they first come to the city, squat on a public land or stay on rental basis in some existing settlement or stay with a friend/family member paying some rent to them. They move to then purchasing a plot of land in an informal settlement. There is no regular legal instrument of such purchase. They would erect a short lived roof over temporary walls. And then on, as and when the money is available, they would carry out incremental improvements: walls constructed of temporary materials are made permanent; temporary roofs are made permanent and so on. The process of integration in the urban economy and system is incremental and depends on the macro economic factors and public policy. If the policy supports their shelter security, their integration is faster through first increase in shelter security, improvement in living conditions, improvement in education and then improvement in employment and incomes, which then feeds back into shelter improvement (Mahadevia, 2012).

The shelter upgrading priorities in low income settlements are:-

1. Repairing a leaking roof.
2. Changing walls from mud wall to brick walls with cement mortar.
3. Making tiling floors.
4. Connecting to water supply.
5. Building individual toilets.
6. Connecting to electricity supply.
7. Extending the house.
8. Buying a new house or hut.

The benefits of each of these improvements are:-

1. A water connection saves time.
2. Roof repairing saves or protects the quality of goods, especially for home-based producers.
3. Electricity facilitates longer working hours, which in turn increases productivity and thus income.
4. Clean drinking water reduces illness and saves expense on healthcare and by that makes income available for other purposes such as education, income-generation, buying durable assets, etc.
5. Tiled floors also improve productivity for home-based workers.
6. Brick walls with cement mortar save recurring expenses of repairing walls after intense rains or flooding.
7. House extension is useful for expanding home-based production activities, renting out for earning additional income and keeping the extended family together.

There are no separate studies to document/analyze living conditions of the migrant workers in urban India. But, there are large numbers of them documenting life and living of slum dwellers. But, it might be worthwhile describing the conditions of living in slums from the national level survey of housing carried out in 2002. This National Sample Survey (NSS) gives the following description of living conditions in slums in India (national sample survey organization, 2004):-

A slum was a compact area with a collection of poorly built tenements, mostly of temporary nature, crowded together usually with inadequate sanitary and drinking water facilities in unhygienic conditions.

1. 67 per cent of the dwelling units were permanent in nature and the rest were semi-permanent or temporary structures.
2. Only 20 per cent of dwelling units during a slum had a plinth area of quite 50 Sqm.
3. Per capita floor area available within the slums was 4.6 Sqm.
4. 66 per cent of the slum dwellers built their own house and could be classified as illegal as far as the urban laws are concerned.
5. 15 per cent dwelling units in urban slums had all the three facilities, drinking water, electricity for lighting, and a toilet and 11 per cent had none of these facilities. For other types of dwelling units, these figures were 63 per cent (for all facilities) and 4 per cent (for no facilities).
6. Only 40 per cent of the slum households had water supply access within their house, when this figure for all other households was 74 per cent.
7. 32 per cent households in slums did not have access to any toilet facility, and this figure for all other households was 16 percent.

There are micro studies of living and dealing conditions of the recent or temporary migrants. A study of the migrants in the destination area indicates that the migrants work long hours and often live in accommodation provided by the employer. But, because of the same reason, it is difficult to contact the migrant workers in their destination area for organizing them for anything. In a sense, these workers are completely disenfranchised. Further, A DISHA (2002: 45) study also states the same: (MoHUPA Report, 2011) (Census, 2011)

In general, housing conditions of the migrants in India is closely related to the type of migrants these are. The long-term migrants like better to follow the trail of incremental housing, as described above. But, some of them employed in manufacturing may also get employee housing. Employee housing in the manufacturing depends on whether the industry is in the organized or unorganized sector. Organized sector manufacturing is generally large-scale manufacturing and employee housing here could vary between semi-permanent to permanent type with adequate basic facilities. But, employee housing in unorganized manufacturing sector is like a slum devoid of adequate basic facilities. The disadvantage of employee housing in the unorganized sector is that the workers may be under the control of the employers and they may lose bargaining power given that they have no choice but to live on the premises of the employers.

The latter type of employee housing also found in the construction sector. But, given the nature of construction sector, this is not permanent arrangement. There are also construction workers who are permanently living in the cities and they tend to live in incremental housing. In fact, the construction workers put in their sweat equity in their housing. Lastly, some regions of India send only male migrants to the cities to work and they tend to live in shared rental room for long years. They do not invest in housing in urban areas and all the savings are remitted back to the rural areas for consumption in rural areas as well improvement in housing conditions in the rural areas.

Defining Affordable Housing

Before framing a reasonable housing policy, it's vital to delineate the contours of this downside by process the term affordable housing. Process AH is additionally vital to create targeted policies geared toward creating funding a lot of accessible, providing rate subsidies, or favorable terms on par with infrastructure funding.

Internationally, housing affordability is outlined in multiple ways that. One among the foremost unremarkably accepted definitions of affordability refers to housing affordability that is taken as a live of expenditure on housing to financial gain of the unit. this is often conjointly accepted by the Indian Government, that states Affordable housing refers to any housing that meets some type of affordability criterion, which may be financial gain level of the family, size of the dwelling unit or affordability in terms of EMI size or magnitude relation of house worth to annual income. The Ministry of Housing and concrete poorness Alleviation (MoHUPA) in its 2011 report takes note of each financial gain and size criteria to outline the conception. Multiple studies within the Indian context have conjointly prompt different metrics of affordability.

Housing affordability may be a multi-faceted live, and while affordability is often outlined victimization the expenditure technique, there are alternative views to affordability moreover, as mentioned within the next sections.

Demand for Affordable Housing for migrants in India

The demand drivers for AH in India are many. 1st is that the progressive urbanization, going hand in hand with a growing urban population, that accrued from 109 million in 1971 to 377 million in 2011, and is projected to grow to 600 million by 2030. The consequence of the growing concentration of individuals in urban areas is felt in land and housing shortages and engorged transit, besides the strain on basic amenities like water, power, and respiratory organ area. The Ministry of Housing calculable a housing shortage of eighteen.78million homes throughout the twelfth arrange amount, with ninety nine percent in the economically weaker and lower financial gain teams.

Slums and informal tenements square measure calculable at sixty five million as per Census 2011. Second, aboard the expansion of the urban population, rising incomes have light-emitting diode to the growth of the center class. This has light-emitting diode to a spike in demand for housing that's affordable however includes basic amenities. (CREDAI, 2013) Housing is that the largest element of the financial likewise because the construction sector (High Level Task Force on reasonable Housing for All). A thrust on AH won't solely result in higher quality of life, but conjointly considerably give a lift to the economy of the country.

2.1.2. Existing norms and policy framework

Housing Policies and Institutional Setting

India does not have a formal policies for controlling migration to cities as any Indian citizen, whether a rural or an urban resident is free to migrate to any part of the country as many times as s/he wants to and access subsidized urban services. But, in reality, access to subsidized urban services is institutionalized and controlled through a set of identity documents namely:-

1. A ration card-a Below Poverty Line (BPL) card or an Above Poverty Line (APL) card, which has the permanent address of the person/household.
2. An election card also called a Voter's Identity (ID) Card issued to all those above age of 18 for the purpose of voting in elections held for the three tiers of government.
3. An electric connection and an electric bill.
4. In urban areas, an ID card issued by the urban local government for those living in slums, based on a specific cut-off date.
5. In urban area a property tax payment receipts.
6. A letter of identity issued by the local elected representative. In other words, urban citizenship definition is fluid and negotiable, through electoral clientelism, organizing, and contestations. On having negotiated the first foothold in the urban settings, with the lowest entitlements of urban citizenship, the household climbs up the ladder of urban hierarchy.

In shelter context it means incremental housing in India. It begins with gaining access to rental housing in an established low income settlement or squatting on a piece of land, mainly public land, then negotiate collectively to get name registered in the urban voting list through getting an urban patron, and then on a gradual and patient march up the ladder to gain full citizenship through possessing a few of the above mentioned documents.

In India, there has not been much of policy discussion on the shelter security of the low-income migrants but this issue is subsumed under the discussion on shelter security for the urban poor. Many draft national housing policies have been framed in the past in India but the most recent one, the National Urban Housing and Habitat Policy (NUHHP, 2007) has been accepted by the national government and the state governments have been asked to make their own policies. The NUHHP, 2007, has nothing specific for the migrant workers, except that there is discussion on increasing supply of rental housing for them. There is mention of temporary rest accommodation with appropriate toilet facilities on the construction sites, to be provided by the construction companies and the public authorities. There is also mention of need for employer housing. For each of these suggestions some actionable agenda has been suggested. In general, housing for the low income recent migrants has been left open. (JNNURM, 2005) The NUHHP, 2007 itself is a market driven policy and there are questions as to whether it is going to serve the purpose of shelter security of the urban poor in general and specific segment such as the recent migrants among them.

Two large national housing programs, Basic Services for the Urban Poor (BSUP) under the largest national level urban development program called Jawaharlal Nehru National Urban Renewal Mission (JNNURM) launched in 2005 December and Rajiv Awas Yojana (RAY), a slum redevelopment program and affordable housing program, launched in 2009, are expected to increase housing supply for low-income households through private sector participation. There is no mention of the special provisions for the low-income recent migrants and no schemes to fund their housing.

Instead of targeting the recent low-income migrants, the housing program, which are generally subsidized program, for the urban poor or the slum dwellers are for eligible beneficiaries, who are identified based on the above mentioned documents. In India,

the poor migrants and not the wealthier migrants, face discrimination on the grounds of regional and language identity; the developed states discriminating against the migrants from the poorer states. A regional chauvinism wave and ensuing violence then hits out at the low-income population from other states. The contemporary political history of India is full of these instances, and the divides flare up just before the local elections. Thus, all the states, in particular the migrant receiving states, which are also economically advanced states, have anti-migrant bias in their slum policies. The institutional and policy environment in India bias against the low-income migrants in their cities. Migrants are left at the mercy of the market.

3. Results

Employer housing in case of construction workers and factory workers had a significant impact on the migrants in India, lowering their expenditures on housing and transport. This ensured that the workers saved and repatriated the savings back home for the use of family left behind. Thus, employer provided housing has great benefits for the low income migrants in spite of its drawback of taking away the migrant workers freedom and choices with regards to family life, employment and housing. On the other hand, the self-help housing option possible for the migrants is a good intermediate solution that gives the migrants freedom to an extent as well as choice with regards to family life, employment and housing.

Migrants in Indian cities have strong intention of staying back, except migrants from some states of origin, in India, employer housing is negligible and large proportion of migrants prefer ownership housing, albeit in the informal sector. Probably, rapid economic growth might bring employer housing in India also. But, that would be only if the industrialization would be labor intensive, and generate demand for labor. Local governments do not consider housing as their main function and hence leave the task to state level agencies to deal with housing.

The housing policies in India have schemes related to slum development and hence there is an acknowledgement of existence of slums in Indian cities. India doesn't have any strong policy for facilitating or ensuring decent housing conditions for the migrant workers in a way that the migrants can enjoy choices in life. Availability of affordable housing and employment determines the fate of migrants in India's urban areas. Housing for the migrants has been tagged on to the overall urban housing policy and there is no specific policy for the migrants. If migrants can afford to buy, they can procure a house from the private housing market.

Policy makers should have more focused with regards to employer housing for certain segments of urban labor force. India have to go a long way with regards to ensuring a decent housing to the low-income migrant population in their cities, given that India would continue to urbanize rapidly in the coming decades.

Atmanirbhar Bharat - Rental Housing for Migrants

Recognizing the predicament and mass departure of incalculable specialists from urban communities during the COVID-19-injected lockdown, the FM divulged a swap conspire for the metropolitan poor under the PMAY - Affordable Rental Housing Complexes (ARHC). Due to abundant business openings in significant urban communities lion's share labor force moved to the urban communities in the pre-Covid-19 time. In any case, the shortfall of moderate rental lodging here prompted mass departure of those transients who had zero pay during the lockdown. Consequently, the govt. needed to change gear of their Housing for All activity and incorporate moderate rental lodging as a neighborhood of it.

Under the plan, the public authority subsidized lodging in metropolitan urban communities are being changed over into ARHC through the public-private organization (PPP) model and government lodging buildings lying empty will be changed over and leased twisted travelers at concessional rates. At the beginning, the Govt. plans to utilize approx. one lakh unused lodging units worked under the JNNURM and subsequently the Rajiv Awas Yojana (RAY) past government's metropolitan overhaul and lodging programs - to give rental lodging. The month to month rentals for homes under ARHCs are probably going to be fixed between INR 1,000 to INR 3,000.

Other than tending to the hardships of metropolitan travelers - a private or gathering of individuals/ groups of EWS/LIG classes it'll additionally help in satisfying the public authority's goal-oriented activity of Housing for All by 2022. ARHC will be executed through two models:

1. By using existing Government supported empty houses by changing over them into ARHCs under Public Private Partnership.
2. Development, Operation and Maintenance of ARHCs by Private/ Public Entities on their own empty land.

Individual or gatherings may book their necessity through government site (for example www.arhc.mohua.gov.in). Concessionaire or an element can likewise gridlock with different substances or associations and furthermore get transient

works or metropolitan poor through aggregators. The plan is consequently a work to connect the deficiency of staying units the nation over. Additionally, it'll add another resource class to be considered by developer. (Anuj Puri, 2020).

4. Discussion

Critical Issues in the Affordable Migrant Housing Sector:-

Scarcity of Land

The more population density, rapid urbanization, and not properly conceived regulations have resulted shortage in land parcels capable of development. This is exacerbated by excessive controls over central districts of cities and difficulties in land recycling, which results in a push toward the periphery. Land acquisition has been a thorny issue, giving rise to land mafias and illegal encroachments, and reducing availability of land at a reasonable price.

Scarcity of Marketable Land Parcels

Large tracts of centrally located urban land are owned by public entities like the railways, ports, and defense authorities. These square measure non-marketable pockets, and lend themselves to the proliferation of slums and squatter settlements because the authorities square measure usually unable to observe their holdings. Further, scattered and poorly planned settlements build it troublesome to supply land for mass housing. Property consumers take several factors aside from project quality and price into thought, like basic utilities, connectivity, infrastructure and then on. Thus, AH demands adequate supply of well-serviced land and this successively influences prices and willingness.

Titling issues

As of now, India lacks a strong system to guard land rights. There are two aspects to land title: first, a formal recognition of property rights by the state through a system of titles; and second, facilitation by the state, of efficient trade in rights, through a process of registration. Both of these elements exist in India, but in incomplete form. First, not all land transactions require registration, for instance land acquisition, court decrees, mortgages, agreements then on. Second, while Indian law requires compulsory registration of land sale, the registration authority isn't mandated to verify history or ownership; thus it's the transaction and not the title that is registered.

Rising Costs

Both land and construction prices have inflated, combined by value appreciation of construction materials and labor. Finance AH is affected as a result of different construction indices and incomes across the country. From the customer□s angle, getting finance is difficult notwithstanding the purchasers have regular incomes once they are used within the unorganized sector or lack financial gain proof as needed within the loan method.

Regulatory Constraints

Project sanctions will take many years, and wish to be cleared by as several as forty departments across the national and sub-national levels, together with the surroundings, fire, revenue and water departments, the traffic police and so on. The resultant time and dealings prices deter many entrepreneurs. Further, lack of clear and clear regulation aggravates things. As an example, building bye laws, rules for floor house index, and division and development plans of urban native bodies usually lack clarity and there are overlapping pointers.

5. Conclusion

In comparison to official urban residents, housing and living conditions of migrants are relatively poor. Better off migrants can only afford to rent a very small flat, whilst others have to share rooms. Urban villages provide low paid migrant workers with the first step toward affordable housing in large cities. For example city like Gurgaon growing at extraordinary pace, migrant housing conditions are no worse than those found in other fast growing cities. In general, urban villages in cities provide good locations for migrant workers. Because the city developed from a small border town, many villages occupy central areas inside the new city. This locational advantage enables migrants to live close to work and cuts down travel time and costs. Due to the shared cultural and professional background of rural migrants and the local village residents, the rental tenure is relatively safe and secure. Amenities in urban villages may not be as extensive as those in properly built new housing estates, but they are affordable.

Local rural residents provided affordable housing here to the large number of low-income migrants in □urban villages□ as rental accommodation with some basic, but modern, amenities. This approach has avoided the problems of slums in other developing countries. It differs from the public housing, aided self-build, self-helping, site and services/upgrading

and the UN/World Bank enabling and support policies reviewed in the second section. The approach resembles some of the ideas promoted by Turner (1976), e.g. with no government support, flexible in meeting the diverse needs of migrants, balanced by the demand and supply through the market, less emphasis on the design standard and being affordable to those with low incomes. (Wang, 2007)

However, this urban village approach is a different type of self-help with a unique partnership between local rural residents and migrants. Large-scale village rental housing development is a type of self-help initiated by local villagers (the landlords) in response to the loss of agricultural land and production resources. Migrants (the users) are their customers and tenants. The rent levels are determined by the demand from the market. This market approach is in line with the recent World Bank prescriptions. However, this housing provision itself is outside the formal urban housing market promoted and supported by the municipal government. Land access rights, property ownership, housing credits and finance systems, emphasized by international organizations, are irrelevant to most migrants living in urban villages. Urban planning is exercised on the public owned land in cities, while village land use is subject to a different type of control. This provides the villagers with some advantage in building their houses on their family plots. Indeed, city municipal corporations tried several times, unsuccessfully, to control the housing expansion in urban villages. The demand from the market was just too strong.

The positive contributions of urban villages during the particular stage of fast industrialization started to fade when the cities began restructuring and pursuing high-tech and finance-oriented development. The once dynamic informal housing market has gradually become a problem for urban planners and officials. Some refer to the urban villages as cancers of modern cities, with poor living environment and high crime rates. There is a tendency for large-scale urban village redevelopment in order to improve the modern image of the city. Redevelopment plans are often drawn up without consulting the migrants living in these villages. Such action should be taken very carefully to avoid the mistakes other developing countries have made and that Turner (Turner, 1976,1988) has criticized. On the surface the dramatic redevelopment aims to improve migrant living areas; in reality it results in the destruction of affordable housing in good locations. Poor migrants will be pushed further away into marginal locations, and large-scale urban village redevelopment will lead to more serious social and spatial division. Gradual improvements, upgrading, rent regulation and other softer policies may be more beneficial and sustainable.

Report on Rental Housing, which stated that ... politicians should change their attitudes regarding current housing policies, and should try to do something practical to help those members of their society who lives in a rental housing, as well as the ones who can provide those dwellings (The Challenge of Slums: Global Report on Human Settlements 2003, 2004).

6. References:-

(Jenkins, 2007) (Jenkins et al, 2007) (Mahadevia & Narayanan, Shanghaing Mumbai-Politics,2008) (Mahadevia Report, 2012) (A DISHA, 2002: 45) (national sample survey organisation , 2004) (Census, 2011) (JNNURM, 2005) (CREDAI, 2013) (MoHUPA Report, 2011) (NUHHP, 2007) (Wang, 2007) (The Challenge of Slums: (Mahadevia, Environment and Urbanization ASIA, 2012) (puri a. , 2020) (Turner, 1976,1988) (The Challenge of Slums: Global Report on Human Settlements 2003, 2004)

An experimental data analysis of close loop pulsating heat pipe

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Abstract

Due to effective heat transfer capabilities and operational characteristics, Closed Loop Pulsating Heat Pipe (CLPHP) has been used in many fields like solar water heater, electronic cooling, heat recovery system, space technology and other different areas for thermal management. CLPHP is a two-phase passive heat transfer device. It involves phase-change phenomena and oscillations generated due to the pressure difference between evaporator and condenser. The present research paper presents the experimental investigations on CLPHP having the appropriate required dimensions of capillary tube, evaporator section, adiabatic section and condenser section. The effect of filling ratio (25%, 35%, 50%, 65% and 75%) and orientations (0° -vertical Position, 45° -Inclined Position and 90° -Horizontal Position) on the thermal performance of 6-Turn CLPHP has been investigated with water as working fluid. No pulsation, pulsations and dry out phenomena are also observed during experimental investigations.

Key words: Closed loop pulsating heat pipe, Start-up mechanism, Thermal performance, vapour plug and liquid slug, Gravitational effect on CLPHP, Filling ratio effect on CLPHP

1. Introduction

Thermal management of electronic and mechanical devices is very necessary for their efficient and up-to date operation. There is tendency of decreasing the size of these components day by day in order to get compact size. Decrease in size and increase in heat input, thermal management is prominent operation to be performed. Since most of equipment rejects heat while they are in operation, they are needed to be cooled for efficient operation and also to increase their life span.

Thermal management can be done by 1. Natural Convection 2. Forced Convection 3. Pool Boiling 4. Falling Film 5. Liquid jet impingement 6. Flow Boiling 7. Thermo-electric devices 8. Conventional Heat Pipe 9. Pulsating Heat Pipe. [3]

Conventional Heat Pipe: Heat pipe has higher thermal conductivity than that of any known material. It is a passive two-phase heat transfer device which is capable of high heat transfer with minimum temperature drop. It employs a capillary wick structure for pumping the liquid against the gravity. It consists of three sections: (1) Evaporator section, (2) Condensation section, (3) Adiabatic section. There exists pressure difference between evaporator and condenser section which causes pulsation. After condensation, liquid returns to the evaporator section due to capillary forces. [11]

Pulsating Heat Pipe (PHP) is a new type of heat exchanger and it has gained much importance in the field of electronic components cooling. It is first introduced by Akachi in 1990. PHP is a two-phase passive heat transfer device. Its working depends on the phase-change phenomena and oscillations created inside PHP due to difference in vapour pressures on evaporator and condenser side. [2]

1. It does not require material of highest thermal conductivity. It is generally made of normal conducting materials like copper, aluminium, glass etc.
2. It does not have wick structure for whole of its dimension but wick construction is limited to only evaporator section and this condition is also not compulsory. [12]
3. It has capillary tube bend in number of turns which dimensions ranges vary in centimetre in length and in mm for diameter similar to conventional heat pipe. [11]

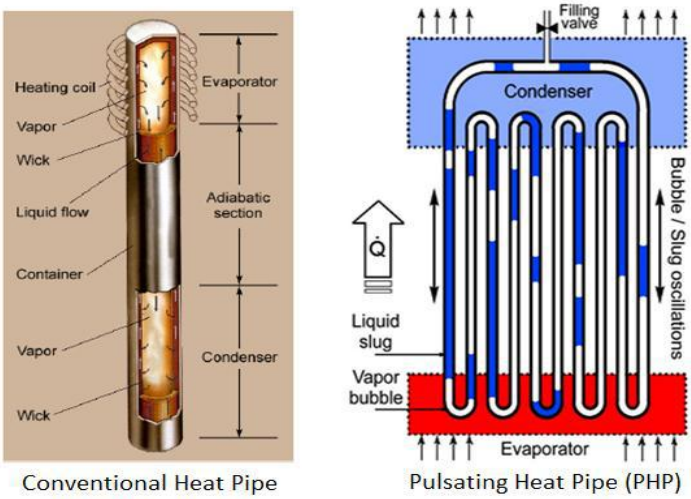

Fig. 1. Schematic diagram of conventional heat pipe and pulsating heat pipe (PHP) [3]

1.1 Type of PHP

There are three type of PHPs: (1) Closed Loop Pulsating Heat Pipe (CLPHP) (2) Closed Loop Pulsating Heat Pipe with check valves (3) Open Loop Pulsating Heat Pipe (OLPHP). [10]

The reliability, leakage and inability for producing desired results (particularly for low diameter) arises the need for development of closed loop pulsating heat pipe without check valves. In both type of CLPHP, one end of PHP is joined with the other end of PHP and there is proper arrangement of circulation of flow of working fluid inside the pipe which enhances the heat transfer capability of CLPHP from evaporator section to condenser section. CLPHP is more likely suited to microelectronic cooling and it consists of a plane capillary tube bend in U-Turn in many number of turns.

Unlike the CLPHP, the two ends are sealed in the OLPHP. The performance and efficiency of CLPHP is better than that of the OLPHP but there is one more advantage of OLPHP over CLPHP i.e. OLPHPH is cheaper and simpler structure than CLPHP. [11]

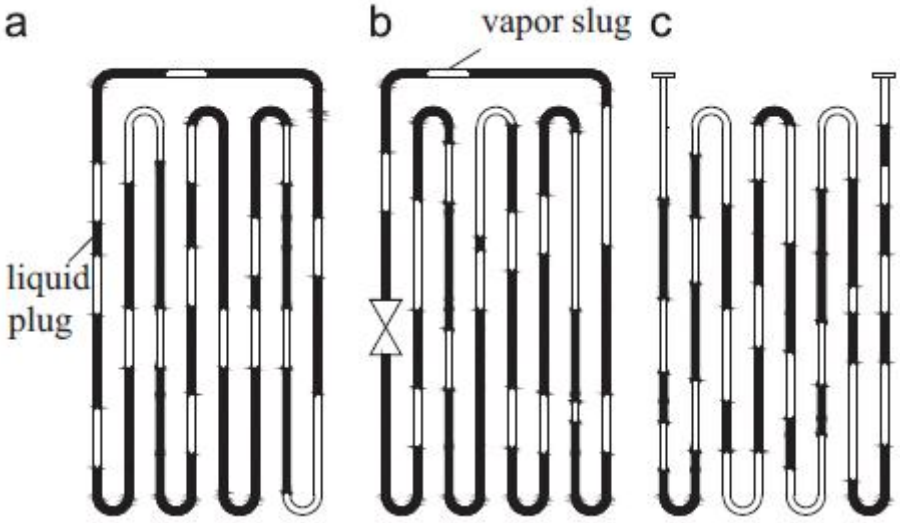

Fig. 2. Schematic diagram of closed loop PHP, closed loop PHP with check valve and open loop PHP. [2]

1.2 Principle of operation of PHP:

The given heat input to PHP is the driving force. It increases the vapour pressure on evaporator side and decreases the vapour pressure of vapour plug on the condenser side because it is subjected to atmosphere. Due this pressure difference, vapour plug and liquid slug inside PHP start oscillating. Therefore, heat is transferred from evaporator to condenser by axial movement of liquid slug (sensible heat) and also by the phase-change phenomena. There is no external force required for its operation. [10]

Due to continuous heating, vapour bubbles are formed by nucleate boiling and due to this there is no equilibrium or steady state of vapour pressure when PHP is in operation. So, PHP is essentially a non-equilibrium heat transfer device.

2. Construction Detail:

The experimental setup consists of a test section, control panel, temperature scanner, USB isolated converter, working fluid filling arrangement, vacuum pump and computer for data storage. The test section consists of an evaporator section, a condenser section and an adiabatic section. The test section is a 2 mm inner diameter, six turn or nine turn copper capillary. Lengths of two end pipes are kept longer than others. These pipes are interconnected to form a closed loop. Two valves are brazed to the outer copper tube.

Table 1: PHP dimensions

S.R No	Parameter Name	Dimension
1	No of Turns	6 or 9
2	Internal Diameter	2 mm
3	External Diameter	4 mm
4	Evaporator Length	40 mm
5	Adiabatic Length	100 mm
6	Condenser Length	50 mm
7	Pith Length	20 mm

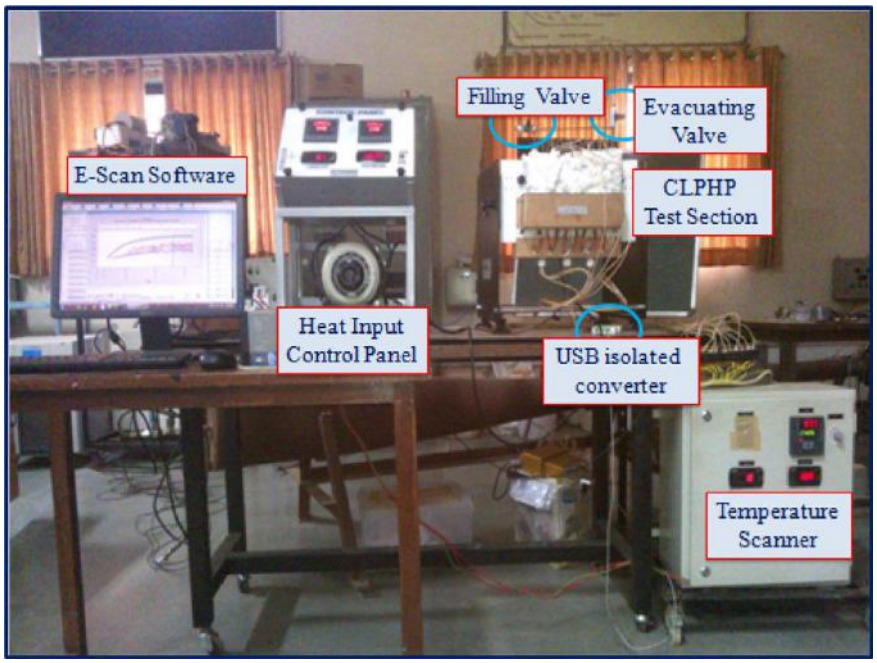

Fig. 3. Experimental set up for a CLPHP. [1]

Evaporator section is prepared from aluminium block due to its high thermal conductivity and good machinability through CNC machining operations to provide uniform heating to the copper tubes firmly fitted in it. The block dimension is $260 \times 25 \times 50$ mm. The circular cartridge heaters ($10.0\ \emptyset \times 40$ mm, 100 W each) are used to provide uniform heating. The alternate slots and holes are machined to house the copper capillaries of 40 mm length and cartridge heaters respectively as shown in Fig. 4.

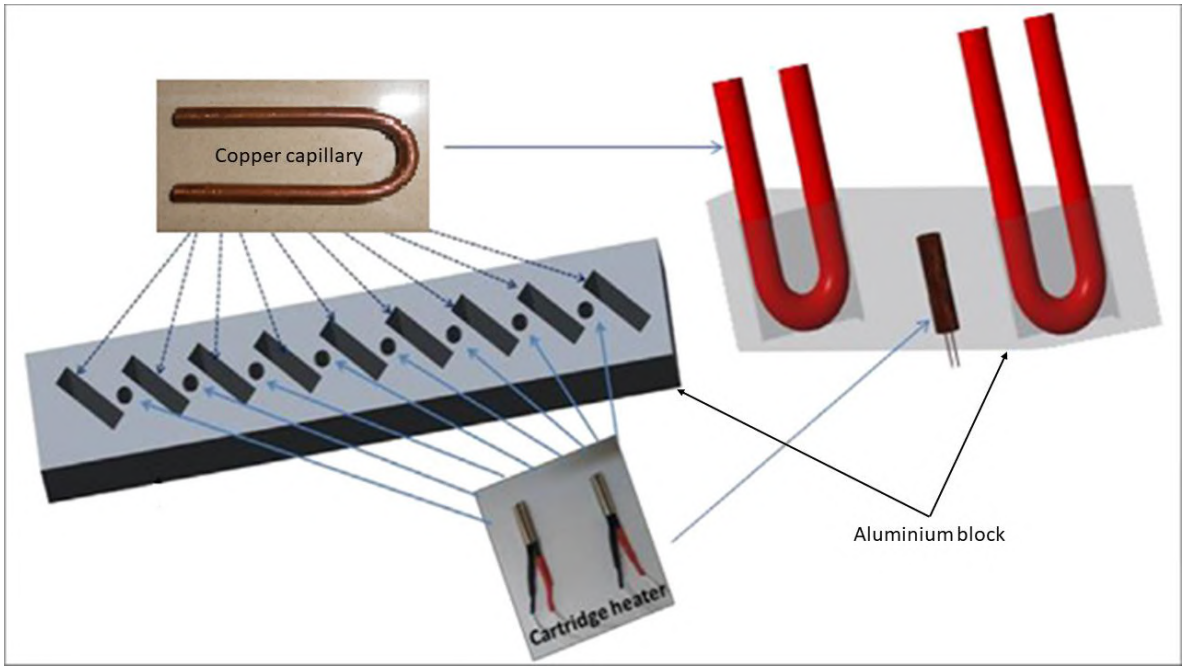

Fig. 4. Aluminium block, capillary U-bend, cartridge heaters.

The adiabatic section is 100 mm long straight copper capillary between evaporator and condenser section. Condenser is section where heat is dumped to sink by natural convective heat transfer. The high temperature two-phase mixture travels from evaporator to condenser in U-bend copper capillary which is exposed to open atmosphere. Temperatures are measured at every U section of copper tube in evaporator and condenser section, adiabatic section and ambient condition with K type thermocouples of ±0.5 ℃ accuracy. To avoid heat loss to the atmosphere a thick layer insulating material, glass wool is wrapped around aluminium block covering from all the sides and adiabatic section.

3. Experimental procedure and data processing

First of all, the copper capillary is evacuated up to desired vacuum pressure using vacuum pump and the pressure is measured using pirani gauge. The working fluid (water) is then injected into the capillary using syringe through charging valve. The control panel is turned on to ensure that heating system is turned off. Then a data logger is turned on to scan data of temperature of different sections with the help of K-type thermocouples under adiabatic condition. The heating system is turned on after ensuring the constant temperature of all the sections. The desire heat input is fixed through dimmer stat, digital voltmeter and ammeter and is kept on until steady state is reached. All the temperatures were measured when the steady state was obtained. It took about 90 minute in attaining the steady state for lower heat fluxes and it took only 45 minute to 50 minute in attaining the steady state for higher heat fluxes. This procedure is repeated many times for other range of parameters.

The heat transfer performance of PHP can be evaluated by the thermal resistance. To evaluate the thermal resistant, the temperature difference between evaporation section and condenser section is evaluated.
As we know, the definition of thermal resistance is:

Thermal Resistance, $R = \frac{T_e - T_c}{Q - Q_{loss}}$ [1] ..... (1)

Where T_e, T_c are the average temperature of the evaporation section and the condensation section respectively and Q is the heat input given by the control panel. Due to the good insulation, the maximum heat losses were about 0.8 W so Q_{loss} can be neglected compared with the high heat flux input. So the amount of heat transferred by PHP was estimated by the heating power of the evaporator section.

Total heat supply; Q= V * I Watt [1] ..... (2)

Where V = Supply Voltage
I = Supply Current

On basis of thermal resistance calculation, it can be predicted that which filling ratio and which orientation would be the optimized parameters for enhanced performance of closed loop pulsating heat pipe.

Table 2: Properties of Working fluid (Water) at 25 °C and 1 atm.

S.R. No	Property	DI water
1	Boiling point (°C)	100
2	Liquid density (kg/m^3)	997.1
3	Liquid specific heat (kJ/kg °C)	4.183
4	Latent heat (kJ/kg)	2257
5	dP/dT (Pa/°C) @ 80 °C	1946
6	Dynamic viscosity (Pa s) x 10^{-3}	0.8905
7	Surface tension (N/m)x 10^{-3}	71.97

4.1 Thermal performance of CLPHP:

4.1.1 Effect of filling ratio

❖ 0^0 Orientation and all filling ratio

Figure shows the graph between thermal resistance of CLPHP and Heat input to the evaporator section for different filling ratios of 25%, 35%, 50%, 65% and 75%.

From the graph it is found that for heat input from 10 Watt to 29 Watt, thermal resistance is very high for each filling ratio because in between these heat input heat transfer is only due to conduction and conduction resistance is high and also there is no pulsation.

Table 3: 0 Degree Orientation and all filling Ratio

0 Degree Orientation and all filling Ratio					
Heat Input (W)	**25%**	**35%**	**50%**	**65%**	**75%**
10.65	2.009	2.084	2.093	2.18	2.155
20.496	1.98	1.911	2.061	2.12	2.0543
29.35	1.831	1.78	1.3684	1.622	1.5977
40.71	1.33	1.15	1.032	0.9935	1.236
49.4	1.763	1.763	1.718	1.7	1.86
63.64	1.86	1.81	1.9445	1.92	1.91

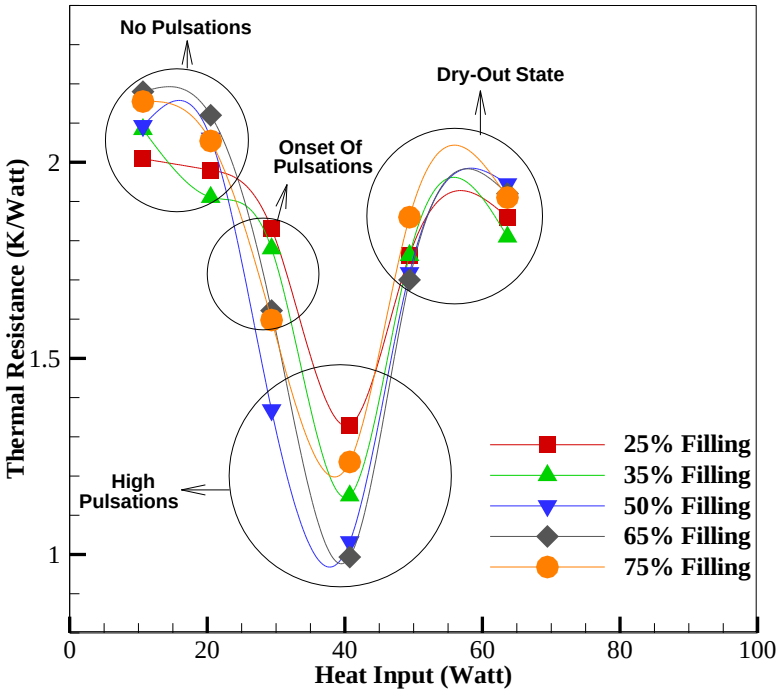

Fig 5. Thermal Resistance vs. Heat Input at 0 orientations and all filling ratio

For heat input from 29 Watt to 41 Watt, thermal resistance of CLPHP drops very rapidly for each and every filling ratio because in between these heat input, heat transfer takes place through conduction and convection mode both and pulsation is also observed and overall thermal resistance is decreased.

For heat input from 41 Watt to 64 Watt, thermal resistance increases rapidly because in between these heat input, dry-out condition is achieved and due this pulsation is also disappeared and heat transfer only takes place through conduction mode and again thermal resistance of PHP is increased.

Observing the graph from filling ratio point of view, it is concluded that CLPHP with filling ratio of 35% shows good thermal performance, CLPHP with filling ratios of 50% and 65% shows the best thermal performance.

CLPHP with filling ratios of 25% and 75% shows the worst thermal performance in terms of thermal resistance because in case of 25% filling ratio, the amount of working fluid inside CLPHP is very less and due this there is very less pulsation and dry-out condition achieved very early where as in case of 75% filling ratio, the amount of working fluid inside CLPHP is more and due to this very less space for pulsation is available and it also takes more time during phase change of working fluid so thermal performance of CLPHP is decreased.

❖ Comparison of 50% and 65% F.R. at 0^0 orientations

From closely observing the thermal performance of CLPHP with filling ratios of 50% and 65%, it is found that for these filling ratios; CLPHP shows the best thermal performance.

Table 4: 50% and 65% Comparison

50% and 65% Comparison		
Heat Input (W)	**50%**	**65%**
10.65	2.093	2.18
20.496	2.061	2.12
29.35	1.3684	1.622
40.71	1.032	0.9935
49.4	1.718	1.7
63.64	1.9445	1.92

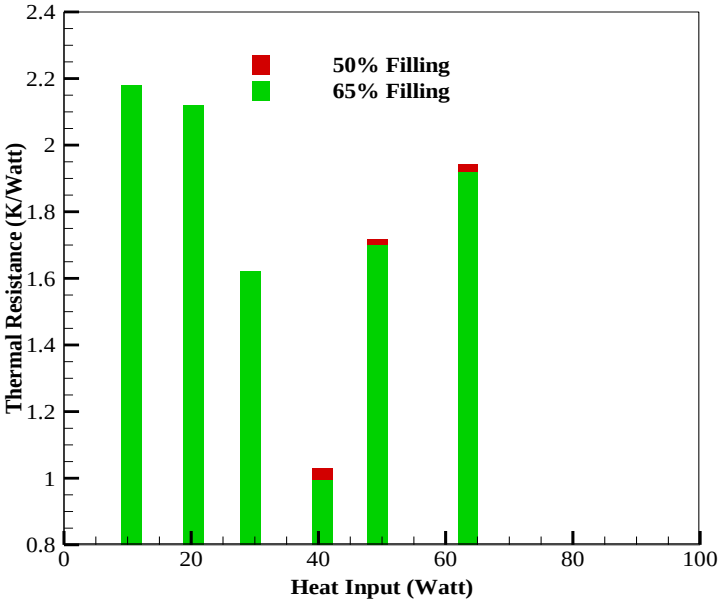

Fig. 6. Comparison between 50% and 65% F.R. at 0 Orientations

CLPHP with filling ratio of 50% shows better result for lower heat flux varying from 10 Watt to 38 Watt because CLPHP with lower filling ratio will take less time in stating pulsation for lower heat fluxes and produces sufficient amount of pulsation which enhances the heat transfer capability of CLPHP for lower heat fluxes and CLPHP with filling ratio of 65% shows better result for higher heat flux input varying from 38 Watt to 64 Watt because at higher heat flux CLPHP with higher filling ratio will give some more pulsation which enhances heat transfer capabilities and it is also resistant to early dry-out condition. So, if CLPHP is required in such heat input condition varying from lower heat flux to higher heat flux, best operational range of filling ratio of 6-Turn CLPHP would be in between 50% and 65%.

4.1.2 Effect of orientation

❖ 50% filling and all orientations

Table 5: 50% Filling and All Orientation

50% Filling and All Orientation			
Heat Input (W)	**0 Degree**	**45 Degree**	**90 Degree**
10.65	2.093	1.899	1.998
20.496	2.061	2.16	2.03
29.35	1.3684	2.036	1.9972
40.71	1.032	2	2.016
49.4	1.718	1.97	1.979
63.64	1.9445	1.92	1.969

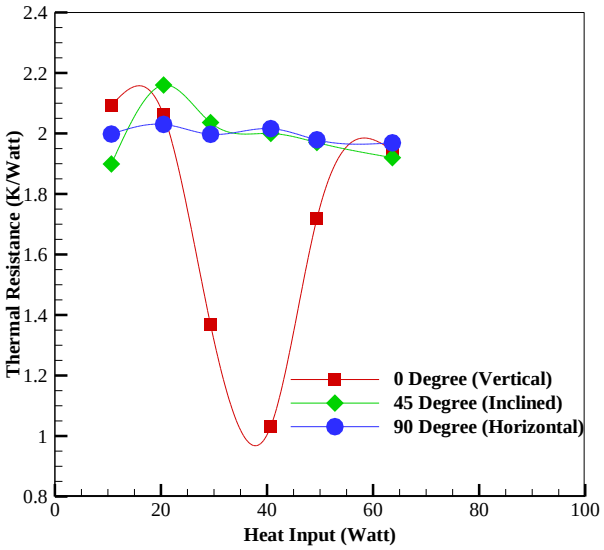

Fig. 7. Thermal Resistance vs. Heat Input at 50% filling and all orientations

❖ 65% filling and all orientations

Table 6: 65% Filling and All Orientation

65% Filling and All Orientation			
Heat Input (W)	**0 Degree**	**45 Degree**	**90 Degree**
10.65	2.18	2.098	1.995
20.496	2.12	2.1	1.969
29.35	1.622	2.013	1.896
40.71	0.9935	1.45	1.954
49.4	1.7	1.922	1.95
63.64	1.92	1.82	1.9

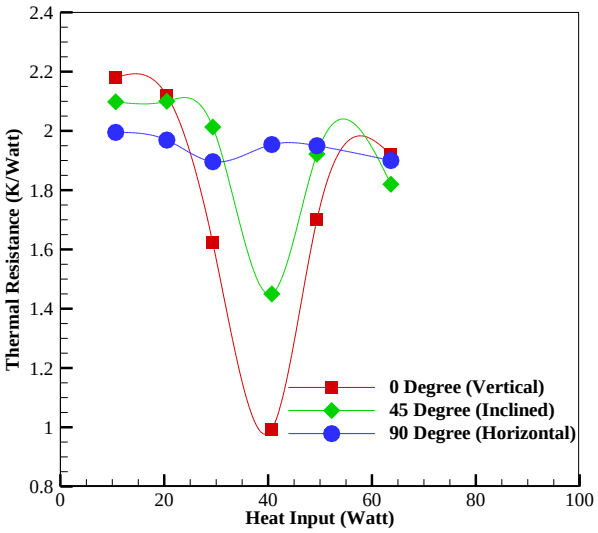

Fig. 8. Thermal Resistance vs. Heat Input at 65% filling and all orientations

Experimental results have been also produced at different orientation for filling ratio of 50% and 65% in order to check the orientation effect on CLPHP. It is concluded that CLPHP is best operated in 0^0 orientation means in vertical position with bottom heating mode for both of the filling ratio. It is not operated in horizontal position (90^0 orientations), however if the number of turns increased and the inner diameter of CLPHP capillary pipe is decreased, it can also be operated in horizontal position. There is slightly good performance in 45^0 orientation for filling ratio of 65% compare to CLPHP with filling ratio of 50% but it is not up to mark so it is better to operate the PHP in vertical position with bottom heating mode in order to get enhanced heat transfer performance of CLPHP.

4.2 Pulsation and dry-out detail: (Start-up mechanism)

Figure shows the graph between temperature and time. The filling ratio for the experiment is kept as 50%. The temperature graph is consisting of evaporator temperature, condenser temperature, adiabatic section temperature and atmospheric temperature with respect to time regarding the application of heat input flux.

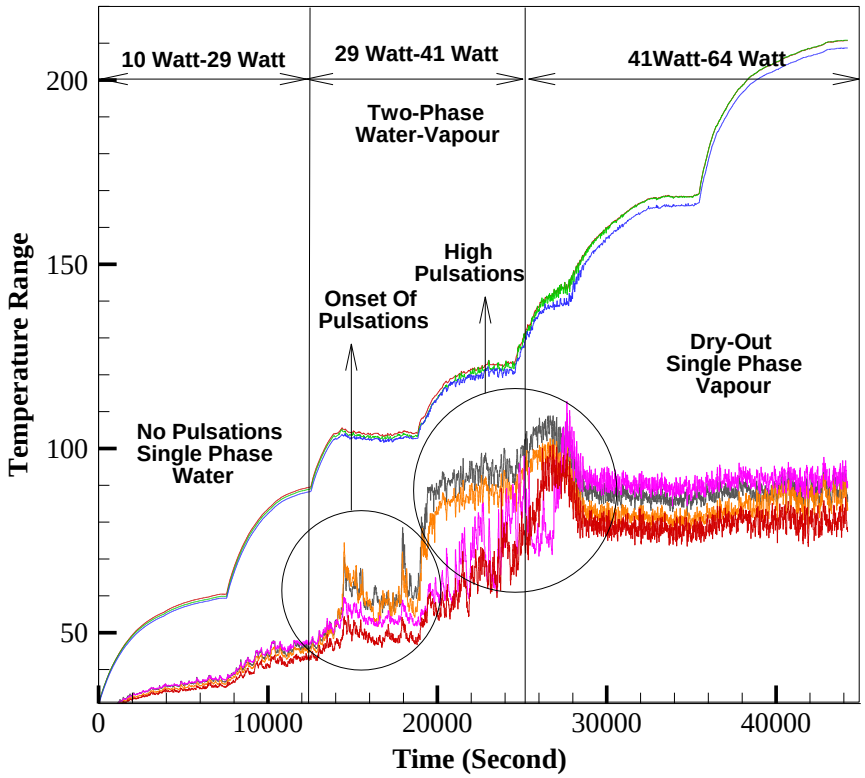

Fig. 9. Temperature vs. Time graph showing pulsation and dry-out phenomena at 50% Filling ratio.

In the graph, it is clearly observed that for heat input from 10 Watt to 29 Watt, there is no pulsation in the condenser temperature line and it continuously increases smoothly as the temperature of condenser section increases and there is only one phase of working fluid inside CLPHP and that is liquid phase. It means that all the heat input given to the evaporator section is transferred to the working fluid through conduction and it only increases the temp of fluid and there is no phase change inside PHP and there is no heat transfer to the condenser section from the evaporator section.

It is also observed that for heat input from 29 Watt to 41 Watt, there is strong pulsation in the condenser temperature line. It indicate that due to increase in heat input, the temperature of working fluid increase and its temperature reaches to its boiling point temperature and due to this phase change of working fluid also takes place and there is two phase of working fluid exists inside CLPHP that is liquid and vapour phase and due to this heat transfer from the evaporator section to the condenser section takes place efficiently through conduction and convection mode both and phenomena of two-phase heat transfer occurs.

It is again detected that for heat input from 41 Watt to 64 Watt, pulsation in the condenser temperature line disappears and it shows that due to high heat input, the temperature of working fluid increases rapidly and the all working fluid is vaporised and again inside the CLPHP, there is only one phase of working fluid and that is vapour phase and due to this heat transfer from evaporator section only takes place through conduction and hear transfer ability decreases. This is known as dry-out condition of the CLPHP and in this state, there is abrupt increase in evaporator temp and thermal resistance of CLPHP and this is worst state of CLPHP.

Specific Track Area

The data in the article is concerned with the field of Mechanical Engineering and specifically in Thermal Engineering. The data provide an overview about the performance of a cooling device named CLPHP which is operating on no electricity.

Types of Data

The article contains the experimental data in form of Table, Charts and Graphs.

Data Format

The data included in the article can be considered as the analysed and filtered data as they have been included after taking the average of data obtained from performing the experiments multiples times on the same input parameters and obtaining the same results within the specified limits.

Parameters for Data Collections

There was no specific condition during the data collection. All the required data have been collected at NTP.

Description of Data

The data have been collected with the help of CLPHP setup equipped with Temperature Scanner, E-Scan Software and Heat Control Panel. The temperature data are collected for the evaporator and condenser section when the steady state has been reached.

Data Source Location

Institution: Sardar Vallabhbhai National Institute of Technology
City: Surat, Gujarat (395007)
Country: India

Related Research Article

V.M. Patel, Gaurav, H.B. Mehta, Influence of working fluids on startup mechanism and thermal performance of a closed loop pulsating heat pipe, Appl. Therm. Eng. 110 (2017) 1568–1577, http://dx.doi.org/10.1016/j.applthermaleng.2016.09.017

Value of Data

- In the article, the data is collected for the cooling device named CLPHP which can be operated without electricity. The operation of any cooling without the consumption of electricity is enough to explain the importance of the data taken for the article.
- The data can be helpful in the remote area. The device can be used for cooling the solar panel due to which the performance of solar panel will increase.
- In future, the data can be used in further discovery in CLPHP and after the complete analysis; it can be used commercially for the efficient cooling devices running without electricity.

Data Description

Table 1: It contains the data concerning the PHP dimensions. Basically, PHP is capillary tube in the form of serpentine channel. The dimensions are taken as they can enhance the capillary effect and decrease the surface tension effect.

Table 2: It contains the data concerning the physical and chemical properties of distilled water as the distilled water has been taken as the working fluid for the CLPHP.

Figure 1: Schematic diagram of conventional heat pipe and pulsating heat pipe (PHP).

Figure 2: Schematic diagram of closed loop PHP, closed loop PHP with check valve and open loop PHP.

Figure 3: Experimental set up for a CLPHP.

Figure 4: Aluminium block, capillary U-bend, cartridge heaters.

Table 3 and Figure 5: It is showing the data and variation in the thermal resistance of CLPHP for all filling ratio at 0 Degree orientation of the setup. The data showing the worst performance for filling ratio of 25% and 75% and better performance for filling ratio of 50% **and 65%.**

Table 4 and Figure 6: It is showing the data comparison for the performance of CLPHP for 50% and 65% filling ratio. The performance of CLPHP with 50% filling ratio is better for the low heat flux and the performance of CLPHP with 65% filling ratio is better for the high heat flux

Table 5 and Figure 7: It contains the data concerning the effect of orientation of the performance of CLPHP with 50% filling ratio. The data show the performance is good at the 0 Degree orientation of CLPHP.

Table 6 and Figure 8: It contains the data concerning the effect of orientation of the performance of CLPHP with 65% filling ratio. The data show the performance is good at the 0 Degree orientation of CLPHP.

Figure 9: It contains the data regarding the time period for the starting the pulsations in CLPHP and the time period for which dry-out condition is occurring.

Experimental Design, Materials and Methods

The CLPLP capillary tube is manufactured with the help of Aluminium Tube and made in the form of serpentine channel which lower part is considered as the Evaporator Section, middle part is taken as the adiabatic section and the upper part is taken as the condenser section. The temperature at all the section has been collected and analysed for the thermal resistance for the evaluation of performance of the CLPHP.

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Acceptance Letter

Ref. No.: MTHM-01-02
Date: 01-11-2022

To,
Dear Dr. Yogendr Bahuguna

The book chapter titled **"Recent Pharmacognosy & Phytochemistry of *Eleusine coracana*: An Ethnomedicine"** is very well written and has been accepted for publication in edited book titled **"Modern Trends in Herbal Medicine (Volume - 1)"**.

Yours Sincerely,

Akhil Gupta

AkiNik Publications Director

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Child Friendly Cities

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Abstract

It is common knowledge that majority of the population growth in the upcoming decades is going to happen in urban cities, it is important to have a clear roadmap and thought process to ensure that growth of the cities happens in a planned and projected manner instead of unplanned or haphazard way. There are multiple aspects of this including but not limited to Safe and healthy housing, Commercial activities, Transport, Energy, Water and Food. A lot of countries in the world are trying to address the same through the theme of 'City 2050'. There are no doubts about the fact however that, out of all the aspects mentioned above, the one relating to healthy and safe living is foremost and has to be considered at top priority. This paper intends to explore this aspect further and focus more on the concept of Child Friendly Cities (CFC) as envisaged by UNICEF in its declaration of 1996.The Child Friendly Cities Initiative (CFCI) is a UNICEF-led initiative that supports municipal governments in realizing the rights of children at the local level using the UN Convention on the Rights of the Child as its foundation. Not only that, it also provides a forum that brings together various constituents and stakeholders such as Governments, civil society organizations, the private sector, academia, media and, importantly children themselves who wish to make their cities and communities more child-friendly. Paper further explores the need of Child friendly cities in general, Guidelines of CFC framework, Trend setting cities across the globe, Challenges faced by them and CFC in India. Paper also discusses a few case studies from across the globe, gaps in implementation of the said projects, major lessons learnt and strategies to leverage the same to mitigate the challenges in pursuing CFC project in developing world.

Keywords: *Planning, Urban Area, City 2050, globalization*

1. Introduction

For the first time in human history, urban areas have more inhabitants than rural areas. It is estimated that around 68% of the population would dwell in urban areas by 2050 (NATIONS, 2018), 60% of this would be constituted by people under the age of 18 years. Many of these children benefit from the benefits of city life, such as greater educational and medical opportunities in addition to leisure facilities. Many children are denied such necessities where there isn't one. Children can travel safely and freely inside their neighborhoods thanks to good urban planning and design. As a result, it is critical that authorities design and create communities that are child-friendly and sensitive, co-creating healthy, inclusive, and accessible public spaces for and with children, especially the most vulnerable. In keeping with these observations UNICEF and UN-Habitat initiated the Child Friendly City(CFC) initiative in 1996 to implement a resolution passed during the second United Nations Conference on Human Settlements to make cities more livable for everyone. A few countries have started concerted efforts towards achieving the objective of Child friendly cities. Child friendly city is a city, town or community in which the voices, needs, priorities and rights of children are an integral part of public policies, programs and decisions.According to UNICEF, CFC is a city, town or community where children:

- Are protected from exploitation, violence and abuse.
- Have a good start in life and grow up healthy and cared for.
- Have access to quality social services.
- Experience quality, inclusive and participatory education and skills development.
- Express their opinions and influence decisions that affect them.
- Participate in family, cultural, city/community and social life.
- Live in a safe secure and clean environment with access to green spaces.
- Meet friends and have places to play and enjoy themselves.
- Have a fair chance in life regardless of their ethnic origin, religion, income, gender or ability.

Given below is a map which shows current status of the same across the globe – cities which are already CFC, cities which are in early stages of designs and also cities where action is yet to begin.

Figure 1:Location of CFC countries on world map
Source: (UNICEF, 2021)

2. Methodology

The research is based on information found in various journals, articles,research papers, and videos related to this topic. Later in this paper some observations from global case studies have been shared which can be considered as benchmark by these developing nations for taking ahead their program for widespread CFC development.

Case studies have been accessed against the 9 building blocks for CFC which are formulated by UNICEF and Sustainable Development Goals 2015._

2.1 Building Blocks for CFC: There are 9 building blocks which have been formulated to address the ongoing challenges.

Table 1:Nine Building Blocks for CFC

1.Children's Participation(B1): promoting children's active participation in topics that concern them; listening to and considering their opinions taken into account during the decision-making process.	**2. A Child Friendly Legal Framework(B2):** ensuring effective promotion and protection of rights by legislation, regulatory mechanisms, and procedures of all the kids.	**3. A city- wide children's rights strategy(B3):** Develop a comprehensive, detailed strategy or agenda Construction of the children's friendly city agreement.
4.A children's rights unit or coordinating mechanism(B4): Develop continuous local government structures to ensure priority consideration of the perspective of children.	**5.Child impact assessment and evaluation(B5)**: Ensure the systematic evaluation process for children during and after implementation of law, policy and practice.	**6.A children's budget (B6)**: Ensure adequate commitment to resources and child budget analysis
7. A regular state of the City's children Report(B7): ensure adequate surveillance and collection of data on the state and rights of children	**8.Making children's rights known(B8)**: Ensure awareness of adult and children's rights.	**9. Independent advocacy for children(B9)**: Support for the promotion of the rights of children by non-governmental organizations and the development of independent human rights institutions

Source: :(Unicef, 2004)

2.2 Sustainable Development Goals(SDG) for CFC: The 2030 Agenda for Sustainable Development was adopted by world leaders in September 2015. The

Agenda is a set of 17 Sustainable Development Goals (SDGs) and 169 targets. Out of the 17 SDG's there are 12 goals which are directly or indirectly concerned with CFC namely

Goal -1 No Poverty, Goal-2 Zero Hunger, Goal-3 Good Health and Well Being, Goal- 4 Quality Education, Goal-5 Gender Equality, Goal- 6 Clean Water and Sanitation, Goal-7 Affordable and Clean Energy, Goal-8 Decent Work and Economic Growth, Goal-10 Reduced Inequality, Goal-13 Climate Action, Goal-16 Peace and Justice Strong Institutions and Goal-17 Partnerships to achieve the Goal. (Unicef, Unicef, n.d.)

3. Research Context/Case Study

Many Cities have attempted to initiate child friendly planning in their cities and for the purpose of this research 4 cities were chosen for case studies i.e. Sharjah (U.A.E), Bogota(Columbia), Denver (Colorado, USA) and Barra Mansa (Rio de Janeiro, Brazil).

Figure 2:Location of Child Friendly Cities taken in case Studies
Source: (UNICEF, 2021)

3.1 Sharjah(UAE): Sharjah , with a population of around 1.4 m people is the third largest emirate of UAE. Under the directives of ruler of Sharjah , the emirate has taken definitive measures over last 4 decades to develop Sharjah into a city where children and young adults can live in a safe and healthy environment enjoying their rights and having access to platforms where their voices can be heard. UNICEF announced Sharjah to be a Child Friendly city in 2018 for its child friendly initiatives and with its concerted efforts on all fronts – legal, institutional, budgetary and planning- the city became first in the middle east region to become a CFC and also the first one in the whole world .

Main CFC Initiative of Sharjah: 'Baby friendly Cities'- The Project was started in 2011. After the successful introduction of four initiatives: Baby-Friendly Health Facilities, Mother-Friendly Workplaces, Mother and Baby-Friendly Public Areas, and Breastfeeding-Friendly Nurseries, the project was able to introduce the idea of a "child-friendly city." It focuses mainly on health of the children. The emirate has

designated 19 government and private health facilities as Baby-Friendly, 22 public places as Mother-Baby Friendly, 30 nurseries as Breastfeeding-Friendly, and 84 workplaces as Mother-Friendly since the project's inception. (NEWS, 2019)

3.2 Bogota(Columbia): Mayor Enrique Perialosa of Bogota initiated many projects to make it environment friendly and child friendly city.

Main CFC Initiatives of Bogota

1. **TransMilenio Project:** To develop a healthy and safe atmosphere for children, in 1999 Bogota started TransMilenio project to established dedicated cycling and pedestrian-only roads, banned cars from the city centre, and built a 700,000-person-per-day rapid transit bus system. As a result, traffic deaths decreased by 50%. The first phase of implementation was completed in 2002, the second in 2006, and by 2012, TransMilenio had 12 lines running across the region, making it the world's largest bus system. (UNICEF, childfriendlycities)

2. **Street Paintings Project:** To minimize traffic speeds and create new play space, street paintings and planters were used to mark a path between a kindergarten, school, and park, while buildings were painted in bright colours. (Laker, 2018)

3. **Camino Imaginado Project:** The third initiative undertaken by Bogota worth mentioning here is the project called 'Camino Imaginado'. Project aims at significantly improving upon social inclusion through safe access of schools to students and teachers and also rehabilitation of youth offenders by providing them job opportunities. Some 40,000 sq.m (Beverly Kingston, 2007). space has been recovered for former and around 1300 jobs for latter purposes. (Devashish Dhar, 2020)

3.3 Denver, Colorado(U.S.A.)

Denver is the number-1 ranked child friendly city of U.S.A.

Main CFC Initiative of Denver: In 2006 with a collaboration of mayor of Denver and children, youth and environment centre, Colorado initiated City Youth Friendly City Initiative (CYFC).

Name was chosen specifically to make it inclusive of a wider age group rather than limiting it to just the Children. Denver's CYFC program revolves mainly around two projects:

1. **Safe Routes to School:** This project by the Children, Youth and Environments Center (CYE) of Denver addresses the need for safe routes to walk and bike to school. It aims to provide children, parents, and other community stakeholders with a process for communicating neighborhood safety concerns and also in addressing these concerns through a community-based approach tailored to the

needs of specific neighborhoods. The said approach helps all the concerned stakeholders to evaluate and address the risks identified by children themselves. This is then followed up by a team representative of neighborhood stakeholders, who assist in implementing changes based on the priorities identified by children and other stakeholders. Project ensures that children can safely walk or ride to school using a variety of strategies including compliance, infrastructure improvements, safety education, and non-motorized transportation incentives. (Beverly Kingston, 2007)

2. **Learning Landscapes:** With a budget of $20m raised in pubic private partnership, this project has Department of Landscape Architecture work with School officials, teachers and students. Project aims at designing new multi generation spaces for outdoor use in the school yards to meet the requirements of different age groups of not only the students of the school but also of the local residents in before and after hours of schools. In nutshell, this program reconnects schools to the communities by allowing community use and as a result increases the sense of belongingness and ownership of the school yards.

3.4 Barra Mansa, Rio de Janeiro, Brazil

Main CFC Initiative of Barra Mansa: Barra Mansa's children's participatory budget council (CPBC) is a good example of combining children's involvement with genuine, budgeted resources for child-initiated projects. Local youngsters aged 9 to 15 and parents were the driving forces behind the formation of these councils. They then invited others to join in and offer their knowledge and abilities. The budgeting procedure is quite transparent because the government has allocated a tiny portion of its budget (about USD 125,000) to the council, with the elected children of the council being able to decide on the public works to which the budget should be given. Elected children also go on "citizenship trips" to various communities to examine the many problems at various geographic levels, allowing them to prioritize which issues should be addressed. The relative budgetary clarity allows children in Barra Mansa to launch projects such as health clinic renovations without risking proposing completely impossible plans. (Guerra, 2002)

The CPBC was founded in 1997 as a result of a municipal program called "Citizenship Knows No Age," which started the citizenship process for children and teenagers. The program established a Children's Secretariat, with the goal of having one child or adolescent participate in each municipal secretariat. Child Secretaries were chosen from a pool of five boys and seven girls aged 8–13. Barra Mansa City Council had been creating activities based on public participation and implementing innovative policies in the field of children's and young people's rights, thus the city consultation process was centered on the theme of "participatory governance and children's citizenship. (N.I.U.A, 2017)

3.5 Child Friendly Cities in India: India has the world's greatest number of children. Children (ages 0-18 years) make up 472 million of India's population (Census of

India, 2011) which is 39 percent of total population. Some of the most prominent issues which need to be kept in consideration while planning child friendly cities are as following:

1. **Vehicular density and congestion:** Given the traffic density on Indian roads and the time an average child spends on the commute to and from school, play areas and friendly meets - it is of utmost important to plan roads, footpaths and crossings safe and inclusive for children in India.

2. **Concrete jungles and limited access to green spaces:** This has led to the limited availability of open and green spaces for children to play and mix up with their peers. This problem has further accentuated itself during covid times and as a result of which children have remained confined to indoors. While considering planning Child Friendly Cities, it is important that there is sufficient green and open space in the neighborhood of all children for them to be able to happily and safely enjoy their childhood and develop into healthy adults. (Devashish Dhar, 2020)

In addition to the above slums, lack of health care centres, increase of crime rates in cities etc. are the main issues which have to be taken care by the government as well as by planners to make cities child friendly. Participation of children in making child friendly cities can play an important role towards this. Indian Government also started some policies and schemes for children such as

- National Education Policy2020 (NEP2020)-For Free Education to children
- Affordable Housing (PMAY)-For Affordable housing
- Mid-day meal scheme-To provide nutritious meal to poor children
- Sukanya Sammridhi yojna-To provide financial support to girl child
- AMRUT Yojna-To provide walkable Communities

The National Institute of Urban Affairs (NIUA), in collaboration with the Bernard Van Leer Foundation (BvLF) has undertaken a project to build Child Friendly Smart Cities (CFSC) in India within the urban agenda of building smart cities. The goal of this initiative is to bring focus to the needs of the children in the urban policy and planning framework. Two cities, namely Pune and Bhubaneswar, are the pioneers in India from CFC perspective. Officials in Bhubaneswar have started the "Socially Smart Bhubaneswar" program, which teaches adolescent girls self-defense tactics. The city has also joined the Bernard van Leer Foundation's Urban95 initiative, which strives to develop cities that meet the needs of a three-year-old (average height is 95 cm approx.). This effort focuses on bringing about changes in urban planning. (Devashish Dhar, 2020)

4. Findings

Through Comparative analysis it is found that out of 9 building blocks Child Participation, Legal framework, children's rights strategy and Children's budget are

the most widely strategies to make child friendly cities. The lowest covered building block is-Child impact assessment and evaluation(B5).

Table 3:Analysis of Case Studies on the basis of 9 Building Blocks

City	Child Participation	CFC legal framework	A city wide children's rights strategy	A children's coordinating mechanism	Child impact assessment and evaluation	A children's budget	A regular state of the city's children report	Making Children's rights known	Independent advocacy for children
Sharjah, U.A.E.	-	-	-			-		-	-
Bogota, Columbia			-				-		
Denver, U.S.A	-		-	-		-			-
Barra Mansa, Brazil	-			-		-			

Source: Compiled from literature

5. Conclusions

Child Friendly Cities is a great initiative towards finalizing master plan vision 2050 of cities. This will ensure that our cities are more environment friendly, sustainable and provide support to our children towards a healthy, safe and learning environment. Almost anywhere in the world, adult urban planners planned city while the end users are frequently teenagers, as is the case in parks, public spaces, and schools. Child Friendly Cities with children's innovative minds can create an environment for children to express their views and influence decisions that impact them, so that urban planners and decision-makers can provide a healthy, stable, and clean environment that takes children's perspectives into account.

To summarize the solution to this challenge lies in making our cities child-friendly through following means;

a) Participation of children in decision making through city parliaments to solicit their views on issues of importance
b) Dedicated corridors/cycle tracks for children to travel to the surrounding areas for attending schools, visiting playground and local markets
c) Creating self-sufficient societies with minimal vehicular movement inside with all the important buildings and areas like schools, markets, libraries and recreational spaces are available to them within the boundaries of that society
d) Formalizing rules to help sensitize the local law enforcement agencies to ensure safety and wellbeing of children
e) Establishment and strengthening of local Aanganwadi for ensuring compliance and adherence with all health and nutrition related matters
f) Formation of exclusive bodies for protection of child right in conjunction with judiciary and law enforcement agencies

g) Introduction of education related to child right at school level to increase awareness

Through the analysis of this research it is concluded that by following the above stated guidelines the cities can grow towards focusing on child centric development. When one looks at the growing population or the current composition of our country it is found that around 39%of the population is in young age so in the coming 10-20 years the concentration of the population would be more in young and child age. Hence our focus should be in the direction to make it useful for the users when they should start thinking on the lines of child centric development.

Given above, the need for a CFC is undeniably proven however, the concept itself is in infancy and as such it might take years, if not decades, before it starts gaining the attention it deserves.

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Review of Counter Magnet City Concept and Setting up Prameters for Future Consideration

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The Population in urban areas is increasing on a very rapid rate. In 1975 the urban population of entire world was 38 percent, in 2000 it increased to 47 percent and it is estimated to be 61 percent by 2030. Indian urban population is also increasing rapidly. The population of people living in urban areas of India, as per the 1901 census, was 11.4%, which increased to 28.53% in 2001 census, and to 34% in 2017 as per the World Bank. Delhi's population which was around 3.0 million in 1960, is estimated to be around 38 million by the year of 2030. The main reason of the fast increasing population in urban areas is migration. This escalating population growth has put a lot of pressure on the existing infrastructure of the Metropolitan cities. Hence to stimulate the process and to control the urban population the new growth concepts like new town, counter magnets, satellite towns and ring towns emerged widely. Out of these approaches concept of counter magnet city was to develop another city far from the origin city and to develop the infrastructure and employment opportunities within it to attract migration and ease out the pressure of the origin city. This paper discusses how the approach for a counter magnet city has been considered to control the migration of main cities via various case studies for Delhi NCR region and other international cities. Further the paper attempts to put forth a set of parameters that are a pre-requisite for counter magnet cities so as to achieve the overall aim of decreasing the pressure from the main city. Case study based approach along with a literature review to analyze and detail out the counter magnet city concept is being adopted.

***Keywords*: Urban Growth, Urbanization, Counter Magnet, Tier-II city, Balanced Development, Region Dynamics**

1. Introduction

Urbanization and migration are considered to be the key elements for rapidly growing mega cities in our country. This can be clearly understood in respect of world urbanization pattern. The urbanization was triggered by the industrial revolution which started in the 19th century In 1975 world urban population was 38% which increased to 47% in 2000 and is expected to be 61% by 2030 **(NCRPB, Introduction (Study on counter magnet areas to Delhi & NCR), January 2008)**.

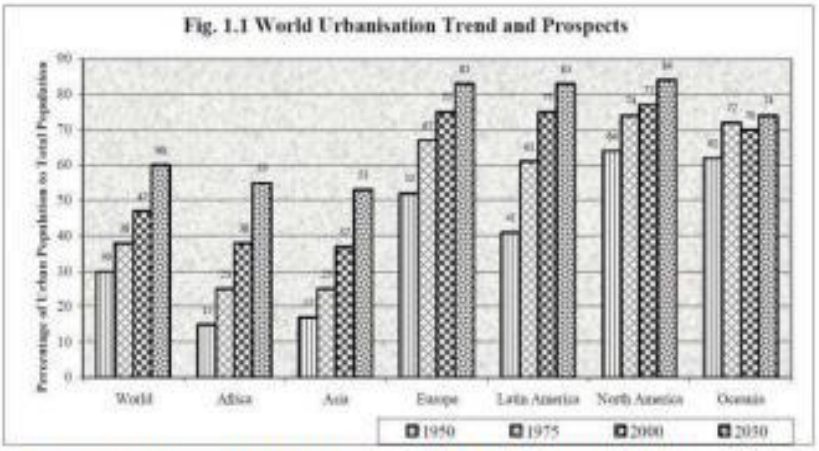


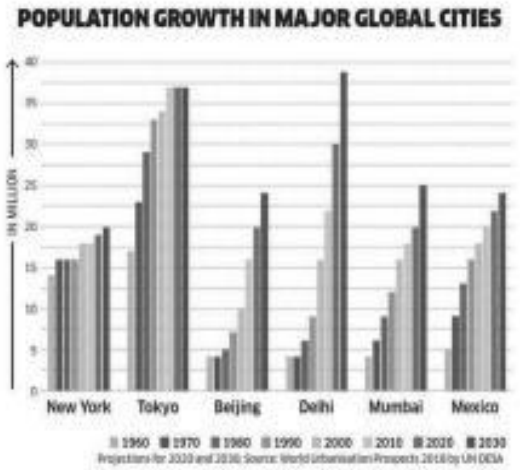
Figure 1 United Nations, World Urbanization Prospects

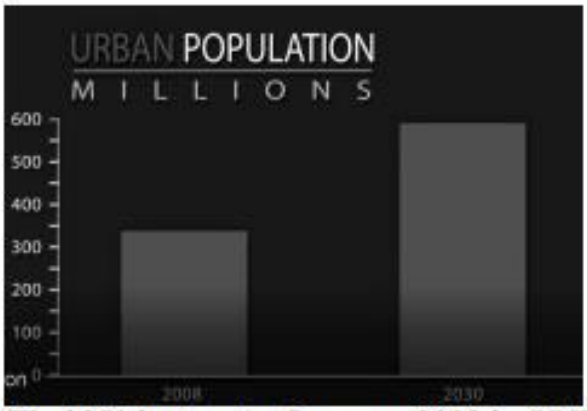
Table 1.1: Number of 10 million + Cities/Agglomerations in the world, more developed and less developed regions of the World

Description	World				Developed Regions				Less Developed Regions			
	1950	1975	2000	2015	1950	1975	2000	2015	1950	1975	2000	2015
No of Agglomerations	1	5	19	23	1	2	4	4	0	3	15	19
Total Population (in million)	12	68	263	375	12	36	67	69	0	33	195	306

Source: United Nations, World Urbanization Prospects

Urban India is also in the race of urbanization. As per Census of India 2011, 377.1 million people live in urban areas out of the entire population of 1210.2 million and this number is estimated to be around 600 million by the year of 2030 **(mckinsey global institute, n.d.)**National capital Delhi and its region (NCR) has grown by 33% to 36% decadal from the year of 1961 to 2001 **(India, Census of India, 2001)** and it's estimated to be 58.2 million by 2021 from 11.1 million in 1961.





Source: World Urbanization Prospect 2018 by UNDESA
Source: Meckinsey Global Institute

Metropolitan cities serve as the center of business development, trade and commerce and lots of different tertiary services. Because of this heavy urbanization the pressure on existing urban infrastructure, amenities and services increases heavily. Hence, the concept of counter magnet town or city came into existence to reduce the burden on existing infrastructure, and other services while giving or generating enough economic activities and a balanced growth to boost the zonal or regional economy. As per **(NCRPB, Migration Study of Delhi & NCR, 2008)** population of the NCR region has grown many folds over the years.

Population Growth in NCR			
Decades	NCR Population in Lakh	Decadal Increase in Population in Lakh	Population Growth rate (Decadal)
1961	111	-	-
1971	147	36	32.4
1981	199	52	35.4
1991	274	75	37.7
2001	371	97	35.4
2011	460	89	24.0

Table 1: Source Census of India 2011

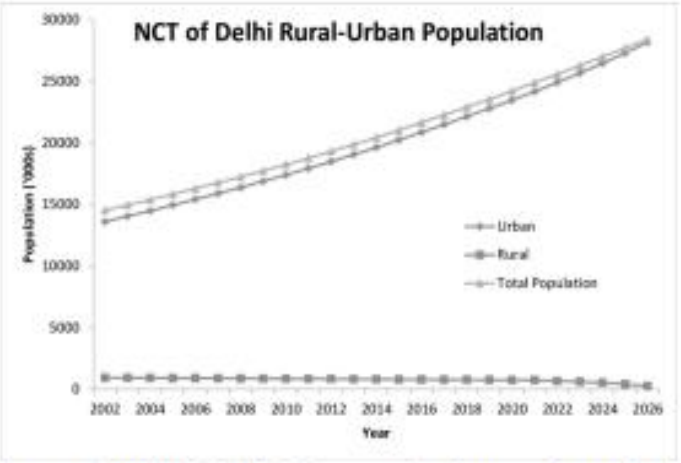


Figure 2: Source: NCT of Delhi Sustainability analysis & plan for the future (June 2015)

The table clearly reflects a serious need to establish the counter magnet areas by developing Tier-II cities, satellite cities, etc. for redistribution of population by reducing the population inflow in major cities enabling a balanced regional development As these tier II cities would function majorly for easing out pressure from megacities they need to be meticulously planned so that they serve their purpose and emerge as promising cities of future.

2. Management Strategies of Urbanization

People, move from rural areas to urban areas or urban areas to other urban areas due to many push and pull factors, better employment opportunities being one such factor. This is called migration and it leads to urbanization which is linked with urban growth. In order to manage such urban growth there are various strategies which can be adopted. These strategies can be divided in two categories namely external and internal **(Agarwal, 2020)**.

External

- New Towns
- Pole Development
- Counter Magnet
- Satellite Town

Internal

- Infill Development
- City Extension

The internal strategies are limited to within the city or by adding the adjoining areas or peripheral areas while in external strategies try to find out the solution beyond the city limit. The primary need to reduce the pressure of existing overexploited

infrastructure and amenities by making appropriate strategy One way for this can be to make the necessary changes in the existing policies by which underutilized potential can be identified and empower the urban area to cater the increasing population. The internal strategy includes the up gradation of current infrastructure, optimization of the existing utilities and services and up gradation of existing policies like FSI limits and vertical development to enhance the event of the internal ways. These include infill development, Brownfield development and city extension. All these strategies have their own limitations in terms of availability of land and provision of services as per the need and demand of the growing population.

The External strategies look for new dimensions of development which explore varied development approaches like satellite town, counter magnet city, new town and pole development etc. Since economic growth is the key factor in the development, 'employment generation' has been proven the key focus area. In Pole development as the name suggest the growth in population and the movement of people is limited to an anticipated area called as growth pole. In this concept growth is not uniform in the entire region but is concentrated to a particular region or area. At a later stage when first growth pole becomes inadequate to cater the needs of increasing population then emergence of 2nd growth pole is possible.

Satellite towns are town which have been developed near the main city or core city and they are neither fully independent of the mother city nor restricted in their function. These have been developed at the adjoining areas or in the suburban areas which are partially independent for its socially and economically growth **(Amit Chatterjee, 2015)**. But it is found that with due course of time these satellite town got merged with the main city due to continuous expansion of these town and main city and hence lose their charm and identity.

3. Magnet City

The city, which pulls individuals, brings investment, provides social amenities & infrastructure is known as a magnet city or town. In foreign countries also the concept got a lot of success. Basically a powerful magnet pulls the people and attracts the business, economic activities and give enough employment opportunities to people on a lower expenditure for living as compared to the metro city. If a counter city has not been planned adequately then it may push people away from the city and can become a negative magnet based on its characteristics. For a successful magnet city the aim should be to give identity to city and generate the opportunities to grow the economy and uplift the living standard of the residing people.

This counter magnet town or city basically acts as a substitute of its origin city and work to reduce the existing pressure of the metropolitan city. These cities or towns provide a better infrastructure and other social amenities as well as good connectivity with the other parts of the region.

Considering the above advantages, the counter magnet city or town acts like a barrier in migratory flows from the near about areas to the core city. Other than that the counter magnet city provides the enough opportunities for the employment and gives better services and stops local people to go out of their roots or their origin city due to these factors. Thus these cities act like an economy generator and help the country to grow equally.

3.1 Counter Magnet City concept

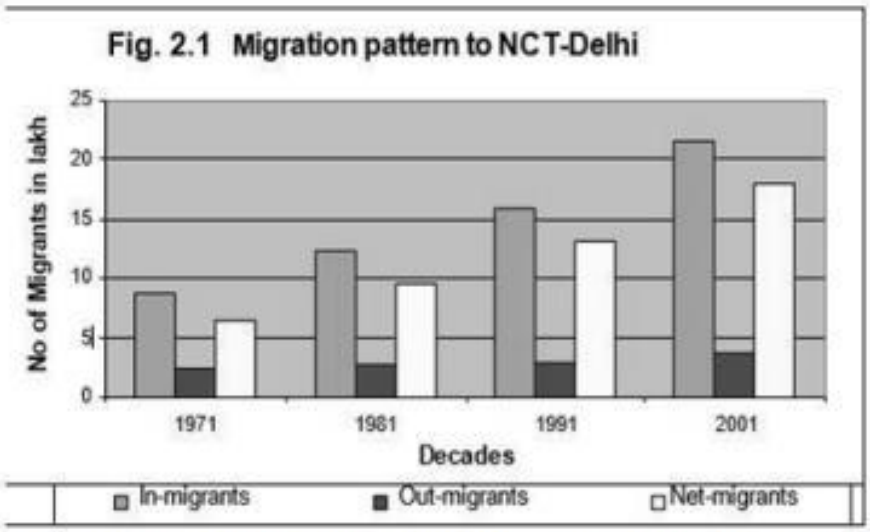


Figure 3: Source Study on counter magnet areas to Delhi-NCR by NCRPB

In the year 1985 the NCRPB (National capital region planning board) was formed to ease out the increasing migration in Delhi-NCR first. Board further studied the region in totality and gave the proposal of counter magnet cities for the balanced growth and to ease out the increasing urbanization and migration for the Delhi – NCR.

Figure 4: Source NCRPB -Counter Magnet Cities of India

The concept was to identify the few cities away from the NCR area which can be developed further and can attract the migration to release the Delhi – NCR migration pressure.

As per NCR plan 2001, first total 36 cities within the range of 100-400 km identified based on various parameters like their size, population growth, status, work participation ratio, population density and spatial parameters like accessibility, congruence with in migration corridors and proximity to other contenders in the region. In final analysis based on city profile, demographic changes, productive activity, finance & commercial services, Public and semipublic facilities, urban management, infrastructure (utilities and services) and growth impulse total 5 cities were identified as counter magnet cities.

1. Hissar (Haryana)
2. Gwalior (Madhya Pradesh)
3. Kota (Rajasthan)
4. Patiala (Punjab)
5. Bareilly (Uttar Pradesh)

Later on as per Regional Plan 2021 three more urban areas Ambala (Haryana), Kanpur (Uttar Pradesh) and Dehradun (Uttarakhand) have been added to these magnet cities by NCRPB in 2008.

3.2 Assigned role for Counter Magnets area

Regional set up 2001 appointed 2 distinctive and reciprocally complementary roles within the context of NCR (NCRPB, Study of existing counter magnet areas, january 2008):

1. As interceptors for the migration flowing in to NCR region, which can step up due to accelerated progress of NCR which can further pull migrants from the near about less developed region.
2. As these counter magnet cities will be growth centres hence the growth of urbanization in entire region should be balanced in an adequate time period.

As per policy guideline of 2001 regional plan, it was a combined duty of state government and NCRPB for the development of identified Counter magnet areas. The state government or the concerned agencies were given to prepare the overall strategic development program for the CMAs to uplift the physical and social infrastructure and economic based activities.

3.3 Development Strategy for CMA

a) General approach to development

The growth of these magnets has been considered in a larger prospect to get the balanced growth or development and equal growth in the neighbouring states as a

complimentary planning process for step by step growth of Delhi – NCR region as these towns or cities are the integral part of the strategy of decentralization of NCR area. Hence the priority has to be given to these towns.

As per suggestion NCR board has to make sure to provide the funds and guidance to the state government. At the same time state government has to make sure the development progress.

b) Area of Intervention

The identified cma had enough potential to grow and develop on their own by the help of state government and local agencies. Certain areas like regional connectivity, social and economic infrastructure were required immediate focus to promote so that development can be accelerated and these cities can function effectively as cma. The areas of intervention area:-

- Up gradation of Regional Linkage
- Improvement of Economic base viability
- Up gradation of infrastructure

4. Case Studies

1. Hisar (Haryana)

Hisar a very important urban center and a very fast growing region of Haryana. Hisar district is taking care of the needs of approx. 17.43 million people's (India, census of India, 2011). Hisar is located to 164 km to the west of New Delhi.Ithas links with other neighboring areas of Rajasthan and Punjab for trade purpose. In radius of 100 km of Hisar, there is no other major urban center. The district covers approx... 3983 sq.km. Area with four no of tehsils. Total density of the district in 2001 was 386 persons per sq.km which was 237 in 1981.

Hisar has a very good connectivity with other districts of Haryana and other neighboring states' districts by rail and road network both.

Basically Hisar is located on NH-10 & NH-65 which connects it with other urban region like Delhi, Sirsa and Rohtak. There are other state Highways as well for connecting hisar with Tohana- Chandigarh, Tohana – Bhiwani, Balsamand – Bhadra. Hisar has its own domestic airport which is situated at 5 km distance to the north east of the city.

Figure 5: map of India website- Hisar district map

Industrial growth inside the city and in the neighboring areas, Shifting of Electrical Board of Haryana State in Hisar, Administrative complex and other judicial complex made the city as a most growing center in the region.

Hisar city has grown with a decadal growth of 31.95% and 45.14% from 1981-1991 and 1991-2001 with population of 1,37,369 in 1981,1,81,255 in 1991, 263,070 in 2001. Once after declaring as counter magnet city growth was 17.54% from 2001-2011 with a population of and 3,09,210 in 2011 as per India census. As per NCRPB report total in migration in Hisar was 1,29,056 from 1991-2001 and on the other hand out migrated numbers to Delhi are 6,894.

Majorly economy of Hisar depends on Industries. Other sources are trade, commerce and education institutes as well. Hisar is known as "**City of Steel**" (saini, 2015) as well. Steel pipe manufacturing makes the Hisar as one of the largest pipe manufacture region the Haryana State. Hisar has the industries like Jindal Steel, Hisar textile mills and sister companies. The work force involvement has also grown up to 33.51% in 2001 from 28.74% of 1991. The total numbers has been increased to 88,145 from the 52,103 during this period. Being a counter magnet city, NCRPB has funded for the various project in Hisar like extension of water supply, Sewage treatment etc.

In conclusion Hisar city has a huge potential for a counter magnet city considering its connectivity with Delhi and other cities, Its own Airport, its industrial growth, job opportunities, its own fabric and socio culture. However city is not serving the purpose of selecting a counter magnet so far as still it is not able to pull mass migration and to decrease the load of the Capital city Delhi.

2. Patiala (Punjab)

Patiala With a population of 6.16 lac. Patiala is situated just off to the National highway-1 on Delhi – Amritsar. City is about 250km from National Capital Delhi. The nearby urban regions are Rajpura on 24km, Ambala on 50km and Chandigarh at 65 kms from the city. Patiala lies on the Ambala – Bhatinda railway corridor but it does not have direct connectivity with Punjab capital Chandigarh and other parts of the country.

Figure 6: Source - Map of India website- Patiala District map

The town lies 62 km SW of the Chandigarh city. Patiala is a very important region for the Agriculture produce and other goods. Patiala is having a good connectivity with Gobindgarh, Rajpura which are the growing industrial towns and it has connectivity with market towns like Samana, Sangrur, Patran and Nabha.

Regionally Patiala has Chandigarh, Rupnagar and Fatehgarh in North, Sangrur in the West, Ambala and Kurukshetra in the east and Kaithal in the south. The district level administrative headquarter is situated in Patiala. There are state and regional government offices like PSEB, Public health Dpt., Punjab state pollution control board, PWD, Excise and taxation Dpt., Income Tax commissioner, Water supply and Sewerage Board located in city. In Education field also there are institutions like Punjab University, Thapar Engineering College, Two dental colleges. It has second largest cantonment in Punjab. Due to these colleges and institutions Patiala has potential to be developed as Knowledge city. Its fertile hinterland may help to develop the various agro based industries.

Population growth of Patiala can be understand by below mentioned table. As per 2011 census Patiala population was 4.06 lac which was 2.06 lac in 1981.

Decades	Population	Increase in population	Decadal growth rate in %
1971	151041	-	-
1981	206254	55213	36.55
1991	253706	47452	23
2001	323884	70178	27.66
2011	406214	82330	21

Table 3: Patiala Decadal Growth

Total Migration from all other parts of India is 1,30,869 in last decade from 1991 to 2001 and out migration to National Capital is 3363 (Migration table).

Majorly Patiala's economy depends on the Institutions, Service, trade and commerce. Gobindgarh, prominent industrial town in Patiala's vicinity is also called as "Steel Town". Patiala is known for tractors wholesale business. Patiala is a fast growing Industrial region.

In 2001 census the nos of main workers is grown up to 5,89,015 in 2001 from 4,69,151 in 1981.

Patiala has huge potential for tourism sector because of many historical and religious points. Tourist spots like Bahadurgarh fort, Quila Mubarak, Maharani Club, Sheesh Mahal, Bara Dari garden and cricket Stadium are the major locations which can further be enhanced to attract people to visit the location to grow the tourism sector.

NCRPB is funding two major project in Patiala (a) integrated township project at Baran (b) Physical infrastructure project (Extension part).

The city does not have a direct railway connectivity with Delhi because of which the entire traffic has to depend up on road transport. Moreover as the city lies just off the excellent national highway -01 the city could not develop at the pace as envisaged by the NCR PB as a counter magnet.

3. Mysore (Karnataka)

Mysore city, the famous historical and tourist places in South India, is situated at a distance of about 145 Kms. South west of the state capital Bangalore city. Mysore city is geographically located between 12° 18′ 26″ north latitude and 76° 38′ 59″ east longitude. Mysore is located in the foothills of chamundi hills. . Mysore is connected with National Highway 212 to the Gundlupet which is on the state border and it further connects the kerala and Tamilnadu states. Mysore is connected with Banglore via state highway no 217 which is a four lane highway. Mysore connects the H D Kote and Mangalore city via State – Highway 33 and national highway 275 respectively. Mysore has implemented the smart transport system to manage the buses and ferrying (Gupta, 2017). Mysore has three railway line which connects the city with Mangalore, Bengaluru and Chamarajanagar. Mysore has domestic airport which is situated at 10 km in south of the city's center. Mysore known as **"cultural capital"** of state is drained by the two river Cauvery and Kabini (Bharath H. Aithal). Mysore covers the area of 286.05 sq.km and as per 2011 census of India total population of city is 9.21 lac.

Mysore also has the centuries-old Devaraja Market, filled with spices, silk and sandalwood. As per State government Mysore has been proven as the destination for the investment in Industrial, Education, Tourism sector and IT.

Figure 7: Source - Map of India website- Mysore district map

Mysore as per history is considered as home for the traditional industries like Weaving, Sandal wood carving, Oil crushing, Production of salt, Lime and Bronze work. By learning from these traditional industries Mysore has transformed itself as the center for the IT industries (Khan, 2007), Manufacturing, Service sector. Infosys Technologies, TVS Motor Company, Reid & Taylor, Raman Boards, Vikram Hospitals, N. Ranga Rao & Sons and Jubilant Organosys are some of them. Currently in and around the city there are 100 large – mid scale and 10000 small scale industries are under operation. These industries are producing products like automobile spares, pharmaceuticals, electrical goods, engineering and machine components, rubber, textiles, chemicals, processed foods, plastics, defence-related goods, Information Technology products and incense sticks. Mysore is also rich in educational institutions, right from kindergarten schools to professional colleges. From the resident point of view also Mysore has many advantages like quality life on lower cost, Salubrious climate and location of the city. The city is second best when it comes to emerging as the second largest software exporter in Karnataka. It contributed Rs. 1363 Cr. To Karnataka IT exports. City provides a very good climate for living conditions. City has good connectivity via rail and road with other cities and even expansion is under progress for road network. Mysore is one of the most prominent tourist destinations in Southern India. This has also helped it emerge as the startup hub. Sound infrastructure and lower **living** cost makes this city a great attraction for the people who are looking an alternate option of Bengaluru. Land price costs less than one-sixth of that in Bangalore. Mysore has been proved a good option to its origin city Bengaluru considering its cheaper land prize, IT industries and people are preferring the city.

4. Gwalior (Madhya Pradesh)

Gwalior district is situated in the Madhya Pradesh state. It is situated at a distance of 319 kms from the national capital Delhi. Gwalior has a very good connectivity with other nearby cities by roads, Rail and air. The city lies on Delhi –

Agra – Mumbai national highway NH-3. Gwalior is also connected via rail network with Delhi – Agra – Mumbai railway line. Nearby cities like Bhind and Shivpuri are connected via rail network. City is situated on North-South corridor and 50 km from East – West corridor. These two corridor creates so many business and trade opportunities for city. Strategically also city lies in the center portion of the state.

Figure 8: Source map of India website- Gwalior District map

Gwalior was identified as a counter magnet city for the NCR in 1985 as it clears all the parameters like distance, size, population density, work force ratio and status. Gwalior is one of the largest urban region in the state. Gwalior has its own history and urban fabric leading to recognition as a historical town. Total population of the Gwalior as per 2011 census is 10.69 lac approx. which was 8.26 lac in 2001 with a decadal growth of 29.53%. Total migration as as per (Migration table) 2001 from all over the India is 1s, 13,587 and total outmigration to the National Capital from Gwalior is 4,692.

Gwalior's major economy is generated by the services sector, Trade and commerce. City has various industries related to manufacturing of chemicals, Paints, Leather, ceramics, Textile, food processing and carpets. In education field also Gwalior has many colleges and institution which are working in the field of Management, Tourism, Technology, Science and agriculture. As per 2001 census work force participation in Gwalior city was 32.54% as compare to 26% in 1991. The district is spread in an area of 4565 sq.km. The district population in 2001 was 16.32 lac from 12.93 lac in 1991. As a counter magnet city NCRPB has funded the projects like 84 km total atrial and sub atrial road, 20 MLD capacity WTP, 33KVA and 11 KVA substation, 2 ohts, Land allocation for SEZ , Forest scheme with 60,000 trees plantation and 5000 residential plots and 1000 acre institutional land.

Overall in spite of so much potential Gwalior could not be developed as counter magnet city for the National Capital Delhi. Still it lacks at so many fronts to

be called a good example of counter magnet city. City could not grow as per the potential and expectation.

4.5 Milton Keynes (U.K.)

In 1965 UK government found that there is serous need of a counter magnet town in south east of England as London was getting more and more congested day by day. There was a huge housing demand in the London city and which was making city very congested. In 1960 Government has identified the north Buckinghamshire a potential site to develop a large town or a new town. The target population for which the city had to be planned was 2.50 lac. The total area for the new town or city was finalized 8855 hectare and the name was given as "**Milton Keynes**". The name was taken from one of the existing town of the site.

Milton Keynes is considered as one of the largest town of the Buckinghamshire, England. The city is situated in north - west of London at a distance of 50 miles. The nearby towns of the city are Northampton, Luton, Bedford and Aylesbury. The nearest major cities are Leicester, Coventry, Cambridge, London and Oxford. As per 2011 census total population of the city was almost 2.30 lac. After reviewing the existing town road situation the city has been planned with open grid pattern road and in each grid square amenities has been designed balanced for retail, Leisure and social. The city has total seven railway stations which serves the urban areas. Three railway station Wolverton, Milton Keynes central and Bletchley serves the local commuter on west coarse between London and Birmingham. Fenny Stratford, Bow Brickhill, Woburn Sands and Aspley Guise railway station are on the Marston Vale line to Bedford. The nearest airport is London Luton and easily approachable. Every year almost 31 million shoppers comes to use these facilities. Major population is young as more than 45% people are of the age of around 30. In 1997 given job opportunities by the city was 1.08 lac approx. which is estimated 1.30 lac in 2015. The unemployment rate of the city is very low as less than 2% (Nikki

Flanagan). It is a important location for the Business activities and almost 25 million people live at a distance of 2 hour drive and the city has a very good road network as well the railway connectivity. The city has more open and green spaces as compare to other nearby cities. It was considered as Future City as it is less congested and less populated while having the high class services at the same time.

Milton Keynes has been proven as one of the most successful economy of UK. It is center for various national and international companies. In the city 90% economy has been generated by the service sector and 9% by the Manufacturing units. 75% people are economically active and 8.3% population is self-employed. Major contribution in the business sector are from the scientist and Technical sector. City has the largest numbers of start-ups in Britain. The contribution in the employment from the public administration, health and education is largest but still comparatively very less to south east or England. The city is known for the wide range of industries and different style of housing. Community facilities like theatre, art galleries, football stadium (30,500 capacity), central church, Concert hall, Teaching hospital make the city a happening city. Milton Keynes has been proved a good example for the counter magnet city to the main city London in terms of all the magnet city parameters like attract the people, to provide employment, to grow equally and to release the stress of the main city. Milton Keynes provide the economical prize housing, business opportunities and employment.

5. Principles for an Ideal Magnet City

A city act like a magnet which either attracts something or repels. A city which has potential, pulls or attracts people as new residents, for business activities, for visiting purpose, for setting up industries for manufacturing, for tourism, for social network. Visitors come to the city which help the city to grow and to develop its infrastructure. By new business and investments jobs are created. Thus a city grows with its economy. Based on the assessment conducted in this research, principals for an ideal magnet city are as follows:

a. **Young Generation:** A magnet city always focus to attract young generation who can create wealth and by which job creation can take place in the city to boost the economy and people's attraction to migrate to the magnet city. If we take example of Mark Zuckerberg, Evan Williams, Sergey and Larry they are the people who did not establish their business in their born cities. They basically moved to other cities and started their startups and businesses which further created thousands of jobs and helped the second city to grow more. When Facebook shifted to Menlo Park in California it created 10,000 jobs and **(Robinson, August 2011)** there was a specific relationship of the city and these young people and that's why these people moved there. These cities provided the required facilities like infrastructure, Transportation, Housing, Social network, Hotels, Restaurants to these young people to start their business. Further a city can work up on its special feature which may be its historical part or present by which it can attract a specific kind of people to migrate to the city and start working there. In Changwon city when

industries and factory workers started to out migrate then city administration went back to the city's history and took reference from there (It was a birth place to the famous Korean artist and poets) and started to attract the people like painters, poets, sculptors. Today city is doing very well and a house for these type of profession's people.

b. **Physical Renewal:** Physical renewal like new buildings, innovative infrastructure keeps cities new and interesting. All the global cities follow this principle and that's why those are successful. Housing part of the city plays a very important role as some time people prefer to have it around the urban core with easy and quick transport and sometime people prefer it should be in mixed use which has bars, offices, restaurants, studios. Also in many cities so much energy has been put to redesign their downtown which gives new life to the city and it starts attracting people. Denver is now reinitiated is union street railway station which is situated in the middle of the city and now many restaurants, Housing apartments, bars are under development to make the center portion more happening which was nothing one time. In Malmo, on the western Harbour one old industrial docs was redesigned and highly sustainable houses has been built for approx. 5000 people **(E., 2013)**.

c. **Defined identity of City:** A magnet city should have its own clear identity like Global cities to draw more attention for investments, Businesses and residents. Global cities like New York, London and Hong Kong are known for their own identity. New York is city which never sleeps **(KPMG, 2014)**and Berlin is a city known for social experimentation and innovation. Similarly these magnet can have strong identities like sustainability, creativity, equality etc. When people of Oklahoma started out migrating from the city, Administration took a bold step by creating many sports facilities like Football stadium, River rafting, basketball team etc. as citizens were sports lover. As a result people started coming back to the city and now Oklahoma comes in US top 10 cities for living and business.

d. **Well connected with other urban regions:** A magnet city have very good connectivity with other nearby cities and other big cities for various reasons. A good connectivity not only make the transportation easy and cheaper but it saves lot of time, people come easily for meeting and other business activities which help to grow the business activities, Labour pooling is also easier, Import of row material and export of final product is easier and cheaper. It is important for a city to have the economical transport system which should be quick as well like high speed trains, metro trains, airports etc. but at the same time to attract the new generation to go out and in should also be easier and economical for a city to grow.

e. **Open to Innovative and New Ideas:** A magnet city which is targeting new generation and young professional people should always be open to new and innovative ideas. City's culture and its heritage, Type of residents, its creative sector like arts and music, Business community, its education system and physical cityscape all contribute in new and innovative ideas. For example cities like

Boston and San Francisco attracts top inventors, Investors and Researchers. Today both the city are in top 5 in entire world for Patent applications as per population ratio.

f. **City as Fund generator:** City's role is just not to distribute the funds but also it also has a significant financial role as well. City works to get the public and private investment. Sometime city puts it capital in risk to get more investment and funds. That's how magnet city reduce its dependency on the national scheme or state government for the funds. This principle of becoming self-dependent makes the city a magnet city. A city can generate the funds by selling its own land, commercial and residential buildings to invest in new infrastructure. For example Malmo city borrowed the money to install the highly sustainable infrastructure in its western Harbour brownfield land. The city first sold the land to developers to develop and later on city made the enough profit to cover up the capital cost and interest payment. As per other studies it's very clear that city cannot transform itself by using only its fund and they need to join with public and private funds as well. It is possible when city itself put its assets on stake and share the revenue. There are many example in various cities of this kind of model.

g. **Strong Leadership** – To make a magnet city a successful city it is very essential for the city to have the strong leadership. Some times while implementing some policies major businesses or central portion activities gets disturbed and starts out migrating but a strong leadership, city's mayor takes bold step and do the required reforms which give very good results later on. So strong leadership for these new cities is very essential.

6. Conclusion

Overall having a counter magnet city to manage the urban growth of any major city or region is a very good concept. But while implementing the concept right sprit is required.

While developing a second city in to a magnet city it is important to understand the city's identity and its inherent potential. A magnet city will not give good results if the transportation is not up to the mark and if the city's connection with other urban regions and major cities is not well defined. The major focus should be given on economic growth which will help to generate the job opportunities and business activities to attract the young generation for migration to the city.

It is imperative to understand a city's strengths like what kind of industries will work in that region. In spite of having so much potential all the Delhi NCR magnet cities are not doing up to the mark. For instance Patiala case, the city does not have a good transport system and even the city is not well connected with other major city or urban region and that's why is not fulfilling the expected result so far and does not attracts the people to migrate. If we take the example of Gwalior, it is connected with north-south, east-west corridor and big cities like Agra and Mumbai but still does not

provide that employment opportunities and get failed as a counter magnet city expectation.

At the other hand we look at the example like Mysore and Milton Keynes, both are doing well as a counter magnet city as both the city worked on the principles of the magnet city. Both the city have good connectivity with major city like Bengaluru and London. Even internal transport is also good. Both cities provides the enough opportunities for the employment and in job creation. In Milton Keynes case the unemployment rate is even less than 2%.

Natural factors play a significant role in city's development. In case of Gwalior city is covered with forest, hills and dam which affected the connectivity of the city with other regional areas. So these factors also play a significant roles and should be considered which planning. Proper budgeting and allocation of funds to complete any project with in the city is very essential. It has been noticed that many time projects do not get completed on time and loose its importance later on. To avoid such situation a city should be self-dependent to bear the cost in case of facing problem the get the funds from state or central government.

A lot of efforts need to be done to make this concept successful in India. Government should take the learnings from foreign magnet cities and implement in India to make the city a successful magnet city.

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Affordable housing for migrants

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ABSTRACT

In high growth economies continuous rural to urban migration has placed forth an oversized challenge for the housing planners in developing countries. India is witnessing a high rate of rural to urban migration. The term migrant worker typically refers to inter-state labor migrants who move to different areas away from their birth places with the aim of employment. These include a good variety of trained and unskilled staff along with the street vendors. Rural to urban migrants are at a disadvantage with relevant housing and access to basic services. In India, urban planning policies and master plans fail to mention the land reserve for migrant housing in cities. Due to this policy level gap, cities never accept the migrants as their permanent residents and the migrant population forever feels neglected in the development journey of cities. This often leads to the development of slums and squatters in the cities. The study through best practices tries to explore options for accommodating the migrants and refugees in urban areas by mainstreaming them through planning and development policies. Moreover, the study highlights the key role of cities and native administrations in housing provision.

Keywords: Urban migrants, Affordable Migrant Housing, Rental Housing for Migrants, Housing policies.

1. Introduction

The high rate of urbanization experienced by India brings immediately to the fore the issue of housing of the recent low-income migrants to the cities. A study lays out before us the whole gamut of the policies related to urbanization as well as on well-being of the most vulnerable population of the society. India the fastest growing economy, but also because, embarked on different policy regimes and development paths and increasing inequalities within the urban areas.

Further, cities are facing real estate boom and severe housing price increase leading to marginalization of a very large section of the urban poor and certainly the recent low-income migrants from the housing market, a realization that has dawned in the national policy making circles. This study presents a brief comparative perspective of this aspect of the urban social policy. Housing for rural migrants and the urban poor is a policy challenge for all governments in India. During the last half a century, various policies have been promoted and implemented by governments around the world. Housing for migrants and therefore the urban poor remains an unsolved problem. Large areas of slum settlements can be found around or within developed cities.

Low-income migrants tend to measure especially locations like urban villages, construction sites or industrial factory dormitories. Urban villages were originally rural settlements located in suburban areas. Because of urban expansion the agricultural land owned by these villages was gradually developed, and these traditional villages became incorporated into the built-up area. Due to their unique locations and the collective ownership of land (non-state ownership), cheaper private rental housing in those villages become the main source of accommodation for poor migrants. For an extended time, researchers and policy makers around the world are founding out answers to the unanswered questions of how the urban poor should be housed in developing countries.

The capacity of the state to provide low-cost housing in urban areas through housing project and self-build methods proved limited. They produced a minimal number of housing units in reference to rapidly growing need, and exacerbated the housing situation through the continued eradication of slums and squatter settlements. In addition, both forms of

housing were too expensive for the vast majority of the population, but in fact tended to benefit the growing number of middle classes (Jenkins et al., 2007).

2. Materials and Methodology

The Methodology adopted to write this research paper was collecting the secondary data available in form of literature, published articles and study of the existing policies on affordable housing for migrants. After collecting the secondary data, than analyze existing policy framework in context with existing problem, identify policy limitations and put the conclusion on the subject.

2.1. Secondary data & analysis

2.1.1. Literature review

Migrants and their Housing Options
In India, there are three sorts of rural-urban migrants: (i) long-term or permanent migrants with the intention of settling down in the urban areas, many getting into regular employment but keeping strong links with the native village/town.

(ii) Seasonal migrants, defined as those who stay in the urban areas for more than 60 days in a year but returning back for some period, mainly returning back during monsoon and going to cities to tide over lean agricultural seasons.

(iii) Migrants tied to the employers, who move from one place of employment to other, and about who no estimates are available. Almost all rural urban migrants in India would like to settle down in the cities if possible.

Three categories of migrants in urban India, discussed above, face different types of challenges. The permanent migrants, those who eventually settle down in the urban areas, enter the urban labor market at the lower end as temporary workers, eventually working their way up into the system through improving their employment situation and through that the housing. Many a permanent migrants come to the urban areas as single male migrants, at young age, and then call their families, once they are reasonably financially, socially and shelter-wise secure. This process is incremental, at the initiative of the migrants themselves in general. Migrants from some states, in particular from Uttar Pradesh and Bihar, do not settle down and would like to return back to their native villages and hence do not bring their spouse or family to the cities. The chances of most migrants returning back to their native villages is rare except under specific circumstances, such as urban violence emanating from communal polity and regional chauvinism and also slum demolition (Mahadevia & Narayanan, Shanghaing Mumbai - Politics, 2008).

The migrants when they first come to the city, squat on a public land or stay on rental basis in some existing settlement or stay with a friend/family member paying some rent to them. They move to then purchasing a plot of land in an informal settlement. There is no regular legal instrument of such purchase. They would erect a short lived roof over temporary walls. And then on, as and when the money is available, they would carry out incremental improvements: walls constructed of temporary materials are made permanent; temporary roofs are made permanent and so on. The process of integration in the urban economy and system is incremental and depends on the macro economic factors and public policy. If the policy supports their shelter security, their integration is faster through first increase in shelter security, improvement in living conditions, improvement in education and then improvement in employment and incomes, which then feeds back into shelter improvement (Mahadevia, 2012).

The shelter upgrading priorities in low income settlements are:-

1. Repairing a leaking roof.
2. Changing walls from mud wall to brick walls with cement mortar.
3. Making tiling floors.
4. Connecting to water supply.
5. Building individual toilets.
6. Connecting to electricity supply.
7. Extending the house.
8. Buying a new house or hut.

The benefits of each of these improvements are:-

1. A water connection saves time.
2. Roof repairing saves or protects the quality of goods, especially for home-based producers.
3. Electricity facilitates longer working hours, which in turn increases productivity and thus income.
4. Clean drinking water reduces illness and saves expense on healthcare and by that makes income available for other purposes such as education, income-generation, buying durable assets, etc.
5. Tiled floors also improve productivity for home-based workers.
6. Brick walls with cement mortar save recurring expenses of repairing walls after intense rains or flooding.
7. House extension is useful for expanding home-based production activities, renting out for earning additional income and keeping the extended family together.

There are no separate studies to document/analyze living conditions of the migrant workers in urban India. But, there are large numbers of them documenting life and living of slum dwellers. But, it might be worthwhile describing the conditions of living in slums from the national level survey of housing carried out in 2002. This National Sample Survey (NSS) gives the following description of living conditions in slums in India (national sample survey organization, 2004):-

A slum was a compact area with a collection of poorly built tenements, mostly of temporary nature, crowded together usually with inadequate sanitary and drinking water facilities in unhygienic conditions.

1. 67 per cent of the dwelling units were permanent in nature and the rest were semi-permanent or temporary structures.
2. Only 20 per cent of dwelling units during a slum had a plinth area of quite 50 Sqm.
3. Per capita floor area available within the slums was 4.6 Sqm.
4. 66 per cent of the slum dwellers built their own house and could be classified as illegal as far as the urban laws are concerned.
5. 15 per cent dwelling units in urban slums had all the three facilities, drinking water, electricity for lighting, and a toilet and 11 per cent had none of these facilities. For other types of dwelling units, these figures were 63 per cent (for all facilities) and 4 per cent (for no facilities).
6. Only 40 per cent of the slum households had water supply access within their house, when this figure for all other households was 74 per cent.
7. 32 per cent households in slums did not have access to any toilet facility, and this figure for all other households was 16 percent.

There are micro studies of living and dealing conditions of the recent or temporary migrants. A study of the migrants in the destination area indicates that the migrants work long hours and often live in accommodation provided by the employer. But, because of the same reason, it is difficult to contact the migrant workers in their destination area for organizing them for anything. In a sense, these workers are completely disenfranchised. Further, A DISHA (2002: 45) study also states the same: (MoHUPA Report, 2011) (Census, 2011)

In general, housing conditions of the migrants in India is closely related to the type of migrants these are. The long-term migrants like better to follow the trail of incremental housing, as described above. But, some of them employed in manufacturing may also get employee housing. Employee housing in the manufacturing depends on whether the industry is in the organized or unorganized sector. Organized sector manufacturing is generally large-scale manufacturing and employee housing here could vary between semi-permanent to permanent type with adequate basic facilities. But, employee housing in unorganized manufacturing sector is like a slum devoid of adequate basic facilities. The disadvantage of employee housing in the unorganized sector is that the workers may be under the control of the employers and they may lose bargaining power given that they have no choice but to live on the premises of the employers.

The latter type of employee housing also found in the construction sector. But, given the nature of construction sector, this is not permanent arrangement. There are also construction workers who are permanently living in the cities and they tend to live in incremental housing. In fact, the construction workers put in their sweat equity in their housing. Lastly, some regions of India send only male migrants to the cities to work and they tend to live in shared rental room for long years. They do not invest in housing in urban areas and all the savings are remitted back to the rural areas for consumption in rural areas as well improvement in housing conditions in the rural areas.

Defining Affordable Housing

Before framing a reasonable housing policy, it's vital to delineate the contours of this downside by process the term affordable housing. Process AH is additionally vital to create targeted policies geared toward creating funding a lot of accessible, providing rate subsidies, or favorable terms on par with infrastructure funding.

Internationally, housing affordability is outlined in multiple ways that. One among the foremost unremarkably accepted definitions of affordability refers to housing affordability that is taken as a live of expenditure on housing to financial gain of the unit. this is often conjointly accepted by the Indian Government, that states Affordable housing refers to any housing that meets some type of affordability criterion, which may be financial gain level of the family, size of the dwelling unit or affordability in terms of EMI size or magnitude relation of house worth to annual income. The Ministry of Housing and concrete poorness Alleviation (MoHUPA) in its 2011 report takes note of each financial gain and size criteria to outline the conception. Multiple studies within the Indian context have conjointly prompt different metrics of affordability.

Housing affordability may be a multi-faceted live, and while affordability is often outlined victimization the expenditure technique, there are alternative views to affordability moreover, as mentioned within the next sections.

Demand for Affordable Housing for migrants in India

The demand drivers for AH in India are many. 1st is that the progressive urbanization, going hand in hand with a growing urban population, that accrued from 109 million in 1971 to 377 million in 2011, and is projected to grow to 600 million by 2030. The consequence of the growing concentration of individuals in urban areas is felt in land and housing shortages and engorged transit, besides the strain on basic amenities like water, power, and respiratory organ area. The Ministry of Housing calculable a housing shortage of eighteen.78million homes throughout the twelfth arrange amount, with ninety nine percent in the economically weaker and lower financial gain teams.

Slums and informal tenements square measure calculable at sixty five million as per Census 2011. Second, aboard the expansion of the urban population, rising incomes have light-emitting diode to the growth of the center class. This has light-emitting diode to a spike in demand for housing that's affordable however includes basic amenities. (CREDAI, 2013) Housing is that the largest element of the financial likewise because the construction sector (High Level Task Force on reasonable Housing for All). A thrust on AH won't solely result in higher quality of life, but conjointly considerably give a lift to the economy of the country.

2.1.2. Existing norms and policy framework

Housing Policies and Institutional Setting

India does not have a formal policies for controlling migration to cities as any Indian citizen, whether a rural or an urban resident is free to migrate to any part of the country as many times as s/he wants to and access subsidized urban services. But, in reality, access to subsidized urban services is institutionalized and controlled through a set of identity documents namely:-

1. A ration card-a Below Poverty Line (BPL) card or an Above Poverty Line (APL) card, which has the permanent address of the person/household.
2. An election card also called a Voter's Identity (ID) Card issued to all those above age of 18 for the purpose of voting in elections held for the three tiers of government.
3. An electric connection and an electric bill.
4. In urban areas, an ID card issued by the urban local government for those living in slums, based on a specific cut-off date.
5. In urban area a property tax payment receipts.
6. A letter of identity issued by the local elected representative. In other words, urban citizenship definition is fluid and negotiable, through electoral clientelism, organizing, and contestations. On having negotiated the first foothold in the urban settings, with the lowest entitlements of urban citizenship, the household climbs up the ladder of urban hierarchy.

In shelter context it means incremental housing in India. It begins with gaining access to rental housing in an established low income settlement or squatting on a piece of land, mainly public land, then negotiate collectively to get name registered in the urban voting list through getting an urban patron, and then on a gradual and patient march up the ladder to gain full citizenship through possessing a few of the above mentioned documents.

In India, there has not been much of policy discussion on the shelter security of the low-income migrants but this issue is subsumed under the discussion on shelter security for the urban poor. Many draft national housing policies have been framed in the past in India but the most recent one, the National Urban Housing and Habitat Policy (NUHHP, 2007) has been accepted by the national government and the state governments have been asked to make their own policies. The NUHHP, 2007, has nothing specific for the migrant workers, except that there is discussion on increasing supply of rental housing for them. There is mention of temporary rest accommodation with appropriate toilet facilities on the construction sites, to be provided by the construction companies and the public authorities. There is also mention of need for employer housing. For each of these suggestions some actionable agenda has been suggested. In general, housing for the low income recent migrants has been left open. (JNNURM, 2005) The NUHHP, 2007 itself is a market driven policy and there are questions as to whether it is going to serve the purpose of shelter security of the urban poor in general and specific segment such as the recent migrants among them.

Two large national housing programs, Basic Services for the Urban Poor (BSUP) under the largest national level urban development program called Jawaharlal Nehru National Urban Renewal Mission (JNNURM) launched in 2005 December and Rajiv Awas Yojana (RAY), a slum redevelopment program and affordable housing program, launched in 2009, are expected to increase housing supply for low-income households through private sector participation. There is no mention of the special provisions for the low-income recent migrants and no schemes to fund their housing.

Instead of targeting the recent low-income migrants, the housing program, which are generally subsidized program, for the urban poor or the slum dwellers are for eligible beneficiaries, who are identified based on the above mentioned documents. In India,

the poor migrants and not the wealthier migrants, face discrimination on the grounds of regional and language identity; the developed states discriminating against the migrants from the poorer states. A regional chauvinism wave and ensuing violence then hits out at the low-income population from other states. The contemporary political history of India is full of these instances, and the divides flare up just before the local elections. Thus, all the states, in particular the migrant receiving states, which are also economically advanced states, have anti-migrant bias in their slum policies. The institutional and policy environment in India bias against the low-income migrants in their cities. Migrants are left at the mercy of the market.

3. Results

Employer housing in case of construction workers and factory workers had a significant impact on the migrants in India, lowering their expenditures on housing and transport. This ensured that the workers saved and repatriated the savings back home for the use of family left behind. Thus, employer provided housing has great benefits for the low income migrants in spite of its drawback of taking away the migrant workers freedom and choices with regards to family life, employment and housing. On the other hand, the self-help housing option possible for the migrants is a good intermediate solution that gives the migrants freedom to an extent as well as choice with regards to family life, employment and housing.

Migrants in Indian cities have strong intention of staying back, except migrants from some states of origin, in India, employer housing is negligible and large proportion of migrants prefer ownership housing, albeit in the informal sector. Probably, rapid economic growth might bring employer housing in India also. But, that would be only if the industrialization would be labor intensive, and generate demand for labor. Local governments do not consider housing as their main function and hence leave the task to state level agencies to deal with housing.

The housing policies in India have schemes related to slum development and hence there is an acknowledgement of existence of slums in Indian cities. India doesn't have any strong policy for facilitating or ensuring decent housing conditions for the migrant workers in a way that the migrants can enjoy choices in life. Availability of affordable housing and employment determines the fate of migrants in India's urban areas. Housing for the migrants has been tagged on to the overall urban housing policy and there is no specific policy for the migrants. If migrants can afford to buy, they can procure a house from the private housing market.

Policy makers should have more focused with regards to employer housing for certain segments of urban labor force. India have to go a long way with regards to ensuring a decent housing to the low-income migrant population in their cities, given that India would continue to urbanize rapidly in the coming decades.

Atmanirbhar Bharat - Rental Housing for Migrants

Recognizing the predicament and mass departure of incalculable specialists from urban communities during the COVID-19-injected lockdown, the FM divulged a swap conspire for the metropolitan poor under the PMAY - Affordable Rental Housing Complexes (ARHC). Due to abundant business openings in significant urban communities lion's share labor force moved to the urban communities in the pre-Covid-19 time. In any case, the shortfall of moderate rental lodging here prompted mass departure of those transients who had zero pay during the lockdown. Consequently, the govt. needed to change gear of their Housing for All activity and incorporate moderate rental lodging as a neighborhood of it.

Under the plan, the public authority subsidized lodging in metropolitan urban communities are being changed over into ARHC through the public-private organization (PPP) model and government lodging buildings lying empty will be changed over and leased twisted travelers at concessional rates. At the beginning, the Govt. plans to utilize approx. one lakh unused lodging units worked under the JNNURM and subsequently the Rajiv Awas Yojana (RAY) past government's metropolitan overhaul and lodging programs - to give rental lodging. The month to month rentals for homes under ARHCs are probably going to be fixed between INR 1,000 to INR 3,000.

Other than tending to the hardships of metropolitan travelers - a private or gathering of individuals/ groups of EWS/LIG classes it'll additionally help in satisfying the public authority's goal-oriented activity of Housing for All by 2022. ARHC will be executed through two models:

1. By using existing Government supported empty houses by changing over them into ARHCs under Public Private Partnership.
2. Development, Operation and Maintenance of ARHCs by Private/ Public Entities on their own empty land.

Individual or gatherings may book their necessity through government site (for example www.arhc.mohua.gov.in). Concessionaire or an element can likewise gridlock with different substances or associations and furthermore get transient

works or metropolitan poor through aggregators. The plan is consequently a work to connect the deficiency of staying units the nation over. Additionally, it'll add another resource class to be considered by developer. (Anuj Puri, 2020).

4. Discussion

Critical Issues in the Affordable Migrant Housing Sector:-

Scarcity of Land

The more population density, rapid urbanization, and not properly conceived regulations have resulted shortage in land parcels capable of development. This is exacerbated by excessive controls over central districts of cities and difficulties in land recycling, which results in a push toward the periphery. Land acquisition has been a thorny issue, giving rise to land mafias and illegal encroachments, and reducing availability of land at a reasonable price.

Scarcity of Marketable Land Parcels

Large tracts of centrally located urban land are owned by public entities like the railways, ports, and defense authorities. These square measure non-marketable pockets, and lend themselves to the proliferation of slums and squatter settlements because the authorities square measure usually unable to observe their holdings. Further, scattered and poorly planned settlements build it troublesome to supply land for mass housing. Property consumers take several factors aside from project quality and price into thought, like basic utilities, connectivity, infrastructure and then on. Thus, AH demands adequate supply of well-serviced land and this successively influences prices and willingness.

Titling issues

As of now, India lacks a strong system to guard land rights. There are two aspects to land title: first, a formal recognition of property rights by the state through a system of titles; and second, facilitation by the state, of efficient trade in rights, through a process of registration. Both of these elements exist in India, but in incomplete form. First, not all land transactions require registration, for instance land acquisition, court decrees, mortgages, agreements then on. Second, while Indian law requires compulsory registration of land sale, the registration authority isn't mandated to verify history or ownership; thus it's the transaction and not the title that is registered.

Rising Costs

Both land and construction prices have inflated, combined by value appreciation of construction materials and labor. Finance AH is affected as a result of different construction indices and incomes across the country. From the customer□s angle, getting finance is difficult notwithstanding the purchasers have regular incomes once they are used within the unorganized sector or lack financial gain proof as needed within the loan method.

Regulatory Constraints

Project sanctions will take many years, and wish to be cleared by as several as forty departments across the national and sub-national levels, together with the surroundings, fire, revenue and water departments, the traffic police and so on. The resultant time and dealings prices deter many entrepreneurs. Further, lack of clear and clear regulation aggravates things. As an example, building bye laws, rules for floor house index, and division and development plans of urban native bodies usually lack clarity and there are overlapping pointers.

5. Conclusion

In comparison to official urban residents, housing and living conditions of migrants are relatively poor. Better off migrants can only afford to rent a very small flat, whilst others have to share rooms. Urban villages provide low paid migrant workers with the first step toward affordable housing in large cities. For example city like Gurgaon growing at extraordinary pace, migrant housing conditions are no worse than those found in other fast growing cities. In general, urban villages in cities provide good locations for migrant workers. Because the city developed from a small border town, many villages occupy central areas inside the new city. This locational advantage enables migrants to live close to work and cuts down travel time and costs. Due to the shared cultural and professional background of rural migrants and the local village residents, the rental tenure is relatively safe and secure. Amenities in urban villages may not be as extensive as those in properly built new housing estates, but they are affordable.

Local rural residents provided affordable housing here to the large number of low-income migrants in □urban villages□ as rental accommodation with some basic, but modern, amenities. This approach has avoided the problems of slums in other developing countries. It differs from the public housing, aided self-build, self-helping, site and services/upgrading

and the UN/World Bank enabling and support policies reviewed in the second section. The approach resembles some of the ideas promoted by Turner (1976), e.g. with no government support, flexible in meeting the diverse needs of migrants, balanced by the demand and supply through the market, less emphasis on the design standard and being affordable to those with low incomes. (Wang, 2007)

However, this urban village approach is a different type of self-help with a unique partnership between local rural residents and migrants. Large-scale village rental housing development is a type of self-help initiated by local villagers (the landlords) in response to the loss of agricultural land and production resources. Migrants (the users) are their customers and tenants. The rent levels are determined by the demand from the market. This market approach is in line with the recent World Bank prescriptions. However, this housing provision itself is outside the formal urban housing market promoted and supported by the municipal government. Land access rights, property ownership, housing credits and finance systems, emphasized by international organizations, are irrelevant to most migrants living in urban villages. Urban planning is exercised on the public owned land in cities, while village land use is subject to a different type of control. This provides the villagers with some advantage in building their houses on their family plots. Indeed, city municipal corporations tried several times, unsuccessfully, to control the housing expansion in urban villages. The demand from the market was just too strong.

The positive contributions of urban villages during the particular stage of fast industrialization started to fade when the cities began restructuring and pursuing high-tech and finance-oriented development. The once dynamic informal housing market has gradually become a problem for urban planners and officials. Some refer to the urban villages as cancers of modern cities, with poor living environment and high crime rates. There is a tendency for large-scale urban village redevelopment in order to improve the modern image of the city. Redevelopment plans are often drawn up without consulting the migrants living in these villages. Such action should be taken very carefully to avoid the mistakes other developing countries have made and that Turner (Turner, 1976,1988) has criticized. On the surface the dramatic redevelopment aims to improve migrant living areas; in reality it results in the destruction of affordable housing in good locations. Poor migrants will be pushed further away into marginal locations, and large-scale urban village redevelopment will lead to more serious social and spatial division. Gradual improvements, upgrading, rent regulation and other softer policies may be more beneficial and sustainable.

Report on Rental Housing, which stated that ... politicians should change their attitudes regarding current housing policies, and should try to do something practical to help those members of their society who lives in a rental housing, as well as the ones who can provide those dwellings (The Challenge of Slums: Global Report on Human Settlements 2003, 2004).

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Acceptance Letter

Ref. No.: MTHM-01-02
Date: 01-11-2022

To,
Dear Dr. Yogendr Bahuguna

The book chapter titled **"Recent Pharmacognosy & Phytochemistry of *Eleusine coracana*: An Ethnomedicine"** is very well written and has been accepted for publication in edited book titled **"Modern Trends in Herbal Medicine (Volume - 1)"**.

Yours Sincerely,

Akhil Gupta

AkiNik Publications Director

Akhil Gupta
Manager
AkiNik Publications

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Acceptance Letter

Ref. No.: RTHM-02-02
Date: 01-11-2022

To,
Dear Dr. Yogendr Bahuguna

The book chapter titled **"Pharmacognosy & Phytochemistry of Jasminum Auriculatum: An Ethnomedicine"** is very well written and has been accepted for publication in edited book titled **"Recent Trends in Herbal Medicine (Volume - 2)"**.

Yours Sincerely,

Akhil Gupta

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Pollution from Building Construction

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Abstract

It is common knowledge that development of any city strengthens the economic infrastructure of the country, across all regions. Among the various urban sectors, the construction sector gives maximum employment with a varied job diversity.

Air pollution from the construction sector is responsible for increasing ambient air pollution. As per a report from Delhi Pollution Control Committee (DPCC), the pollution and dust emanating from the construction sector is 30 percent of the air pollution that is generated from the construction sectors. Due to the proximity of construction sites and the materials used, construction sector can generate domestic pollution.

This includes soil, water, air and noise pollution. In addition, construction can also reveal pollution on the existing subsurface due to which the construction workers are also exposed to pollution. The paper explores the various implications of the construction sector in relation to environmental conditions, including air, water, soil, and noise pollution, as well as suggestions and measures to prevent and combat pollution from the construction sector.

1. Introduction

Due to proximity to construction sites and substance used in building, construction sites can generate domestic pollution. This includes soil, air, water, and noise pollution. ... In addition to noise pollution and poor air quality and ground water are the most affected pollution. You can experience by visiting or staying at a construction site yourself.

Construction sites that harm the environment globally, and also affect the local community. In fact, construction can lead to soil erosion and problems with water quality and flow.

Additionally may be pollute the existing subsurface of construction work. In such a situation, the construction work is stopped and the work needs to be improved. Thus construction work poses construction pollution problems affecting the site owners nearby. In addition workers engaged in construction (especially in the past) may have been exposed to pollution. So, let's discuss these aspects in more detail below.

2. Source of Pollution

- Construction dust: Construction and demolition operations contribute to windblown dust problems—sometimes called fugitive dust—onto nearby roadways which can remain in the air for days or even weeks.

- Significant source of PM 2.5 on construction sites comes from the diesel engine exhausts of diesel generators, vehicles and heavy equipment's.

- Harmful and dangerous vapors from thinners, oils, glues, treated woods, paints, plastics, cleaners and other many more hazardous chemicals that are widely and maximum used on building construction sites, these are also contribute to air pollution

- C&D Waste: The waste comprising of building materials, debris and rubble resulting from construction, re-modeling, repair and demolition of any civil structure. Construction industry in India generates about 11-12 million tons of waste annually.

3. Air Pollution

Pollution during construction work makes the air polluted. In addition to noise, poor air quality is the most effective pollution effect you can experience from a building site. This means that air hauled pollution, including contaminated particles and inconstant compounds, is spreading to the surrounding neighborhood (mostly from the air) (the main wind direction will affect the area most affected by air pollution around a construction site). Air-circulating components can travel large distances in a short period of time. The main building pollutants circulating around the air include particles such as PM10 (contaminated material with a diameter of less than 10 mm), PAH particulate matter, VOC (volatile organic compound), mica, carbon monoxide, carbon dioxide, and nitrogen oxide.

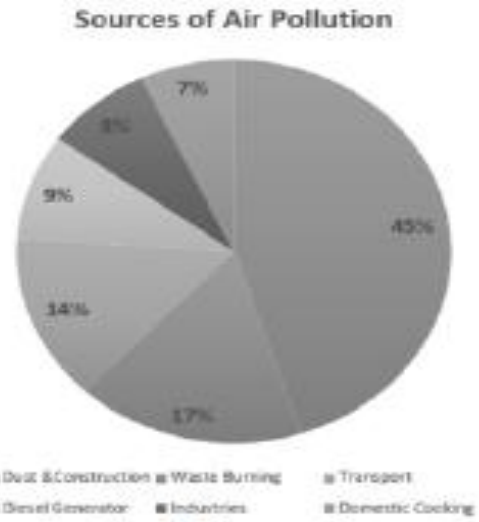


Figure 1: (Air Pollution Chart-i)

Figure 2: (Air Pollution-ii)

3.1 PM-10

These large quantities of construction, such as cement, concrete, silica, paint and wood, at very large levels, are collectively classified as PM10. (PM10 is particulate matter less than or equal to 10 micrometers in diameter that is invisible to the naked eye) Diesel engine emitting smoke from plants and other vehicles on the construction site is a major contributor to the emitted PM10. Diesel smoke in particular pollutes the atmosphere, referred to as diesel particulate matter (DPM), and the smoke emanating from an engine or machine contains sulfates and silicates that add pollutants to the atmosphere.

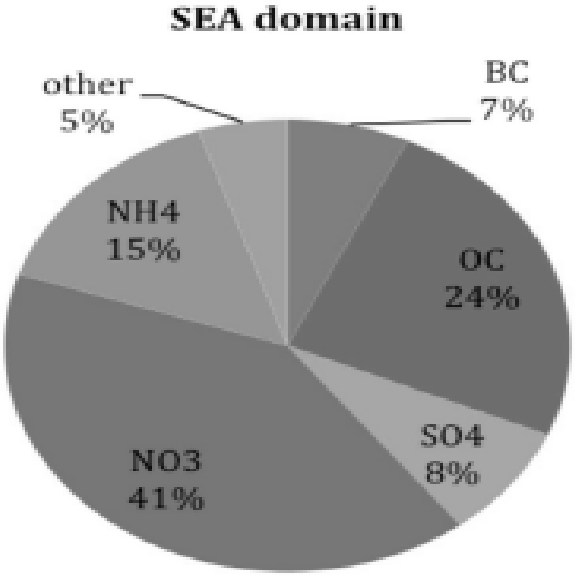
A research in PM10 has shown that people living on nearby building construction sites can understand deep in the lungs, which is due to polluted air. Damage to engineers and workers who regularly work on building construction sites, resulting in an high risk of physical and health complications. Many health problems arise due to air pollution:

- Difficulties in breathing,
- Cough and wheezing.
- Respiratory disease and cardiac arrest.
- Lung cancer.
- Strokes.
- Acuteness of Asthma.

It is believed that 56% of men effected with cancer from building construction industry are responsible. This includes diseases such as mesothelioma, this type of cancer that develops on the lining of the lungs and chest and the only cause of which is asbestos exposure. Dust and gas fibers, such as silica and asbestos, as well as continuous exposure to fumes and gases emitted by vehicles and machinery used on construction sites, cause lung cancer especially among workers engaged in construction. Indeed, workers working in the building construction industry are

potentially exposed to between 16 and 20 carcinogens as a result of common work activities. People living around building construction sites also have the effects of air pollution that they may experience.

Site workers have to work on foot on site who will not be so close to pollutants as dirty air can experience the effects of poor air quality long after the project is completed. PM10 and other air pollutants are spread by air to the surrounding area and can then settle down. Residents living nearby often inhale inadvertently through polluted air and may then develop a cough or shortness of breath as a short-term result.



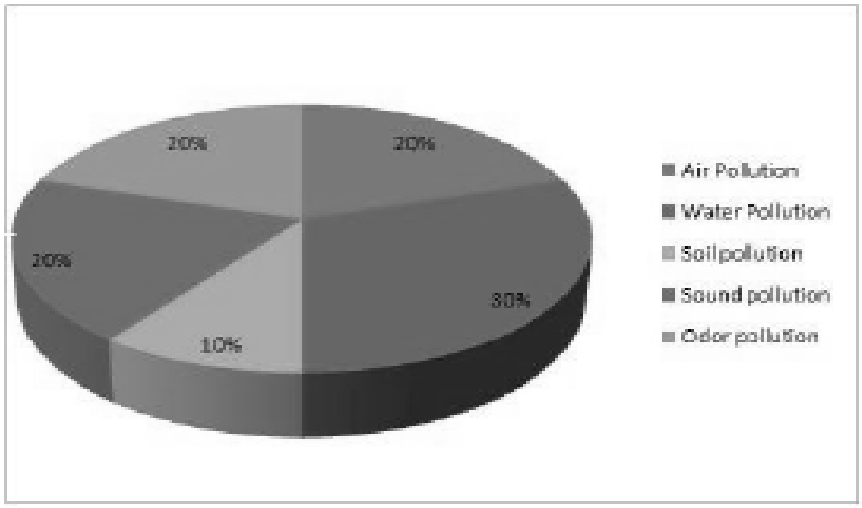


Figure 3: (Environmental Pollution Chart-1) Figure 4 (Environmental Pollution Chart)

Types construction sites are responsible for 14.6% PM 2.5 (particulate matter which is 2.50 micrometers in diameter) and 8.5% PM10 emissions. Most of it comes from using generators and construction machinery running on diesel, representing 1.2% of dust from construction sites activities such as excavation, moving vehicle on site and demolition. Plants, hedge and animals both are also effected and struggle to life has to struggle to flourish as a result of pollution, causing loss of biodiversity, farming and affecting the food chain.

4. Water Pollution

The surface water runoff and the groundwater close to a construction site become polluted with various materials used in the construction sites work. The following construction sites contaminants can be pollute the water: VOCs, Oils, paints, glues, diesel, other toxic materials and chemicals, and cement. The immediate effect is creating turbidity in the runoff water and affected surface groundwater (since some of the runoff water may infiltrate in the subsurface reaching the groundwater. In fact, residential area are effected by both surface and ground water contamination.

Domestic animals and pets may drink contaminated water and soil may become contaminated too. Additionally, the groundwater, it may affect the pollution in the following ways: through direct consumption if you use water from a property well, and indirectly by affecting the quality is used indoor air (vapor intrusion of the volatile contaminants from water). Overall, water pollution from construction sites is underestimated and has potential to generate severe environmental problems. Construction activities often involve the use of toxic chemicals and pollutants that can end up in the water table if not managed well.

Common construction sources that contribute to air pollution include:

4.1 Diesel and oil.
4.2 Cement.
4.3 Glues.
4.4 Paints.
4.5 Other toxic chemicals.
4.6 All of these contaminants have the potential to end up in water as a result of runoff from construction work. Pollutants can enter the water system in a number of ways, such as through drains, seeping into soil, or runoff directly into rivers or lakes.

4.7 Impact of water pollution - Pollutants from construction sites can soak into the groundwater. It is to treat much harder to treat groundwater than it is surface water and so, as a source of human drinking water, there is a risk that some chemicals may end up being consumed. Chemical pollutants such as arsenic and mercury can cause serious health issues, including cancer, if ingested through contaminated water supplies.

4.8 Environmental -- Water contaminated by pollutants produced by the construction industry poses a serious danger to the Environment. Once pollution has entered the water system, it can harm or kill fish and animals living in it or drinking from it. This can disrupt the entire ecosystem of animals, plants, bacteria and fungi, causing many species to suffer as a result.

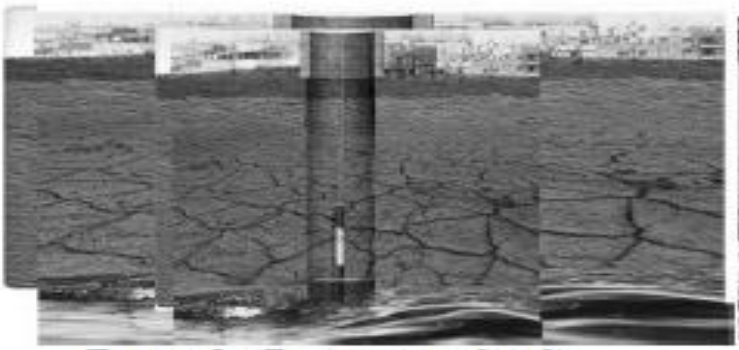


Figure 5: (Down water level)

Figure 6: (Water Pollution)

5. Soil / Dust Pollution

Soil at and around a construction site may become contaminated due to air transport followed by deposition of construction contaminants (listed at air pollution) as well as water runoff of construction contaminants (as listed for water pollution). Soil may constitute a sink for pollutants and some of those may accumulate in soil and persist over longer periods of time.

5.1 Dust Pollution

Dust Particles, also known as particle pollution (or PM), are made up of a number of components Including nitrates and sulfates, organic chemicals, metals and soil or dust particles. Some particles such as dust, dirt, soot or smoke, are large or dark enough to be seen by the naked eye.

5.2 Airborne dust functions in a manner similar to the greenhouse effect: it absorbs and scatters solar radiation entering Earth's atmosphere, reducing the amount reaching the surface, and absorbs long-wave radiation bouncing back up from the surface, re-emitting it in all directions.

Figure 7: (Excavated Earth Covering)

Figure 8: (Truck Sprinkler System)

6. Noise Pollution

Noise is usually associated with construction work although modern preventive measures may substantially reduce the amount of noise (in the neighboring community). Noise may adversely affect health, including effects such as stress, sleep disturbance, high blood pressure and even also consider the effects of noise pollution on the construction workers themselves. Additionally, if employees use equipment that is particularly loud, they may even Experience hearing loss.

6.1 Construction Pollution

Construction pollution involves the following main types of construction work:

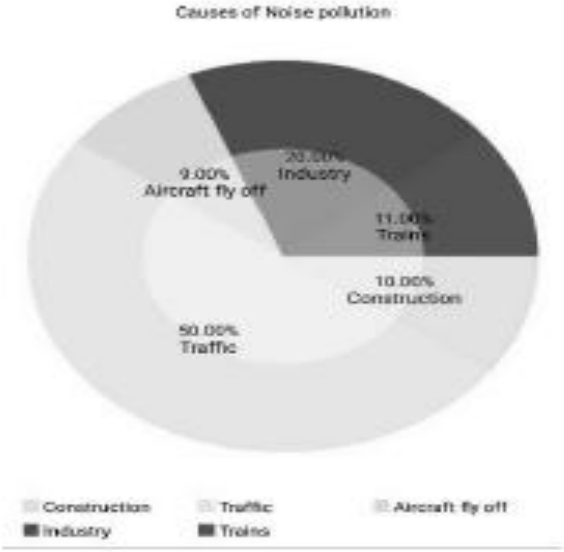


Figure 9

Figure 10 (Noise Pollution)
(Noise & Dust Pollution by Construction Machinery)

i- Building construction pollution - represents the generation of construction contamination at sites where buildings are constructed which may involve also a demolition phase (if the construction site has an existing building)

ii- Road construction pollution - represents the generation of construction contamination at sites where roads are built Construction Pollution Prevention and Cost Recovery

7. Impact of Construction Pollution

i- Personal damage. From the perspective of the public, the best prevention is to spend as little time as possible outside (e.g., in your yard or balcony) close to a construction site during operation time. Additionally, having a rich vegetation around houses (and between them and the construction site) will act as a natural filter for the generated pollution, reducing the amount of pollution one may come in contact with. So, planting in yards or even potted plants in a balcony can help. The greener the better. Also, regular spraying of water around the home will reduce the amount of dust and exposure through inhalation, although the soil and water pollution may increase (but these are affecting less directly than air!).

ii- Property damage. From the perspective of the construction site owner / developer, you may be faced with building on polluted land (pollution could be discovered during construction excavation work). To prevent such situation, you should order a full land quality survey before starting any construction work. However, if this is not possible and you are faced with building on polluted land, you may be able to recover remediation costs from

iii- the original polluters. In this situation, specialized forensic investigations and legal advice (using top specialized legal firms) are recommended.

Figure 11: (Noise from Construction Site)

8. Conclusions

I believe that proper enforcement, incentives and education, strong citizen participation and strict adherence to national green building regulations can significantly reduce pollution from construction. It is our duty to strictly follow it while constructing buildings and saving lives. We as individuals and the government can transform the development of construction and infrastructure into a non-polluting source.

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Solid Waste Management In Smart Cities

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Abstract

Solid waste management is a biggest threat faced by the developed, under developed and developing countries like India. Day by day solid waste generation levels are increasing significantly because of population explosion, lifestyle habits, urbanization etc. Thus growing number of cities and rapid growth in population demands higher efficiency in terms of resources to keep their cities clean. Waste management is a fundamental pillar of a smart city, within the public services.

The aim of this article is to evaluate the role of solid waste management in the development of smart cities. The waste management concept followed by smart cities is to curtail the large amount of waste production by creating awareness amongst people to follow the 4 R's rule- rethink, reduce, reuse and recycle. This will help in waste production curtailment at the source. Management of urban waste is composed of different stages from collection, transportation, treatment and finally disposal. Out of these the collection of waste is the key factor to achieve efficient waste management system because of two reasons- cost and logistic development. The smart city concept integrates information and communication technology and various physical devices connected to the IOT network to optimize the efficiency of city operations and services and connect to the citizens.

ICT is used to enhance quality performance and interactivity of urban services to reduce costs and resource consumption and to increase contact between citizens and government. Smart city Technology has evolved together with the help of the Internet of Things (IOT) and Wireless Sensor Networks (WSN). The current state of Technology in the field of smart waste management involves the use of sensors that measure the fill level of trash bin.

The paper is based on the case studies of two smart cities of India and abroad. At the end in the discussion the comparisons of waste management is done to derive how waste can be managed efficiently.

Keywords: *Solid waste management, Smart cities, ICT, Internet of Things (IOT),*

1. Introduction

Around the globe, waste generation rates are increasing rapidly. In 2016, 2.01 billion tonnes of solid waste was generated all over the world, amounting to 0.74 kilograms waste per person per day. (Silpa Kaza, 2018)

The majority of waste is discarded or disposed of in landfills around the world. About 37% of waste is disposed of in a landfill, with 8% of that going to sanitary landfills with landfill gas collection systems. Around 31% of waste is dumped openly, while by recycling and composting 19% is recovered and for final disposal, 11% is incinerated. As compared to 2 % in high income countries, 93% of waste in low-income countries is disposed in dumps. The amount of waste dumped in the landfill sites in the upper middle-income countries and high income countries is 54% and 39% respectively. (Silpa Kaza, 2018) The world's oceans are contaminated, clogged, flooded because of the poor management of waste.

High-income countries tend to produce fewer food and green waste, which accounts for 32 percent of total waste, and 51 percent of total dry waste that can be recycled, such as plastic, paper, cardboard, metal, glass etc. Food and green waste produced in middle-income countries is 53 percent and low-income countries is 56 percent respectively, with the proportion of organic waste rising as economic development levels fall. (Silpa Kaza, 2018)

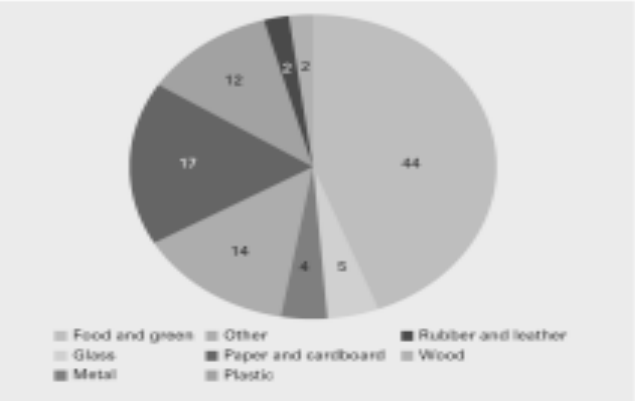

Figure 1: Waste composition in world (Silpa Kaza, 2018)

India's 1.33 billion population is the second highest in the world, which contributes to 17.86 % of the total world's population. Urban population has a share of 32.8 percent of country's total population. According to projections, by 2050 nearly half of the total population will live in urban areas. Rapid industrialization and population growth have resulted in migration of people from villages to towns,

resulting in the generation of thousands of tonnes of MSW every day. Other factors that contribute to waste generation include changing lifestyles, eating patterns, changing living standards, rapid economic growth, urbanization, and the rising tourism industry. Thus significant rise in waste management is a serious issue as it not only affects the aesthetic aspect of the country but also has severe environmental impact. (Praneetha Surapaneni, 2018)

According to the Union Ministry of State for Environment, Forests and Climate Change, the country generates 62 million tonnes of waste annually, with 5.6 million tonnes of plastic waste, 0.17 million tonnes of biomedical waste, 7.9 million tonnes of hazardous waste, and 15 lakh tonnes of e-waste. 75-80 percent of municipal waste is collected, with the remaining 22-28 percent being processed and handled. (Government notifies new solid waste management rules, 2016).

Waste accumulation is caused by insufficient storage and transportation. Due to lack of adequate facilities to process and dispose of the largest amount of MSW produced daily in metropolitan cities, MSW management is in a critical phase. In general, urban solid waste is disposed of in low-lying areas with no safeguards or organizational controls in place. Some waste may rot eventually, but not all and it can smell or produce explosive methane gas, which contributes to the greenhouse effect. Nearly 5% global emissions took place because of solid waste in 2016. (Silpa Kaza, 2018) Landfills that aren't well-managed can attract vermin and litter. As a result, MSWM is the most serious environmental problem. Reduced waste has a lower environmental impact, uses less water and energy, and saves money. SWM is in control of activation.

Reduced waste has a lower environmental impact and thus saves money. SWM encompasses all aspects of solid waste processing, storage, collection, transportation, treatment, and disposal. However, only four operations, namely processing, collection, transportation, and waste disposal are carried out in the current scenario. Municipal solid waste disposal necessitates proper facilities, maintenance and upgrading.

There are eight different types of urban solid waste:

1. Materials that can be recycled which include glass, bottles, cans, paper, metals, and plastic etc.
2. Composite wastes such as Tetra packs and waste plastics from toys, clothing, and other items.
3. Biodegradable wastes include paper (which can also be recycled), food and kitchen waste, and green waste (flowers, vegetables, fruits, leaves)
4. Inert waste (dirt, rocks, etc.)
5. Light bulbs, fluorescent tubes, washing machines, TVs, monitors, screens, alarm clocks, watches, and other electrical and electronic waste.
6. Hazardous waste which includes paints, additives, batteries, spray cans, fertilizers, and pesticide containers, among other things.
7. Toxic waste such as pesticides, herbicides, and fungicides, among other things
8. Biomedical waste (expired pharmaceuticals, human body parts)

The smart cities mission is a welcome move that aims to boost economic growth and enhance people's quality of life by facilitating local development and leveraging technology to achieve smart outcomes for residents. One of the key challenges those cities face, particularly due to population growth is improving the urban waste collection service and in general achieving a more effective waste management.

As a result, smart waste management is an essential aspect of smart cities. Fortunately, the new digital era offers tremendous opportunities for smart waste management, allowing us to implement sustainable policies in this crucial area and create an environment friendly city concept. As a result, smart waste management is an essential aspect of smart cities.

The smart city concept combines information and communication technology with a variety of physical devices linked to the Internet of Things (IoT) network to improve the city operations efficiency and services while also connecting to people.

2. Methodology

The research work is carried out from the details published in different journals, newspapers, websites, articles, reports and videos related to this topic. One foreign city and two Indian cities are reviewed to analyze the best practices to deal with the challenging solid waste management aspect of the smart cities.

3. Case Studies

Case studies of three different cities are carried out to understand the various aspects of solid waste management of smart cities. Various aspects of solid waste management are the composition of solid waste, waste collection mechanism, transportation and finally management of solid waste i.e treatment and disposal of waste.

A. Case Study - Indore

It is ranked number one smart city of India. As the city's economy is growing at a very fast pace and due to population explosion the city generates tons of municipal solid waste on daily basis. Indore generates almost 1.2MT of garbage daily which comes either from households, industries or commercial establishments.

To collect the garbage from every nook and corner, door to door collection service was started in January 2016 and to achieve 100% it took almost a year. It is the collective effort of citizens and authorities who played a significant role in making the city clean. The municipal corporation has played a vital role in the educating citizens to segregate the waste at source thereby considerably reducing the waste dumped in open areas. (Solid waste management- smart city Indore)

Composition

The major composition of MSW in Indore is biodegradable waste, Industrial waste, commercial and garbage waste, institutional waste, constructional and demolition waste.

Waste composition is:

Wet or organic waste	-	58.25%
Dry waste	-	41.75%
Hazardous waste	-	0.5%

To meet this challenging task of achieving 100% door to door collection identification was carried out to figure out the population and waste generation at each ward. Indore city has 85 wards and 19 zones for the waste management. For the optimization of the collection process a spatial geodatabase was constructed, in a standard commercial GIS environment (ArcGIS). This ensures compatibility with available data from municipality and many network routes. A detailed route plan was choked out to Cover all the wards of city.

Partitioned vehicles known as tippers along with staff were deployed on a specific route plan in order to meet the waste collection demand. Wet, dry and domestic hazardous waste was collected in these three separate collection bins. The vehicular route is monitored by the monitoring cell by a GPS enabled tracking system.

In Indore every smart bin is equipped with ultrasonic sensors which measure the fill up levels of each dustbin. Each container has three levels, a camera is placed at each can for capturing the images and the data is viewed, saved and sent on the other network using internet. The waste collected by tippers is transported to garbage transfer stations for secondary collection. Every time the garbage crosses a level the sensor receives the data of filled level which is further sent to garbage analyzer as instant message using GSM module. Out of the total waste generation of 1115 MTPD, wet waste is approx 650 MTPD and dry waste is approx 465 MTPD respectively. (Solid waste management- smart city Indore)

Gasification, Incineration, composting, recycling etc processes are followed to treat the municipal waste. The untreated waste is disposed off in a landfill site of Devgurada which is 15 km away from the Indore's city centre. It is the oldest and economical method to treat the solid waste. Although the gases like methane produced from waste is a big threat to the environment. Thus, for the treatment of MSW, the Indore Municipal Corporation (IMC) primarily employs landfill and composting methods. Since it is a renewable energy source for electricity production, IMC also uses various treatments for MSW treatment, such as gasification technology. (Agrawal, 2017)

B. Case Study - Kochi

Kochi is the industrial and commercial capital of Kerala state. The population of Kochi is 12, 52,000 spread over an area of 330 sq.km. (Chedambath). Due to migration there is a rapid surge in the solid waste generation in the city. Waste generation of the city amounts to 180 to 250 MTPD. River Kadambrayar and surrounding water bodies in the city are getting polluted and affecting the water life considerably. (Hridya K K1, 2016)

The most common practice of dealing waste management in majority of Indian cities is dumping in open areas, which is practically not feasible in congested and populated city like Kochi. Only for the dumping of waste Kochi cannot spare its valuable land. Kochi Corporation's health department and Engineering department bears the responsibility of cities solid waste management. Health department bears the collection, transportation and disposal responsibility whereas planning, choking of programs, procurement of vehicles, equipment etc. are borne by the Engineering department. (Hridya K K1, 2016)

Kochi has 74 wards for governance and administrative purpose. (Administration of Kochi) Household waste is collected by Kudamba Sree workers on daily basis. Tippers, auto rickshaws, handcarts are used for waste collection. 75% of waste is collected through door to door collection and is finally loaded to larger tipper and compactor trucks to transport them for treatment 20 km away from the city at Brahmapuram solid waste treatment plant. (Project – IUC: Sustainable and innovative cities and region)

Table 1: Quantity of MSW in the city

MSW Generation sources	Quantity
Domestic sources	134.70
Commercial establishments	32.99
Marriage and community halls	4.75
Hotel and Restaurants	29.90
Markets	20.39
Institutions / Schools, offices	14.75
Street sweepings	31.30
Hospitals (Non infectious)	4.22
Slaughter house	5.26
Construction and Demolition	17.00
Total	295.26
Per capita generation(g/day/head)	482.00

source: (Hridya K K1, 2016)

From the total waste generation of 305 TPD- 230 TPD is collected from door to door collection. Out of which 130 TPD is sent for processing and 100 TPD is dumped at the landfill site. Kochi Municipal Corporation (KMC) transports waste to the

Brahmapuram plant having an area of 110 acres, from waste collection points for processing and treatment, using 83 vehicles owned by the company as well as by the 500 handcarts. (Project – IUC: Sustainable and innovative cities and region)

Brahmapuram plant treats biodegradable waste only and plastic, sanitary along with other hazardous wastes are disposed off outside the plant which has resulted in environmental issues. On an average 220 tonnes and 72 tonnes biodegradable and non biodegradable waste respectively is received by the plant on daily basis. Although the plant is in dilapidated state, it treats organic waste using Inoculum bacteria by aerobic decomposition. Situated on the shores of Kadambrayar River, the plant affects the water life to a great extent as it contaminates the water bodies. The other drawback is the odour nuisance. Brahmapuram requires a new waste treatment unit as the available treatment facility is not sustainable. (Hridya K K1, 2016).

The waste management issue of the city can be resolved by adopting a solution comprising of the following four methods namely 4R's (Rethink, Reduce, Recycle and Reuse), Gasification, composting and land filling.

I Rethink- Before deciding to buy any product, think that no residue is left behind.

II Reduce- it helps in regulating the waste product e.g. instead of using polythene one can use paper /jute bag.

III Recycle- the leftover material is used as a raw material for other product after recycling. Like Plastic after shredding can be used for road construction or for brick manufacturing

IV Reuse- to use the products again after using once like cans, bottles etc, refill it again and reuse it.
The people of Kochi should be made aware of these 4R's to achieve maximum success following the example of Indore where the citizens have set an outstanding example of collaboration of public and Municipal Corporation .

Gasification -It is a preferred process as compared to the traditional combustion in which gas is achieved as a byproduct by converting solid or liquid waste material. Further the energy recovered is used for plant operation and will benefit Kochi Municipal Corporation economically. To prevent the accumulation of dioxins and a significant amount of Sulphur Oxide and Nitrogen Oxide, a low oxygen atmosphere is used.

Composting -By product fertilizer is achieved after decomposition of organic matter. At present this technology is practiced at the plant.

Landfill - The leftover waste after composting and gasification is dumped in the land fill areas. Its main aim is to isolate it from the surrounding environment. It is one of the most conventional methods.

Kochi city has witnessed consecutive floods in 2018 and 2019 because of global warming and solid waste is one of the factors contributing to it. Thus above methods are proposed to be adopted to resolve the waste management issues in Kochi. Public participation at a large scale is required to resolve the issues related to solid waste management.

C. Case Study – Singapore

Singapore is home to nearly 5.5 million people and spans over 700 square kilometres of area, which is mostly surrounded by water. The rising economy of Singapore has resulted in a rise in waste generation, with about 7.23 million tonnes of solid waste produced in 2019. (Five facts about unsustainable waste management in Singapore)

National Environment Agency administers the waste management in Singapore. The agency also recognizes the value of waste reuse and disposal due to land constraints. The NEA, which is in charge of waste management, sends the collected waste to be incinerated, with over 40% of it being incinerated. Incineration eliminates waste by up to 90%, allowing landfill space to be saved. (How will Singapore defuse a 16 year waste timebomb?)

As Singapore is a small Island only one landfill site is available so land filling is not preferred to a large extent. Priority is given to incineration and presently Singapore has four plants available for incineration. Dioxins produced due to excessive waste burning poses threat to environment. Modern incinerators in Singapore is provided to control 90% of nitrogen oxides and 99% toxic acid gases. (Khoo, 2006) Singapore has only one landfill site for disposal of waste -Semakau landfill. Only 10% of solid waste is dumped in this landfill site. Due to the outbreak of covid-19 pandemic, leading to the increase in waste generation, it is projected that the only landfill in the city- Semakau Landfill will reach its capacity by 2035 only. (How will Singapore defuse a 16 year waste timebomb?) Despite the fact that the amount of waste produced in 2018 was 9,000 tonnes less than in 2017, recycling rates have also decreased. The recycling rate dropped by 5% in 2019 as compared to 2018. Government programmes such as "the circular economy" and the "Zero Waste" vision, on the other hand, emphasise keeping for longer periods the resources in use through increased recycling and reusing. (Smart Waste Management: How iZeeM is helping environmental service providers in Singapore (Part 1), 2019)

Recycling of waste saves energy and reduces the emission of carbon dioxide. Singapore aims for zero landfill because the overuse of land causes threat to the society. Recycling of waste was targeted which comprises of the following:

1. Recycling of ferrous metals, woods, tyres, plastic etc
2. Construction waste is converted into aggregates for example mixture of cement, steel, aluminum wood, sand etc.
3. Food waste is converted into animal food.

Few waste materials for processing and recycling are sent overseas such as glass, paper, textile, non ferrous metals etc. Singapore aimed for increase of recycling rate in year 2004 from 48 % to 60% by the year 2012. (Khoo, 2006) Major portion of Singapore's recycling waste is exported abroad. National recycling program of Singapore gave access to recycling bins to all households, wastes such as glass, plastic, paper, metal etc. if not recycled correctly poses the risk of contamination. Biological treatment of horticulture waste is adopted to decompose biodegradable wastes. This process involves decomposition of biodegradable wastes by microorganisms occurring naturally. Garden compost is formed from leaves and pruned tree trunks. (Khoo, 2006)

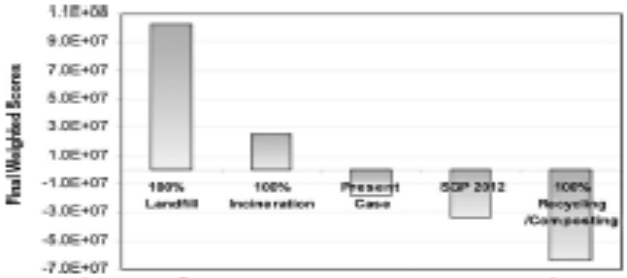

Figure 2: Overall Comparison of waste management options source: (Khoo, 2006)

Waste management system of Singapore comprises of collection of waste, transportation, treatment involving incineration and recycling and finally disposal to Semakau landfill by truck and barge.

Greenhouse gases are emitted in large amounts by the landfills but in Singapore due to restriction of organic wastes sent to the landfill it does not pose threat to the environment. The ability to generate electricity by the Incineration plant helps the public to get 80% of the electricity generated. (Khoo, 2006)

Singapore has started the construction of its first integrated water and solid waste treatment facility next to a water reclamation plant which will work on the system of food waste digestion and water sludge to increase the output of electricity. It will annually treat solid waste of approx 2.5 million tonnes. It will be amongst the world's largest plant. (How will Singapore defuse a 16 year waste timebomb?)

By maintaining efforts to reduce waste and increase recycling at work, Singapore is aiming to achieve:

a. **Zero landfill**
b. **Zero waste**

By doing this lifespan of Semakau landfill can be extended. By 2030, Singapore targets to achieve 70% recycling rate. (Lee, 2010)

4. Results

After observing the solid waste management of the above mentioned smart cities, it is observed clearly that solid waste collection and management at the source plays a vital role in the waste management of any city. Maintaining efforts to reduce waste and the treatment method helps in the restriction of the amount of waste to be sent to the landfill site.

Sr. No	City	Waste collection	Waste generated	Treatment method	Remarks
1	Indore	100% door to door collection.	1115 MTPD	100% door to door waste collection. Gasification, composting, incineration and recycling methods are adopted. The untreated waste is disposed off in a landfill site of Devgurada which is 15 km away from the Indore's city centre.	Waste is segregated at the source with the help of partitioned vehicles.
2	Kochi	75% door to door collection	180-250 MTPD	75 % door to door waste Collection, Composting and finally dumping in the landfill site. Brahmapuram plant treats biodegradable waste only using Inoculum bacteria by aerobic decomposition and plastic, sanitary along with other hazardous wastes are disposed off outside the plant.	Waste transported to treatment plant through trucks and vehicles owned by the company as well as by the handcarts.
3	Singapore	Public recycling bins provided at source	7.23 Million tonnes in 2019.	Collection of waste, transportation, treatment involving incineration and recycling. Biological treatment of horticulture waste is adopted to decompose biodegradable wastes.	Restriction of organic wastes sent to the landfill, does not pose threat to the environment.

5. Conclusions

Cleanliness and hygiene are the key factors contributing to the success of smart cities. Public participation along with the municipal corporations plays a significant role in achieving a clean city. Door to door collection of waste is the foremost step along with the effective segregation of waste at the source. 4R's namely (Rethink, Reduce, Recycle and Reuse) can play an effective role in checking the solid waste production. Processes such as Gasification, composting, setting up of incineration plants can considerably help in reducing the amount of waste sent to the landfill site for dumping. Great emphasis should be laid on integrated solid waste management system. Restriction of disposing of organic wastes to the landfill leads to less environmental impact as it keeps a check on emission of greenhouse gases. By striving to achieve zero waste and zero landfill the solid waste management system can be a great success in smart cities. The success of any smart city depends largely on solid waste management system.

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Dedicated Freight Corridor: Policy and Impact

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Abstract

India is a growing economy and Indian railways plays an important and crucial role in this growth. Need of time and technology has led to requirement of dedicated fright corridors to enable a continuous and efficient fright movement. Planning of dedicated freight corridor along Golden Quadrilateral rail route amplify this economic and spatial growth of the entire region. Dedicated freight corridor is targeted to meet demand, supply, need so as to improve the supply chain not just at national level but also internationally. The paper is an attempt to explore the changes in Indian railway infrastructure system and its impact on transportation network system and development. The research includes a study of the requirements of various ancillary activities and built environment along with a focus on the planning guidelines and development norms for such spaces around the industrial corridors. The paper reviews the present policies and planning guidelines in India and identifies the gap in the same. Indian railway shift towards great autonomy of making Indian Railway sole owner and customer. This has opened up lot of opportunity for Indian railways and Indian economy.

Keywords – Fright Corridor, Economic Development, Planning Guidelines, Industrial Corridor

1. Introduction

1.1 Background

India is one of the fastest growing economy in the world. Growth in economy of a country is a reflection of not just increase in production of goods and services in all sectors but also the consumption of these. Transportation as a commercial activity drives economic benefits by attributes likes cost, efficiency, reliability, capacity, speed and competitiveness. Transportation is closely related to socioeconomic development and changes. 19th century globalization and 20-2st century of economic integration have opened gates for globalization. Transportation system- international, regional

and local is now one of the fundamental component of economic activities. The importance of freight services is also increasing with globalization as more multinational companies are growing and operating all over the world. This results in a demand of faster and more reliable transportation system. Different transportation model for goods and services exist in India. These transport model not just help in movement of people but also movies good that directly and indirectly impact economy of the country. Socio-economic development of a country depends on Policy plan and its emphasis on infrastructure development in all sectors. Transportation infrastructure is life line of any Economy, and Indian Railways plays an important part in that. Indian Railways world's second largest network is spread across 1,15,000 km and with track length of 68442 km. Indian Railways is also one of such transportation mode which is serving India from long way back. India railway (IR) has one of the largest railway network which spread 108706 km's in route length. It serves with 13,523 passenger and 9146 freight trains, daily plying 23 million passengers and about 3 million tons of fright (Indian Railways Industry, 2021). Based on concept of "Pacific Belt" (Tokaido Corridor- Japan) (Chaudhary, 2016) dedicated fright corridor was introduced in House of Parliament during presentation of Railway Budget for year 2005-06. Indians 11th five year plan (2007- 2012) introduced Dedicated Freight Corridor (DFC) by Ministry of Railways. Dedicated Freight Corridor Corporation of India Limited (DFCCIL). DFCCIL is designated as "Special Purpose Vehicle" for purpose of its planning and development, mobilization of financial resources, construction, operations and maintenance.

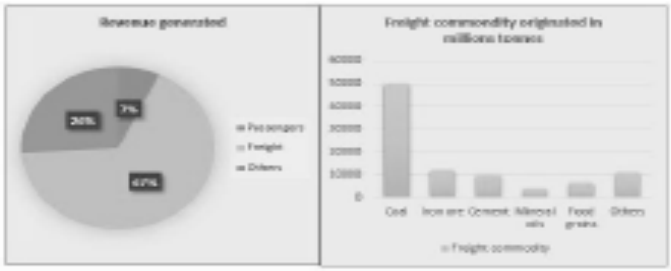
1.2 Need of DFC

1991 Economic liberalization, followed by Information Technology has placed India in leading development counties. 1990's reform reflected increase in private sector investment in major sectors specially targeting urban regions. Continuing with this trend and essential excellent development lead to specific development policy resulted emerging of different urban forms like Special Economic Zones, National Investment and Manufacturing Zones and adding new settlements towns around existing urban developments. In future also Indian economy is likely to show the same trajectory. Indian Railway has shown high cargo volumes with decrease in turn-around time, reduction in transportation cost and improved operations. With the course of time.

According to the Indian Railways Statistical Publications 2013-14, freight accounts for 67 percent of total revenue. As a result, rail infrastructure improvement has been long overdue.Besides, the saturation of existing railway lines has led to congestion and loss in the freight market share for Indian Railways. From the earlier 90 percent in 1950, the freight market share has dipped.

The Eastern Cargo Passage arm (1,839 km) begins from Ludhiana (Punjab) and passes through the states of Punjab, Haryana Uttar Pradesh, Bihar and Jharkhand, to end in Dankuni (West Bengal). The Western Cargo Hallway arm (almost 1,500 km) begins from Dadri in Uttar Pradesh and goes to Jawaharlal Nehru Harbour in

Mumbai, passing through UP, Haryana, Rajasthan, Gujarat and Maharashtra. The project's centrality lies within the truth that once completely operational, 70 per cent of the products trains will move to the DFC, subsequently liberating up the existing tracks totally for traveler trains. The Indian Railroads carries the fourth most noteworthy tonnage of cargo universally — at over 1,200 million tons — which incorporates coal, steel, petroleum items, press metal, cement, manures, foodgrains and containers. While there has been a hop of over 700 million tons of freight in India within the final decade and a half, there has not been a comparing increment within the stacking capacity of the trains.



Source: https://www.99acres.com/articles/what-is-a-dedicated-freight-corridor.html

2. Study

Study is based on one of the world's largest infrastructure project- Dedicated freight corridor, one of the critical driver of Indian economy that has a direct impact on socio- economic activity of each person leaving in this Country. The focus of study is not just to increase knowledge, but also to evaluate and understand its impact on society, economy, and environment. Study also includes dedicated freight Projects whether promotes sustainable development in country. Large projects of such type has a direct impact on development policy in long run.

3. Purpose

Broad purpose of this study is to understand and determine policy impact on factors like social and economic efficiency, sustainable growth and environment. The major goal that are aimed by Government and policy makers which lead to motivation behind purposing of Dedicated Freight Corridor project. Aim of study is to assess impacts from such type of transport infrastructure enhancement.

3.1 Scope

Broad study to access potential of dedicated freight corridor with respect to Social, economic and environmental. Ambitious project of Government of India with India Railways was primarily based on exploring potential of Indian Railway with respect to rising demand of freight transportation. This would lead in higher economic efficiency and significant environmental benefits. However, no explicit data or analysis related to these considerations is availed right now. A more elaborate study is required for understanding these elements.

The study compromises of following aspects of Dedicated Freight Corridor:

1. Overview of Project and its implementation strategy
2. Potential Economic development benefitted by this project
3. Potential regional / social development benefitted by this project
4. Potential environmental development benefitted by this project
5. Assessment of Economic and Environmental benefits

4. Overview: Freight Transportation in India

4.1 Past Trends and Future Projects

India's first railway proposal was made in Madras (Chennai) in year 1832. In 1837, Red Hill Railways ran it from Red Hill to Chintadripet Bridge in Madras to transport granite for road building. In 1947, at time of India's independence fairly a large railway network wa available. Indian Railways used to enjoy 90% share in Goods movement. With passage of time Indian Railway could not able to sustain this and showed a decline. In 1980's Indian Railways discontinued small and wagonload traffic.

Demand growth is limited in-between 0.8 to 1 in past decades. With India's future economic growth railways demand is expected to rise and to be 1.2 times GDP growth. With requirement of increase in capacity let to dedicated freight corridor requirement.

Japan International Cooperation Agency and World Bank with Indian Railways started this project with heavy investment.

4.2 Infrastructure gaps and future challenges

India's economy has seen uncommon development amid the final decade, averaging 7-8% per annum. While this has made a awesome bargain of openings, it has moreover come about in numerous challenges particularly for infrastructure required to maintain the rate of development. Transport is seen as one of the basic infrastructures for the economy. In national transport frameworks, cargo transport acts as the basic interface between ports, markets and fabricating centres. Concurring to an gauge by Indian Railroads, flexibility of transport demand to GDP is 1.25. Subsequently, GDP development of 9% would decipher into development in transport demand of more than 11% (MoR, 2009). On the other hand, it is additionally a truth that existing transport foundation has not kept pace with the growth in request. The thruway advancement ventures have moderated down and the railroad systems are highly congested. It is accepted that line capacity utilization on existing trunk courses is distant in abundance of saturation capacity. The same are

- Dedicated Freight trains modified dimensions. Length of freight trains modified to 1.5 km long, wit to be 3660 mm and clear height of 7.1 mts. This is one of its kind and first in World.
- Track Gauge of 1676 (5 ft 6 in) track that can easily run trains with speed of 100kmph have to be followed by all dedicated fright corridors.
- Double stack shaped containers to be standard and can be transported through electrical locomotives. These locomotives capable of handling load of 15000 ton with 400 containers. This is first and only in world.
- Bridges & formation to support 32.5 Ton axel. Track loading capacity 12t/m.
- High speed freight corridor capable of running trains with speed greater than 100km/h.
- GSM based tracking and Radio communication for all freight corridor.
- "No level Crossing" to reduce time and enhance safety in all respect.
- Increasing railway share in freight market through customized logistic services.
- Segregating infrastructure for both passengers and freight services.
- Introduction of latest and high end technology in transportation and services.
- "Guaranteed transit time" with accurate time tabled freight services.
- Reduction and promotion of Low carbon transport system in India
- Reduction in cost of transportation through dedicated corridor and speedy movement of freight trains. This will result in high productivity and economical savings.

5. Genesis of Dedicated Fright Corridor

A network of 68000kms and serving each nook and corner of India, it plays crucial role ofbalancing socio- economy development of India. Major core sectors – Coal, Mining, steel, petroleum, power, fertilizer cement and food grain heavily depends on Indian Railway. Serving with 1230 daily rake loading, 2815 indents a day, 302364 wagons, 13068 locomotives and 646 commodities Indian Railways define its extensions (About Us, n.d.).

1. Golden Quadrilateral Freight Corridor

GQFC has six DFCs, two of which are currently operational, and funding for the remaining four was approved in January 2018. The Golden Quadrilateral connects the four largest metropolitan cities of Delhi, Mumbai, Chennai, and Kolkata, as well as two diagonals, the North-South Dedicated Freight Corridor (Delhi-Chennai) and the East-West Dedicated Freight Corridor (Kolkata-Mumbai) (GQFC). These account for 55% of the total.

Source: https://en.wikipedia.org/

5.1.1 Eastern Dedicated Freight Corridor

The Eastern Dedicated Freight Corridor commences from Dankuni in West Bengal and passes through the States of Bihar, Jharkhand, Uttar Pradesh, Haryana, and finally terminates in Ludhiana, Punjab. It will be a 1,839-kilometer stretch with two electrified stretches. However, the track between Ludhiana and Khurja covering a distance of 400 km will be single electrified line owing to the lack of land.

5.1.2 Western Dedicated Freight Corridor

Dadri in the National Capital Region (NCR) is linked to Mumbai's Jawaharlal Nehru Port (JNPT) by the Western Dedicated Freight Corridor. It will take place in Uttar Pradesh, Delhi NCR, Haryana, Rajasthan, Maharashtra, and Gujarat, and will span six states. It would be a 1,500-kilometer rail line. Sections of the creation are expected to be announced by the government. Initially, 190 km of the stretch between Dadri (UP) and Phulera (Rajasthan) was closed.

6. Scope of DFC

The DFCs were launched to:

- "Reduce unit cost of transportation by speeding up freight train operations & higher productivity
- Increase rail share in freight market by providing customized logistic services
- Segregate freight infrastructure for focused approach on both passenger and freight business of Railways
- Create additional rail infrastructure to cater high levels of transport demand
- Introduce of high-end technology & IT packing of Freight Services
- Introduce time tabled freight services & guaranteed transit time".

6.1 Global experience of DFCs

Numerous nations around the world utilize rail foundation for "long pull operations", which is another term for cargo passages, particularly built for transportation of bulk cargo merchandise by railroads. Be that as it may, few countries have committed cargo passages. Among the ones that do, the foremost conspicuous are, Australia, South Africa, China, Netherlands and USA.

"Dedicated cargo lines are rail lines whose arranged utilize is confined to cargo trains as it were. A dedicated rail cargo arrange would comprise of an necessarily arrange of such lines, either recently built lines or existing lines changed over to devoted cargo utilize, with adjustment where necessary" (Dirand, 2007). Conventional lines, then again, work with traveler and cargo trains sharing the same infrastructure, which frequently comes about in clashing needs and decreased carrying capacity of the framework.

In South Africa, the 861 km long Sishen-Saldanha railroad line, known as the Mineral Trade Line, operates 4 km long trains carrying net stack of 41000 tons with 30T hub stack (Kuys, 2011). Cargo Railroads in America, which are totally secretly claimed, are among the cheapest within the world and one of the most efficient systems. Since its deregulation within the 1980s, the share of rail cargo activity within the USA has increased consistently. In spite of the fact that there are a few committed hallways, much of the arrange is simultaneously used by Amtrak traveler administrations as required beneath current directions. With future request for freight traffic anticipated to develop at exceptionally tall rates, the industry is stressed around inescapable struggle with intercity passenger rail administrations, which are too increasing rapidly (The Financial analyst, 2010). So also, DFCs in Europe, such as the Betuweroute within the Netherlands, are centering on genuine issues of financial viability and integration with blended activity at connecting hubs. The German DFC.

China has incredibly extended its rail arrange and modern DFCs are being built to interface hinterland regions with ports as well as to transport key assets between different generation centres within the northern and southern locales. Concurring to the "Medium and Long-Term Railroad Arrange Plan", traveler transport will be isolated from cargo transport on active trunk lines by 2020. In spite of the fact that current development of the rail organize in China is government financed, more prominent private segment support is expected in coming years. Similar to American Railroads, China is additionally confronting the troublesome approach choices and uncertainties associated with deregulation of this division for accomplishing advertise proficiency. Whereas China is committed to rapidly extending the rail cargo arrange, their involvement with DFCs has not been reported.

By and large, the worldwide encounter of DFCs appears that integration of DFCs with blended activity systems is problematic at the meeting focuses (hubs). These issues must be tended to with meticulous planning of systems and frameworks.

The other major challenge is that of choosing between tight regulations and state control on one hand, and deregulation and free showcase competition on the other.

7. Conclusion

DFCs display a critical opportunity for cargo coordinations in India. What is vital is to see how the increasingly optimistic activity projections will be realized. That depends upon the mechanical and exchange development in India, and the development of mechanical hallways and the feeder organize. In arrange to use the complete productivity of the DFC, we will too require rolling stock that can take advantage of the expanded pivot stacking capability. On the EDFC, the dependence on coal activity would be a concern since there may be troublesome changes on the sources of vitality in the long run. Encourage, the prospect of expanding holder activity can be influenced antagonistically since the EDFC would permit single stacking as it were. Another imperative concern would be the sole mediator part played by the Indian Railways, which needs to bring within the conclusion clients. Indian Railroads has not continuously been known for its client centricity. Overall, the DFCs have the potential to be a diversion changer for the Indian.

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8

Synthesis, Characterization, and Application of Modified Textile Nanomaterials

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Abstract

There is a growing concern related to the effects of textile nanomaterials. The development of textile nanomaterial has been one of the most active and important research areas in recent years. Design and synthesis of nanomaterials with a novel combination of textile material is expected to expand the demanding scope in the future. Present chapter will emphasis on the chemical nature and synthesis of textile nanomaterials by using different method such as hydrothermal, microwave, fabrication as well as the methods used to characterize them with regard to their different applications. Recent developments in textile nanomaterial have various applications in the field of sports, cosmetics, swimming, and lifestyle.

Keywords: Textile nanomaterials, nanofibers, synthesis, application

8.1 Introduction of Textile Nanomaterials

The word of nanotechnology (Nano-tech) can be applied in different fields [1–3]. This word was first time applied on textiles and also known as Nano-Tex. Later, other textile industries also started to invest in the textile nanomaterial development [4]. Nanoparticles on textile material have been the goal of different studies, to develop the fabrics with miscellaneous practical performance [5]. These nanomaterials (nano silver,

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Mohd Shabbir, Shakeel Ahmed, and Javed N. Sheikh (eds.) Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques, (167–188)

nano ZnO, and nano TiO_2) have been used as an antibacterial [6, 7], UV-blocking [8, 9], and self-cleaning [10, 11]. Textile nanomaterials can observe the high toughness for washing purpose, as owning great surface area and increase surface energy which declare more attraction for fabrics (textile nanomaterial) [12]. Improve the fastness of textile nanoparticles against washing by a specific solution [13] and other properties of fabric (tensile and bursting strength, friction and air penetrability) can also enhance by this solution [14].

Textile materials were prepared from natural occurring fibers, and have an important part in human being's life. Nowadays nanomaterials are broadly used in the advance textile industry for their appreciated properties as high quality textile materials. Natural fibers such as silk, hemp wool, and cotton are wasted throughout dispensation till further usages. Recycling of these fibers has large marketing area by a new route, because their extra-ordinary characteristics. Any other industries such as bio-medical industries required such bio-compatible materials based on these characteristics [15–17]. Some other valuable applications of textile nanocomposites are in the field of paper and paperboard applications as dry strength, surface strength agent. Textile nanomaterials were also used in cosmetics creams, nano-coatings, bio-nanocomposites, food industry, nano-barriers, pharmaceutical applications, absorbent products, oil recovery applications, and dispersion applications. Current literature works have described a new technique of synthesis of textile nanomaterials and their application in bio-medical and bio-technological fields [18–20].

The most popular textile nanomaterial is Chitosan (derivative of chitin), which is also known as the most popular bio-polymer with exceptional morphological and physiological characteristics [21–23]. These nanomaterial known as ideal polymer for textiles, food science, pharmaceuticals, agriculture and biomedical industrial application, because it has exclusive properties like as biodegradability, biocompatibility, and antibacterial activity [21, 24, 25]. New technique is quickly developing and broadly used in chemical, Pharmaceutical, food processing, cosmetics, and in the present time to textile finishing, which is known as nano encapsulation [26].

8.2 Synthesis of Textiles Nanomaterials

The selection of synthesis technique can be an important factor in identify the effectiveness of the textile nanomaterial studies. There are different methods of synthesizing textile nanomaterial such as hydrothermal [27],

combustion synthesis [28], gas-phase methods [29], microwave synthesis, and sol–gel processing with silver, ZnO and TiO_2 [30]. Synthesis of textile nanomaterial to have a better control over particle morphology, size distribution, quality, purity, and quantity, by engaging environment friendly and economical processes has always been a big task for the scientist and scholars [31].

8.2.1 Synthesis via Hydrothermal Method

Hydrothermal synthesis is commonly performed in a pressurized vessel, which is known as autoclave. Autoclave can be increased the temperature more than 100°C or until form the vapor. This type of synthesis is widely recommended for the synthesis of TiO_2 nanoparticles, which can easily be synthesized through hydrothermal treatment of peptized precipitates of a titanium precursor with water [32]. The hydrothermal method can be utilized to control morphological properties such as (size, morphology), crystalline phase, and surface chemistry through control of the solution composition, pressure, solvent properties, additives, and aging time and reaction temperature [33].

8.2.2 Synthesis via Solvo-Thermal Method

The Solvo-thermal and hydrothermal method both are the same, but the solvo-thermal process variety of solvents can be used in the place of water. This method normally has better control of the shape and size distributions and the crystallinity compared to hydrothermal method. It has been used to synthesize TiO_2 nanoparticles and also used to synthesize nano rods with or without the surfactants.

8.2.3 Synthesis via Chemical Vapor Deposition (CVD) Method

In the chemical vapor deposition process the substrate is covered with volatile precursors, which react on the substrate surface to produce the desired film. The quality of the placed materials completely depends on the reaction temperature, reaction rate, and concentration of the precursors [34]. Gracia *et al.* synthesized metal-doped TiO_2 by the same process [35]. The main feature or advantages of this synthesis method is the uniform coating of the nanoparticles or nano film. Cao *et al.* prepared Sn4+-doped TiO_2 nanoparticle films by this method and found that due to doping with Sn and observed more surface defects were present on the surface [36].

8.2.4 Synthesis via Physical Vapor Deposition (PVD) Method

PVD is also another method to preparation of thin film for the covered the substrate. In this technique films are formed precursor to product without a chemical transition. It has greater features or advantage in the place of CVD. PVD grown films have smoothness, conductivity, presence of contaminations, and crystallinity of titanium dioxide films with E-beam evaporation [37].

8.2.5 Synthesis via Template Method

The synthesis of textile nanostructure materials using template method has become very ideal through the last decade. In this method prepare numerous new materials with a regular and controlled morphology in the range of nano and micro by simply changing the morphology of the template material. The different type of templates has been studied, which utilized the synthesized the TiO_2 nanomaterials [38].

8.2.6 Synthesis via Conventional Sol–Gel Method

This method is used for synthesized various oxide materials such as nano silver, nano ZnO, and nano TiO_2 nanoparticle. The important of this technique contains high purity of the precursors, molecular scale mixing, and homogeneity of the products with a high purity of chemical, physical, and morphological properties. It is also known as multipurpose method.

8.2.7 Synthesis via Microwave Method

Various nanomaterials have been synthesized by microwave radiation. Microwave technique use of high temperature calcination for extended periods of time and allow for fast the synthesis of crystalline TiO_2 nanomaterials. Corradi *et al.* prepared colloidal TiO_2 nanoparticle suspensions within 5 min using microwave radiation [39].

8.2.8 Synthesis via Fabrication Process

Electro-spinning is the most important method among the synthesis of nanofibers.

In the electro-spinning process a high voltage is create an electricity for deposition or melt or streaming of polymer solution (Figure 8.1). Electric

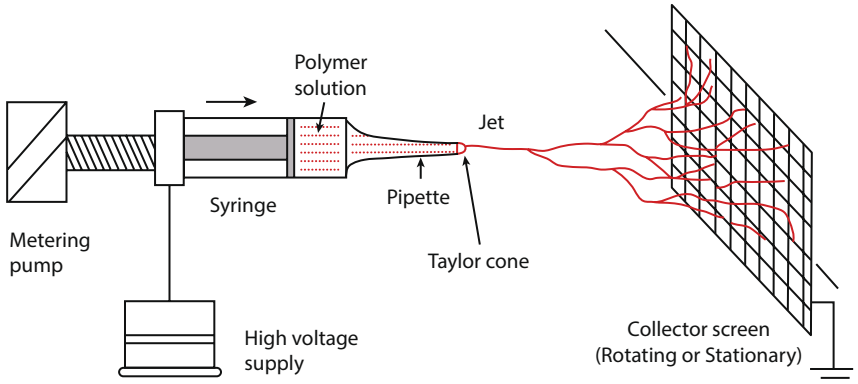

Figure 8.1 Schematic of electro-spinning.

field between the tip of capillary and a grounded collector is very high, and formed at the tip of capillary producing sub-micron diameter fibers. Different types of material were processed into nanofibers in the range of 50 to 1000 nm [40].

8.3 Characterization

Textile nanomaterial characterized by different technique such as spectroscopic, microscopic, X-ray, and other common techniques. The imaging techniques such as (SEM) scanning electron microscopy, (TEM/HRTEM) transmission electron microscopy, (AFM) atomic force microscopy, (STM) scanning tunneling microscopy have been utilized to observe the micro and nano size materials. The basic concepts of all the techniques are different but some common thing is that they observed extremely magnified image of the surface. The spectroscopic method such as (UV-Vis) Ultraviolet-Visible, Raman, infrared spectroscopy and many spectroscopic methods have been utilized to observe the optical properties of micro and nano size materials of textile. Textile nanomaterials can be analyze through X-rays technique like as (EDX) energy dispersive X-ray analysis, wide angle X-ray diffraction, (XPS) X-ray photoelectron spectroscopy, particle size analyzer. Some other common techniques also analyze the physical properties of textile nanomaterials. The basic principles of all these methods used in nanotechnology are described below (Figure 8.2).

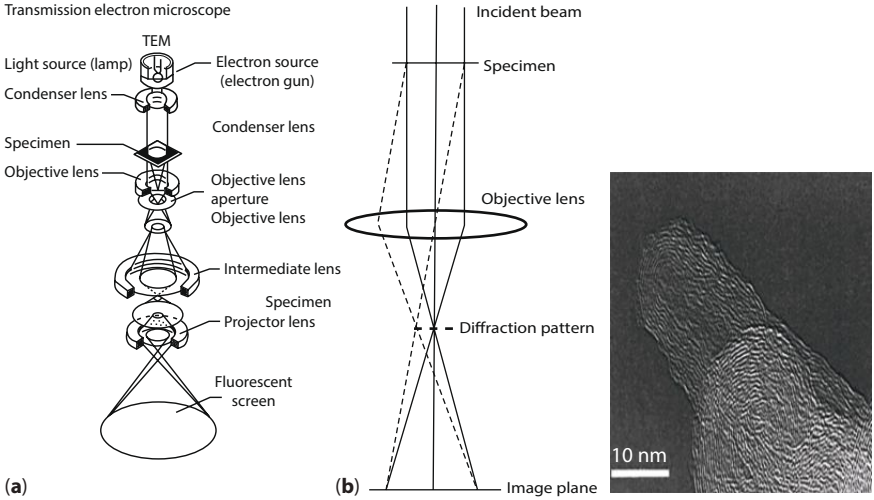

Figure 8.2 (a) Schematic diagram of transmission electron microscopy (b) TEM images of PP/MMT nanocomposites.

8.3.1 Microscopic Characterization of Textile Nanomaterials

8.3.1.1 Transmission Electron Microscopy (TEM)

The micro and nano image is formed by the electron transmeter by the sample and focused by a microscopic lens and looked on a display screen. This technique is widely used in material science, textile, metallurgy, and biological sciences. TEM images reveal the intercalation, exfoliation, and dispersion of nanoparticles in polymer matrices of textile nanomaterial, etc. [40].

High resolution transmission electron microscopy (HRTEM) is a similar imaging technique of electron microscope that allows to take image of the crystal sample at an atomic length with high resolution. This technique is a useful tool to find the nanoscale properties of crystalline material. It showed the maximum resolution is 0.8 Å.

8.3.1.2 Atomic Force Microscope (AFM)

This technique is ideal for quantitative measurement the nano scale textile material. AFM also used for surface imagining and roughness of the surface. Many types of material surface such as polymer nanocomposites, nanofinished, and nanocoated textiles were coated by nano-texture. It is a nondestructive technique and has very high three dimension (3D) [41] (Figure 8.3).

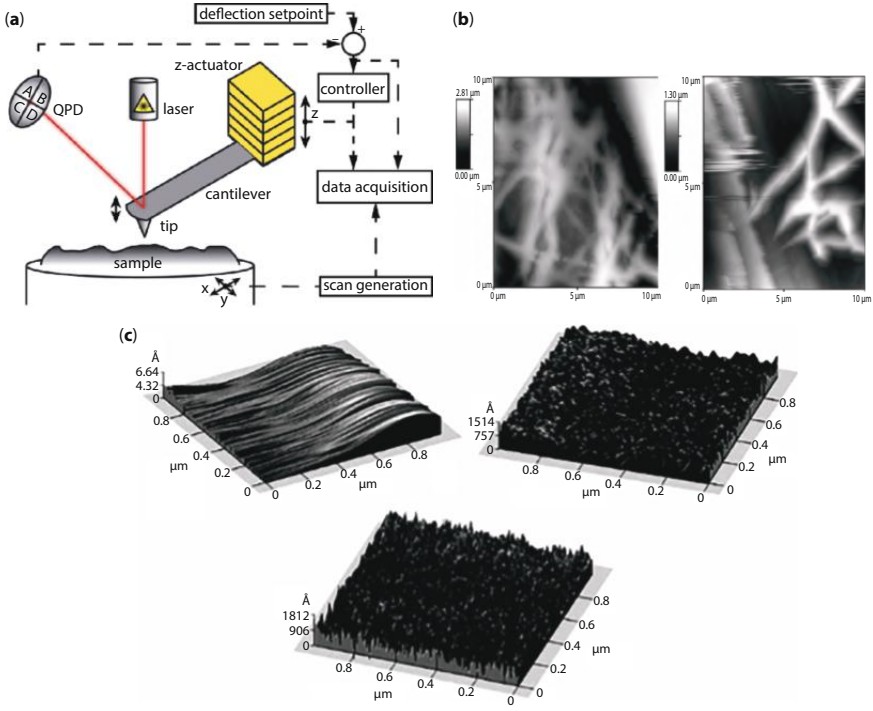

Figure 8.3 (a) Schematic diagram of atomic force microscopy. (b) nanofibers, nanofibers laid on nonwoven substrate (c) 3D views of non-contact mode AFM images of PET textile surface.

AFM can be used to identify the properties, nanostructures, surfaces, and interfaces of fibers and fabrics.

8.3.1.3 Scanning Electron Microscopy (SEM)

SEM is also an electron microscope that images is scanning of surface with a high energy beam of electrons. The SEM shows perfect 3D images with high magnifications (up to 300,000). But the images are only black and white which formed without light waves. The surface image and texture of polymer nanofibers, nanocomposites, nanoparticles, and nanocoating can be viewed through Scanning electron micrograph with high clarity by high magnification [42].

This technique can also be used to interpretation of the dispersion of nanoparticles such as carbon nanotubes, nanoclays, and hybrid POSS nanofillers and coatings on yarns and fabric samples (Figure 8.4c).

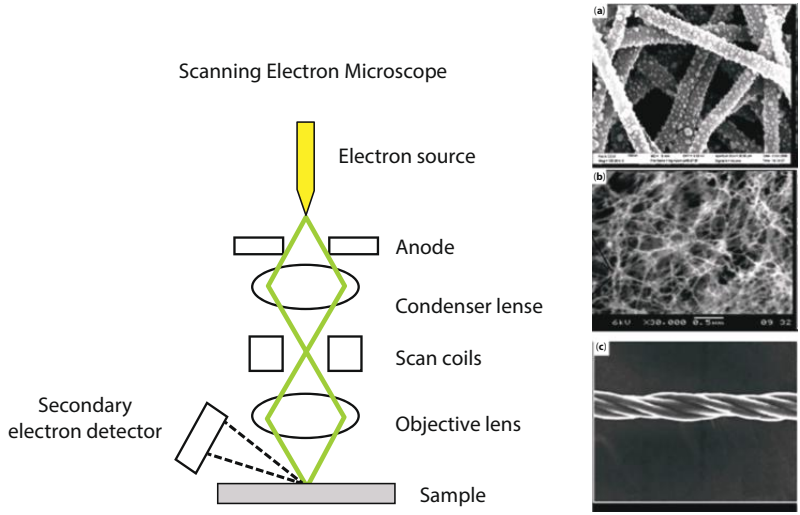

Figure 8.4 Schematic diagram of scanning electron microscopy. (a) Electrospun nylon 6 nanofibers with surface bound silver nanoparticles, (b) peptide nanofiber scaffold for tissue engineering, and (c) SEM image of plied CNT yarn.

8.3.1.4 Scanning Tunneling Microscopy (STM)

Scanning tunneling microscopy (Figure 8.5) is a minor different instrument for observing surface images with atomic scale resolution, in this technique a fine probe tip is scanned over the surface of a sample, with the help of a piezoelectric crystal, and the resulting tunneling [43].

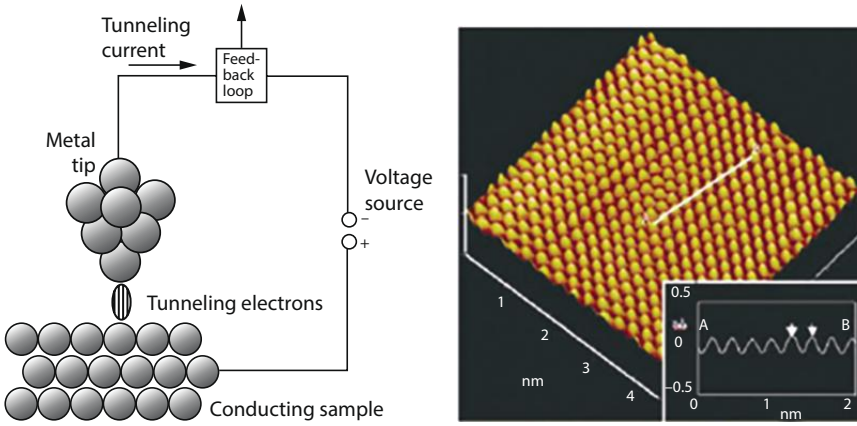

Figure 8.5 Schematic diagram of scanning tunneling microscopy and highly oriented pyrolytic graphite sheet under STM.

8.3.2 Spectroscopic Characterization of Textile Nanomaterials

8.3.2.1 Ultraviolet-Visible (UV-VIS) Spectroscopy

In the Ultraviolet spectrophotometers light source forced on reference and sample beams then output comes in monochromator, detector, and form the spectrum. The ultraviolet spectrum for a sample is obtained by exposing a sample of the compound by Xenon lamp. Spectrum was observed for absorbance versus wavelength [44] (Figure 8.6).

8.3.2.2 Raman Spectroscopy

This type of spectroscopic technique used for condensed matter physics and chemistry. It used to study vibrational, rotational, and other low-frequency modes in a system [45]. The laser light interacts with phonons or other excitations in the system, and the energy of photons being change high or low. The level of energy provides information about the energy of phonon in the system (Figure 8.7).

8.3.2.3 Infrared Spectroscopy (IR)

This technique specially used for characterization of nanomaterials. Fourier transform infrared (FTIR) spectrometer is preferred over dispersive spectrometer due to non-destructive technique. It can increase sensitivity of scan rate

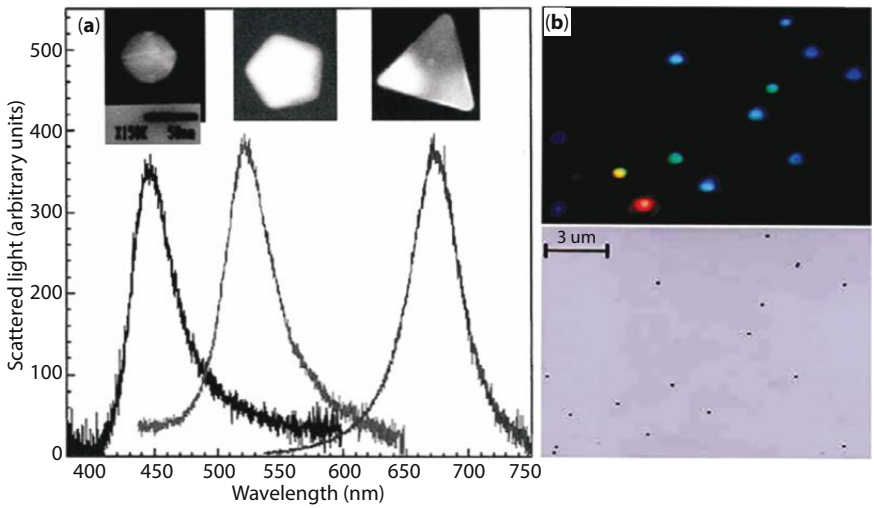

Figure 8.6 (a) UV-Vis spectroscopy of silver nanoparticles of different shapes and (b) color image of a typical sample of silver nanoparticles.

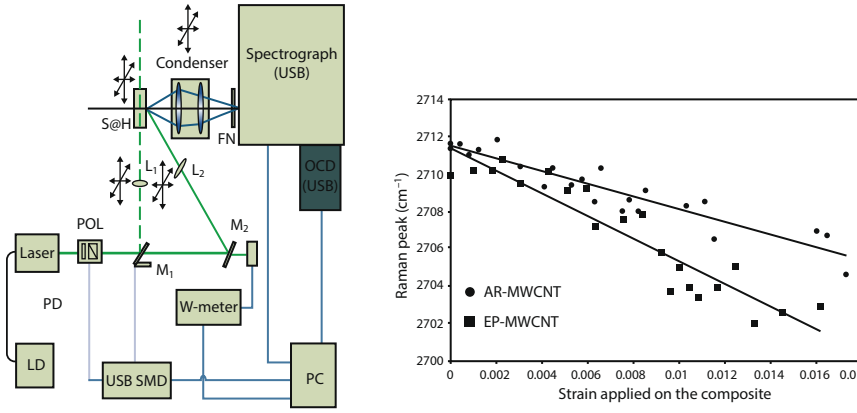

Figure 8.7 Schematic diagram of Raman spectroscopy and Shift in the Raman peak as a function of applied strain.

and co-added together to ratio of random noise. It has better optical through output and is also mechanically simple with only one moving part, etc.

8.3.3 Characterization of Textile Nanomaterials by X-Ray

8.3.3.1 Energy Dispersive X-Ray Analysis (EDX)

This technique analyzes the surface elements at different positions and provides an overall measurement of the sample. The concentration of nanomaterials at the surface can be observed using this technique. EDX contain some heavy metal ions (Au, Pd, and Ag) on the surface of nanoparticles (Figures 8.8b, c). EDX spectra have to be taken by focusing the beam at different regions of the same sample to verify spatially uniform composition of the bimetallic materials [46].

8.3.3.2 Wide Angle X-Ray Diffraction

This technique is similar to electromagnetic radiation of X-ray diffraction, but have shorter wavelength. This technique produced spectrum when electrically charged particles have sufficient energy. In an X-ray tube, the high voltage is maintained by electrodes toward a metal target. X-rays are produced and radiate in all directions.

8.3.3.3 X-Ray Photoelectron Spectroscopy (XPS)

This spectroscopy (Figure 8.9) is a quantitative spectroscopic. Surface chemical, elemental composition, chemical state, and electronic state of

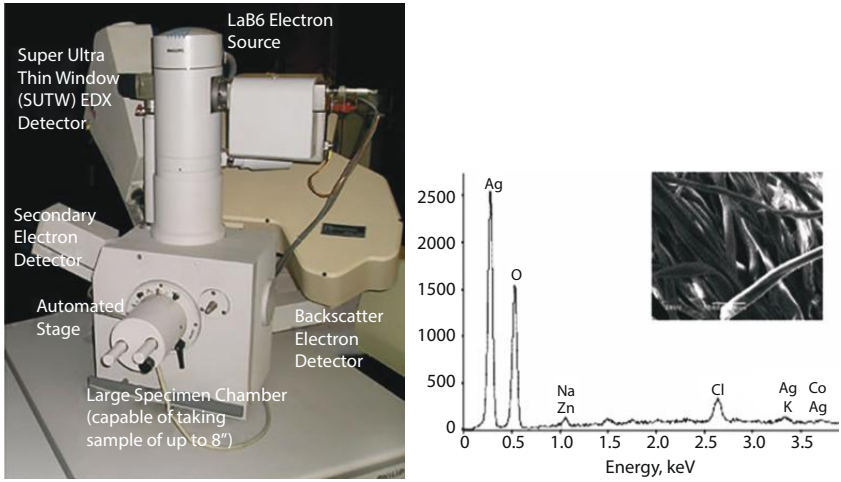

Figure 8.8 Schematic diagram of energy dispersive spectroscopy and SEM images and EDX spectra of nanoporous materials made of cotton cloth with silver nanoparticles 8.

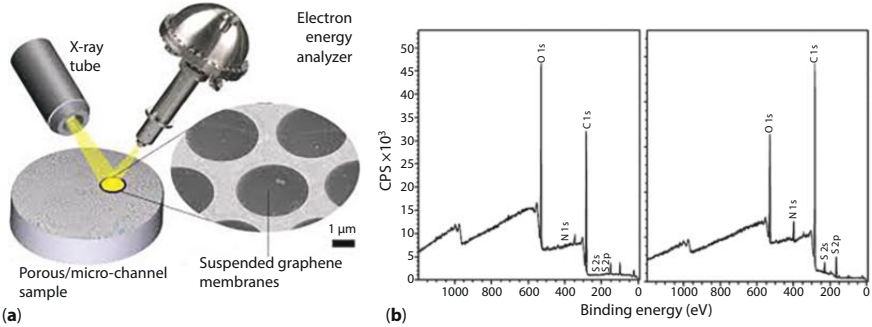

Figure 8.9 Schematic view of XPS. (a) Positively charged woven cotton fabric and (b) positively charged woven cotton fabric supporting 20 self-assembled layers of PSS/PAH.

the elements on the surface (up to 10 nm) of a material were analyzed by this technique [47]. XPS is also known as ESCA (electron spectroscopy of chemical analysis).

8.3.3.4 Particle Size Analyzer

Different techniques were available for the measurement of particle size distribution (PSD) such as optical counting methods, sieve analysis, electro resistance counting methods, laser diffraction methods, sedimentation

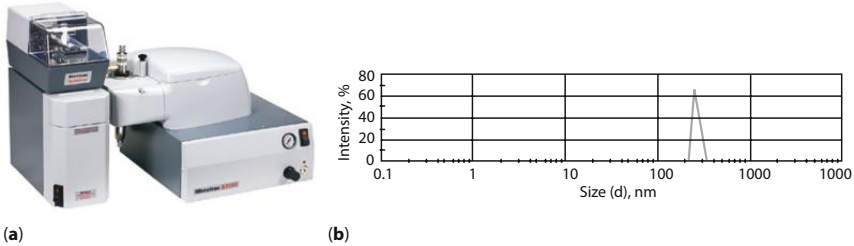

Figure 8.10 (a) Schematic diagram of particle size analyzer. (b) Size distribution of TiO_2 nanoparticles.

techniques, dynamic light scattering method, acoustic spectroscopy, etc. All of them dynamic light scattering (DLC) is regularly used for obtaining size of silver, titanium, silica, and zinc oxide nanoparticle are often used in textile substrates to get enhanced quality of the nanoparticle finished textile materials.

TiO_2 nanoparticle size and size distribution (Figure 8.10b) can be observed using DLS technique [48]. The enhanced property is dependent on the size of the sample nanoparticles. Therefore, size and size distribution performance of the nanoparticle in the dispersion as well as suspension is important before to characterize to the textile substrates.

8.3.4 Characterization of Textile Nanomaterial by Some Other Technique

The complete structural and chemical modifications of fabrics were further analyzed in terms of physical testing, determine the tensile properties, crease recovery angle, bending length, air, and water permeability.

8.3.4.1 Physical Testing

Before starting physical testing the samples were dried and conditioned at 65± 2% RH and 27 ± 2°C temperature.

8.3.4.2 Determination of Recovery Angle and Tensile Properties

Recovery angle was measured by folding and compressing the specimen under controlled condition. Tensile strength was observed as per B.S. 2576:1959.

8.3.4.3 Determination of Absorbency by Wicking Test and Bending Length

Wicking behavior of the treated and untreated samples were evaluated as per T-PACC standard method.

8.3.4.4 Evaluation of Water and Air Permeability

Water permeability test conducted using ASTM D 4491 constant head Methods. Metefem air permeability tester used ASTMD 737 test method for measurement of air permeability.

8.4 Application of Textiles Nanomaterials

Nanotechnology can offer high strength for textile material because nanoparticles have high surface energy and area and, based on this quality, improved the affinity for these materials and have to increase the strength. The overlap of nanoparticles on textile material will not affect their breathing and observation.

Now current researchers are developing nanotechnology to enhance the performances or to create extraordinary quality of textile material, which is prosperous.

8.4.1 Application Based on Properties of Textile Material

The properties of textile nanomaterials comprise oil resistance, water repellence, anti-static, wrinkle resistance, UV-protection, anti-bacterial, improvement of dye, flame retardation, ability, self-cleaning fabrics, and many more, which are described below.

8.4.1.1 Anti-Bacterial Properties of Textile Nanomaterial

Nano-sized silver, titanium dioxide, and zinc oxide are used for the anti-bacterial properties of textile nanomaterial. These metallic ions and compounds show the degree of sterilizing condition. The number of the oxygen in the air or water is changed into active oxygen by catalysis with the metallic ion and dissolves the organic substance for sterilizing effect. The use of nano-sized particles per unit area is increased, and thus anti-bacterial effects can be also increased [49].

8.4.1.2 UV Protective Properties of Textile Nanomaterial

The UV-protection property of a textile nanomaterial is improved when a dye, pigment, delustrant, or ultraviolet absorbance is complete, and the absorbed ultraviolet radiation blocks its transmission through a fabric to the skin. The excess of skin protection is required for different types of human skin, and it depends on distribution in reference to geographical location, time of day, UV radiation intensity, and season. This UV-protection is known as SPF (Sun Protection Factor). High SPF value is a better protection against UV radiation [50].

8.4.1.3 Water Repellence Properties of Textile Nanomaterial

Nano technology in the textile nanomaterial enhances the water-repelled property of fabric such as production of nano-whiskers, which are also hydrocarbons and known as cotton fiber. The addition of this fabric creates a peach fuzz effect without decrease in the strength of cotton. The particular space of the whiskers on the textile nanomaterial (fabric) is smaller than a drop of water and larger than water molecules [51]. However, liquid can still pass through the fabric, if pressure is applied.

8.4.1.4 Anti-Static Properties of Textile Nanomaterial

Static charge usually builds up in synthetic fibers such as nylon and polyester because they absorb little water. Cellulose textile nanomaterial have higher moisture ratio to carry away static charges. As we know synthetic fibers provide poor anti-static properties, so the scientist and researcher work to enhance the anti-static properties of textile materials by using nanotechnology. TiO_2, ZnO, and ATO show anti-static effects because they are electrically conductive nanomaterials. Such material helps to disperse the static charge, which is collected on the fabric. Silane nano sol improves anti-static properties, as the silane gel particles on fiber absorb water and moisture in the air by amino and hydroxyl groups in water [52].

8.4.1.5 Flame Retardant Properties of Textile Nanomaterial

Nanotechnologies has been applied in textile nanomaterials for flame retardant finish, which known by colloidal antimony pentoxide. Colloidal antimony pentoxide has a fine dispersive particle for use as a flame retardant synergist with halogenated flame retardants. Nano antimony pentoxide is used with halogenated flame retardants for a flame retardant finish to the textile nanomaterial [53].

8.4.1.6 Wrinkle-Free Properties of Textile Nanomaterial

Improved performance of nano-Tex has known as a new nanotechnology (wrinkle-free treatment). This technology preserves fabric strength and integrity, an alternative to harsh traditional processes. Conventional methods are commonly used to wrinkle resistance to fabric, resin. However, there are boundaries to applying its in fibers and resin, such as decrease in the tensile strength of fiber, abrasion resistance, water absorbency, dye ability, and breathability. To overcome the limitations of using resin, some scientist employed nano-titanium dioxide, and nano-silica [54] to improve the wrinkle resistance of cotton and silk, respectively.

8.4.1.7 Self-Cleaning Properties of Textile Nanomaterial

American company was developed nano-care, which is known as a self-cleaning cotton fabric. In the scientific terms, the fabric has been purified super-hydrophobic or super-non wet able. The nanowhiskers also make less interaction with dirt. When water is react to stained fabric, the dirt adheres to the water far better than it adheres to the textile surface and is carried off with the water as it beads up and rolls off the surface of the fabric. Self-cleaning fabrics could reform the sport apparel industry. The technology has already been used to create t-shirts and underwear that can be worn hygienically for weeks without washing [55].

8.4.1.8 Economical and Environmental Aspects of Textile Nanomaterial

The extraordinary properties of textile nanomaterials have attracted not only scientists and research scholar but also attract by businessman. The national science foundation (NSF) reported that textile nanomaterial related product and facilities will increase in 2015 with 1 trillion dollar. This amount is more than the all businesses such as telecommunications and information technology industries. In the future more than hundred billion Euros are forecast to be created by textile nanotechnology [56]. The textile nanomaterial markets could expand to US$ 1 billion. Due to huge development of textile nanomaterials, it was believed that 2 million new employment opportunities would be created in order to meet the worldwide annual production demand of US$ 1 trillion in future. Nanotechnology may impart favorably on the economical as well environment. Nanotechnology may save raw materials and also upgrade quality of life by using less resource without forgoing performance.

8.4.2 Application in Textile Industry

Nanotech enhanced the overall properties of textile material, which are seeing above based on properties. Some applications have for sport industry, space research, skin care, garments, and material technologies with better protection in environments. The modified textile material by nanotechnology is a unique method to improve the properties of the textile material, prolonging the process and also having multiple color options, etc. Nanotechnology can also be used to add new advantage such as energy storage and communications.

8.4.2.1 Textile Nanomaterial Used in Swimming Costume

The currently used swimming costumes have a plasma layer to repel the water molecules. The quality of the plasma layer is enhanced by nanotechnology that is prepared with the help of swimmer glide. The most widely recognized application is in the shark-skin costume in the Olympic swimming championship.

8.4.2.2 Textile Nanomaterial Used in Sports Goods

The quality of all sports wear has also been enhanced by textile nanomaterial. Scientists have developed naturally existing viral textile nanoparticles that have some of the toughest environments on earth and have new material for nanotechnology, a textile nanomaterial that minds their surface and interacts with the wearer. These textile-based nanosensors could provide a personalized healthcare system, which monitors your changes sign, such as responding to changes in the weather.

8.4.2.3 Textile Nanomaterial Used Inflexible Electronic Circuit

Textile nanomaterial (nano ribbon) used as chips, which are very flexible. These nano ribbons can cover the control of stretchable microscope cover slip. The researchers and scientists are describing applications in the healthcare industry and where these little, flexible electronic circuit could be used to monitor the activity of patients' brain. This circuit could also be used in surgical apparatus to monitor patients during surgery.

8.4.2.4 Textile Nanomaterial Used in Lifestyle

Nanotechnology is seen in many fields and also has application in lifestyle. Textile with the combination of cosmetics is among the first products to

use in nanomaterials. Nanotube fibers are used to make a material at least 17 times tougher than the present quality. In this view there are future developments with the use of this nanotechnology to create smart and interactive textiles (SMIT). That can be sensitive chemically, electrically, magnetically, thermally, or other stimuli.

8.5 Current Trends and Future Prospects

In the literature various studies have been describe the synthesis and characterization of nanomaterials for textile industry. Nanomaterials can be practically applied to textiles to impart antibacterial, self-cleaning, anti-wrinkle, UV protection, waterproof, and electrical conductivity functions. There have been many efforts to apply nanomaterials in the textile so far, but further research and developments would be necessary in the future. In this chapter, we have reviewed that the synthesis and characterization the textile material for different type of application. Although many researchers and scientist have been show interest for discovered more textile nanomaterials, and understand their functions. It is compulsory to increase its application for functional textiles such as sportswear, military wear, and fire safety wear, etc. Nanotechnology research in textiles has maximum possibility for the future approach but would be primarily an overview by current research progress in the simple, fast, new, and more resourceful characterization techniques for nanomaterials, nano-coatings, and nano-composites used in textile applications.

8.6 Conclusion

Textile nanomaterials have the possibility to improve the quality and stability of human life as well as industrial effectiveness in world. Still, the new textile nanomaterial may also pose harmful for the environment and decrease health safety issues. The Scientific Committee has decided that recently developed and identified nanomaterial is not risky for health and textile nanomaterials are not hazardous. There is still scientific doubt, which is not clear about the safety from textile nanomaterials by many characteristics, and therefore the safety concern of the substances must be done on a case-by-case basis. Although these are textiles, still very few studies are available in the literature, which describe the possible health risks involved with “nanotextile.”

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5

Synthesis of Nanomaterials and Their Applications in Textile Industry

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Abstract

Unexpected surface properties of nanomaterials *viz*. their relative low cost make them popular worldwide and due to this reason various type of nanoparticles have been synthesized by the researchers in last few years. After the revolutionary industrial development of twentieth century, manufacture of fabrics, natural fibers such as rayon, nylon and many others, which involve the incorporation of nanomaterials in synthetic materials and fibers, have been increased day by day with significant properties like low cost, chemical stability, and low cost production techniques. Development of nanomaterials is area of great interest for the improvement of existing functionality for the synthesis of new textile products with different properties and functions in single textile material. In last few years, significant improvement has been found in textile technologies like coloring, digital printing on textiles, and smart fabrics in which nanoparticles play key role in technological evolution because of their surface properties and for attaining new properties like flame retardant properties, antibacterial activity, and analyzed for special ultrathin fibers functionalization. In present chapter, we have reviewed the different methods for the synthesis of nanomaterials and their applications after the incorporation of nanomaterials into textiles.

Keywords: Nanomaterials, textile, fibers, antibacterial activity

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Mohd Shabbir, Shakeel Ahmed, and Javed N. Sheikh (eds.) Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques, (117–134)

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Modification of Textiles via Nanomaterials and Their Applications

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Abstract

Over the past few decades, Nanomaterials have boomed in an unprecedented way in field of textiles, due to demand for functional and durable apparel manufacturing. Nanomaterials can provide wrinkle-freeness, stain repellence, electrical conductivity, and static elimination to fibers without compromising their comfort and flexibility. Development of nanomaterials is a unique and multidisciplinary approach for textile functionalization, coloration along with UV blocking, antibacterial/microbial resistance, water repellent imparts flame retardancy, sensors, and self-cleaning property of textiles makes them a suitable candidate for smart textile material and for various end uses among all technologies. These nanoparticles can be deposited on various types of fabrics using various irradiation methods such as ultrasound, plasma, ultraviolet and gamma for maintainable coloration as well as functional finishing of various textile materials. The book chapter emphasizes on most appropriate approaches for incorporating nanoparticles in textile industry along with their advantages, recent advances, and studies concerning the use of nanomaterials in recent functional modifications such as textile coloration, UV protection, antimicrobial textile, and smart textiles of natural and synthetic textile materials.

Keywords: Nanomaterials, textile coloration, UV protection, antimicrobial textile, smart textile

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Mohd Shabbir, Shakeel Ahmed, and Javed N. Sheikh (eds.) Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques, (135–152)

Chapter 12
Outdoor Pollution Management by Nanotechnology

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ABSTRACT

Remediation of environmental pollution has become a hot issue in the world. Environmental pollution, mainly caused by toxic chemicals, includes air, water, and soil pollution. This pollution results not only in the destruction of biodiversity, but also the degradation of human health. Textile industrial effluent often contains the significant amount of synthetic and toxic dyes. Some dyes are water-soluble, dyes such as azo dyes, sulfonated azo dyes, etc. Hazardous effect of dyes results in the formation of tumor, cancer, liver or kidney damage, insomnia, diarrhea, nausea, vomiting, dermatitis, chronic asthma, coughing, headaches, and allergies in humans

DOI: 10.4018/978-1-7998-0311-9.ch012

and also inhibit growth of bacteria, protozoan, plants, and different animals. A range of wastewater treatment technologies have been proposed that can efficiently reduce toxic dyes to less toxic forms such as nanotechnology. In this chapter, the authors give an overview of the various aspects of nanotechnology to remediate industrial textile dye effluents.

INTRODUCTION

Dye is considered as colored material which can be natural, semi-synthetic or completely synthetic. Natural dyes are of natural origin and therefore it is non-hazardous in comparison to the synthetic dyes. Plastics, textile, printing, paper, leather, rubber, and paints industries are the major sources of synthetic dyes pollution (Singh & Arora, 2011). Several dyes containing effluents are released into the water streams by these sources. Textile effluent consists of large quantity of unfixed dyes as compared to other effluents which are discharged by other industries (Ali 2010). Textile dyeing industry intensively affects the earth and is considered as first water-Polluting activity (Kant 2012, Silva 2018). Human beings along with aquatic flora and fauna are affected by the discharge of contaminated dye effluents in the water streams (Korbahti & Rauf 2008, Fernandez *et al.,* 2014, Bouaziz *et al.,* 2015, Li *et al.,* 2018). For coloring of different materials, azo dyes are frequently used (Solis *et al.,* 2012).

Dyes can cause several health related problems to human body and can damage different organs such as liver, central nervous system, reproductive system, brain, and kidneys (Kadirvelu *et al.,* 2003). Water polluted by dyes at a concentration of 1.0 mg/L is not suitable for human's consumption (Malik *et al.,* 2007, Mittal & Gupta 1996). Benzidine and arylamine-based dye are harmful and found to have some carcinogenic properties (Ozcan *et al.,* 2004). Therefore, it is necessary to find economic and eco-friendly method for treatment of dye effluents (Song *et al.,* 2018).

BACKGROUND TO DYES

Colorants are basically chemicals which is responsible for imparting color to the materials on which they are applied. Pigments and dyes are the types in which dyes are classified. Both are different from each other on the basis of their solubility. The crystalline or the particulate nature of the pigments is retained during the application. But dyes on the other hand became the integral part of the material because these are soluble and can be easily diffused into the material. Polymers, paints, and inks are the materials in which pigments are used. Dyes are considered as main source

for contamination of water and it is considered as ionizing, aromatic, and colored materials. These compounds which originate from hydrocarbons such as anthracene, toluene, xylene, naphthalene, and benzene which are based on coal tar are used for coloring several materials such as greases, drugs, cosmetics, paper, food, waxes, fur, plastics, leather, textile materials, hair, and other products. Factors other than solubility are required for a coloured material to be considered as dyestuff.

The Physical Basis of Color

Dyes are colored due to adsorption of light in the visible region or in the 400-700 nm range. Color –possessing group i.e chromophore and conjugate systems i.e the system consisting of alternate single and multiple bonds must be possessed by dyes. Resonance of electrons is the force of stabilization in case of organic compounds which is exhibited by dye molecules. Presence of a chromophore which is the area of the molecule where the difference of the energy between the two separate molecular orbitals lies in the range of visible region is responsible for imparting colors to the dyes. π–π^* and n–π^* transitions occurs in chromophore and the solubility of dyes are effected by auxochromes which are present in most of the dyes. Transitions of n electrons occurred in auxochromes not the π–π^* transitions. Carboxylic acid, amino, hydroxyl, sulfonic acid groups the the various auxochromes which is present in dyes and are responsible for color of the colorant. But these functional groups are not accountable for color production (Gupta *et al.,* 2013, Janaki 2014, Mallakpour 2017, Mallakpour 2018, Saini *et al.,* 2018).

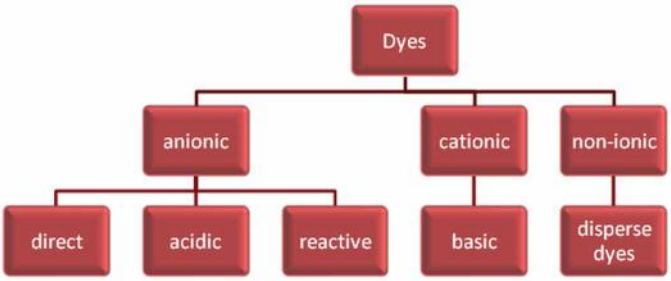
Classification of Dyes

Dyes are categorized on the basis of its chemical structure and color index (CI). Mono-azo, di-azo, tri-azo, anthroquinone, triarylmethane, and phthalocyanines are some of the general classes of the dyes. Anionic, cationic, and non-ionic are the different types of dyes which are classified on the basis of their utilization in textile industries. Yellow, orange, red, violet, blue, green, and black are the subclasses of the dyes on the basis of color.

There are generally two groups in which dyes are characterized:-

1. **Anionic Dyes:** Azine, nitroso, triphenylmethane, xanthene, and anthraquinone are the anionic dyes which are used for silk, wool, modified acrylics, nylon etc.
2. **Cationic Dyes:** Crystal violet, amaranth, and methylene blue are the cationic dyes which are used for polyacrylonitrile, modified nylons, in medicines, polyesters, and paper.

Figure 1. Classification of dyes
(Fu & Viraraghavan 2001)



Dyes are categorized according to the nature of their chromophore:-

1. **Nitro Dyes:** These dyes consist of NO_2 group (nitro group) which is attached to electron donating group such as amino and hydroxyl groups in an aromatic system.
2. **Nitroso Dyes:** These dyes are prepared on reaction of nitrous acid with naphthols or phenols. These dyes consists of nitroso group (chromophore) at orthoposition to the –OH group. These dyes are utilized in varnish industry, in paint, for rubber dyeing, and in the manufacture of pencils and wallpapers.
3. **Acridine Dyes:** These dyes are heterocyclic compounds which consist of acridine and its derivatives in their structure. These dyes are generally used for coloring mordant cotton and leather.
4. **Cyanine Dyes:** These dyes consist of delocalized charge on the two nitrogen atoms which are joined together by polymethine bridge. These dyes are used in industry, and in biotechnology for analysis and labeling because they are helpful label for nucleic acids and proteins.
5. **Oxazine Dyes:** These dyes consist of oxazine ring which act as a chromophore in which oxygen atom is attached at para-position to nitrogen atom.
6. **Thiazole dyes:** These dyes consist of thizole ring and it is mostly utilized for cotton.
7. **Anthraquinone Dyes:** These dyes are based on anthraquinone. The chromophore is provided by the resonance structure of the aromatic rings and the –CO groups. These dyes are utilized for dyeing silk, cotton, and rayon.
8. **Arylmethane Dyes:** These dyes are derived from CH_4 in which in which hydrogen atoms are replaced by aryl rings. Arylmethane dyes categorized into two subgroups:-

a. **Diarylmethane dyes:** these dyes are derived from methane in which two hydrogen atoms are replaced by two aryl groups.
b. **Triarylmethane dyes:** these dyes are derived from methane I which three hydrogen atoms are replaced by three aryl rings.

9. **Phthalocyanine Dyes:** These dyes consist of the derivatives of the phthalocyanine (tetrabenzotetraazoporphyrin) and its complex compounds with metals. The phthalocyanine dyes which are not soluble in water are generally used as pigments in the manufacture of printing colors, resins, plastics etc. the phthalocyanine dyes which are soluble in water are utilized for color fabrics.
10. **Indigoid Dyes:** These dyes consist of indigo as chromophore. These dyes are utilized for printing of cotton for dyeing proteins fibers and cellulose (Fabian & Hartmann 1980, Pisoni *et al.,* 2014, Raue & Corbett 2000).

Dye classification on the basis of the use or application is as follows:

There are some properties of dyes which are classified on the basis of their usage are:-

1. **Acid Dyes:**It is sodium salts of sulfonic acid and other acids like carboxylic or phenolic organic acids. Azo, nitro, nitroso anthroquinone, triphenylmethane, xanthenes, and azine are the different functional groups which are present in the acidic dyes. They are anionic dyes which are soluble in water and are used for dyeing silk, polypropylene fibers, nylon, polyamides, wools, and modified acrylics.
2. **Cationic (basic) Dyes:** They are called cationic dyes because colored cations are formed into the solution. Cationic dyes are also known as basic dyes and after the modication they can be water soluble. Hemicyanine, acridine, triarylmethane, thiazine, diazahemicyanine, oxazine, and cyanine are the different functional groups which are present in the cationic dyes. The positive charge carried by these dyes in their molecules is usually localized on the NH_4 group. These are used for cationic dyeable polyester, acrylic, cellulosic fibers, modacrylic, protein, and cationic dyeable nylon. Cationic dyes are utilized for dyeing dried flowers, jute, coir, cut flower etc.
3. **Disperse Dyes:** These dyes are free of the ionizing group and are insoluble in water which remained as suspended microscopic particles. Azo, nitro, benzodifuranone, anthroquinone, and styryl are the different functional groups which are present in the disperse dyes. Disperse dyes are mostly used for polyster dyeing and also used in form of aqueous dispersion for dyeing acrylic fibers, cellulose acetate, cellulose, and nylon.
4. **Direct Dyes:** These dyes are anionic dyes which are water soluble and coloured anions are produced due to ionization. For high affinity to cellulosic fibers,

this dye can be useful when applied with sodium sulfate and NaCl. Direct dyes are easily available in market, can be applied easily and utilized for dyeing leather, cotton, paper, nylon, and rayon. Direct dye without the help of other chemicals can easily hold on the cellulosic fibers.

5. **Reactive Dyes:** These dyes consist of atleast one reactive group which is able to form covalent bond with the fiber. The reactive group present in these dyes may be activated double bond or haloheterocycle. These dyes are generally used in the alkali situation and chemical bond is formed between reactive group of the dye and the –OH group on the cellulosic fiber. Bonding which occurs during dyeing leads to the fastness properties of these compounds. Due to the easy dyeing procedure, these dyes are used for dyeing cellulosics, some nylons, cottons, and rayons etc.
6. **Solvent Dyes:** These are characterized by its solubility in organic solvents. These dyes are nonpolar in nature and do not ionize in solution. Solvent dyes are used for coloring the waxes, organic solvents, plastics, hydrocarbon fuels, oil, lubricants, and gasoline etc. The compounds such as alcohols, chlorinated hydrocarbons, and liquid ammonia which are soluble in organic solvents are water insoluble is utilized for dyeing. Anthroquinone and azo group are the main groups present in these dyes.
7. **Sulfur Dyes:** These are called sulfur dyes because of the presence of sulfur-containing heterocyclic rings in their chemical structure. Sulfur dyes are synthetic organic molecules and it is utilized for the coloration of cotton, cellulosic fiber, and rayon due to the presence of sulfur group as chromophore. Sulfurization or thionization of organic intermediates leads to their ionization. These dyes are water insoluble and do not have affinity to cellulosic materials. Leuco compound is water soluble which is formed by treatment of sulphur dyes with weak alkaline solution of reducing agent or sodium sulfide and has affinity to cellulosic materials.
8. **Vat Dyes:** These are water insoluble dyes. These dyes polycylic compounds based on quinine structures which is utilized for the coloration of cellulosic fibers. These dyes are used generally used for color polyester and polyamide blends with cellulose fibers and also dyeing and printing cellulose fibers and cotton. These dyes are applied through the impregnation of fiber under the reducing conditions. It is further oxidized to insoluble form.
9. **Azo Dyes:** These dyes consist of aromatic compounds containing at least one azo group. These dyes are used for dyeing rayon, cotton, and polyester.
10. **Mordant Dyes:** Example of this dyes are dyes with metal chelating groups. These dyes are utilized for dyeing wool, cotton, and other protein fibers.
11. **Drug, Food, and Cosmetic Dyes:** These are natural and synthetic dyes. These are normally used in cosmetics, drugs, and foods, of which synthetic dyes

releated to anthraquinone, triarylmethane, carotenoid, and azo groups are the most commonly used (Hunger 2003, Gupta 2009, Janaki 2014, Parimalam 2012).

Nearly 1 lakh different types of dyes are synthesized with the rate of 9×10^6 tons/ year nowadays. These dyes are used in numerous industries including paper, colors, foodstuffs, textiles, and printing industries etc. The dye and textile manufacturing industries are responsible for the release of the color into the water. It is not easy to evaluate the quantity of dyes discharged into the water streams. It is estimated that >10,000 tons/year of dyes are consumed in the textile industries worldwide and nearly 100 tons/year of dyes are discharged into the water. The increased usage of dye causing water contamination leads to serious environmental trouble. The water quality is changed if dye is present in very small quantity (<1 ppm). Hence, for the supply of fresh water to the society there is need to remove these contaminants from the wastewater (Mu & Wang, 2016).

TECHNOLOGY FOR THE TREATMENT OF DYE EFFLUENTS

Various techniques are employed for the treatment of dye effluents such as adsorption (Baeza *et al.,* 2017), activated carbon (Yu *et al.,* 2016), osmosis (Luo *et al.,* 2017), clay-based adsorbent coating (Ab Kadir *et al.,* 2017, Azha *et al.,* 2017), membrane filtration (Dickhout *et al.,* 2017), electrochemical oxidation (Anglada *et al.,* 2007), organic resin (Nabi *et al.,* 2011a), coagulation/ flocculation (Shahadat *et al.,* 2017b), biodegradable nanocomposite (Shahadat et al., 2017b), hybrid ion-exchange adsorbents, incineration (Lin & Wu 2006), biomass (Rahman *et al.,* 2016), and nanocomposite material (Dong *et al.,* 2015). The techniques mentioned above characterized as conventional methods which involves elimination and recovery methods. Out of these techniques, adsorption is considered as most important technique for the treatment of dye effluents. Various adsorbents such as organic resin, graphene oxide, activated carbon, polyaniline, etc are used for the recovery and removal of dye effluents from the wastewater (Cazetta *et al.,* 2018, Banerjee & Chattopadhyaya 2017).

Nanomaterials

Nanotechnology refers to the study of extremely small structures in the range of 0.1 to 100 nm. The particle which lies in the range of 1-100 nm is termed as nanoparticles. Harmful pollutants including dyes, polychlorinated biphenyls, furans and dioxins, pharmaceutical and personal care products, phthalates, inorganic

pollutants, polycyclic aromatic hydrocarbons, viruses and bacteria, agrochemicals and pesticides, volatile organic compounds etc can be removed from the wastewater by using several cost effective, efficient and eco-friendly nanomaterials (Abdolmaleki *et al.,* 2017, Mallakpour *et al.,* 2017, Zare *et al.,* 2018, Prathna *et al.,* 2018, Tyagi *et al.,* 2018). Nanomaterials due to tunable pore size, high specific surface area (SSA) and related sorption sites, surface chemistry, short intraparticle diffusion distance have rapid adsorption rates and better efficiencies over wide range of pH as compared to conventional adsorbents. Low cost is needed for the fabrication of nanomaterials and only its small amount is utilized for efficient and effective dye removal. Hence for the adsorption use, these are effective in comparison to activated carbon due to less cost. Carbonaceous nanomaterials are one of the major class of nanomaterials, which comprise carbon nanofibers, fullerenes, graphene, and CNTs (carbon nanotubes). Carbonaceous nanomaterials due to higher affinity, high adsorptions kinetic and capacity are effective for dye removal from wastewater as compared to conventional activated carbon. Dyes are removed from the wastewater by π–π stacking, hydrogen bonding, covalent interaction, electrostatic interaction, and hydrophobic effect (Cai *et al.,* 2017, Shan *et al.,* 2017).

Coagulation–Flocculation

Sulfur and disperse dyes presented high coagulation and flocculation capacity while this method is not effectively applied for the color removal of acid, vat, direct and reactive dyes. Ethylediene dichloride, penta ethylene, and hexamine are the various co-polymers and ferric chloride, aluminum sulfate, copper sulfate, ferric, ferrous sulfate, and calcium chloride are the several coagulant agents which are generally used for color removal of colorants. The floc formed with the dyes is the mechanism behind the coagulation process and can be separated using filtration or sedimentation. The ability of settling of floc can be increased by dosing the polyelectrolyte during the phase of flocculation (Forgacs *et al.,* 2004). It is economic that only the separation of colorants is taking place. But the disadvantage of coagulation and flocculation process is the production of sludge (Valh *et al.,* 2011).

The characteristics of the suspended particles are changed in the coagulation method and floc are formed which sinks rapidly. The colloidal suspensions with negative charge are not effectively separated by conventional physical process. In coagulation process, electro kinetic repulsion between the particles is decreased by the addition of positive charge. Marmagne and Coste reported that in coagulation process, there is efficient removal of colour of sulfur dyes. The experiment was performed in bench flocculators, pH, temperature, and chemicals are the factors which affects the process of coagulation (Nguyen & Juang 2013).

Filtration Technology

For wastewater treatment, filtration technology is considered as a major part. Microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverses osmosis (RO) are the different filtration technology. Several promising results are shown by this technology for the color removal and for the process of water treatment, individual membrane is important. Various sorts of dyes are removed efficiently by the help of NF and UF but MF due to its large pore size is not sufficient for the treatment of wastewater. High membrane cost, high pressure, short life span, and momentous energy consumption are some of the limitations of this process and removal of organic contaminants or treatment of dyestuff are hindered by these properties. Salts rejections is better in case of RO. It is applied for recycling and gives improved results against several dye effluents in desalting and decolorizing.

Micro-Filtration

Dye baths consisting of pigment dyes as well as for rinsing baths are treated by this technique (Babu *et al.,* 2007). Chemical will remain in the dye bath which are not filtered by MF. Colloids, suspended solids or macromolecules having pore size of 0.1 to 1 micron are separated using MF and it is the pretreatment for NF or RO (Ghayeni *et al.,* 1998). For silt density index or turbidity, the performance of microfiltration is greater than 90. Poly (Vinylidene Difluoride), Poly (Ether Sulfone), Polycarbonate, Poly (Vinylidiene Fluoride), Poly Tetrafluoroethylene (PTFE), Poly (Sulfone), Polypropylene etc are the specific polymers from which MF membranes are formed. Operation at high temperature or where extraordinary resistance for chemicals are needed; carbon coated with zirconia, ceramic, carbon, alumina and sintered metal membranes, glass have been used. The operational velocities for micro and ultra filtration is 20 to100 cm/s and pressure is 20 to 100 (Ptm) (Naveed *et al.,* 2006).

Ultra-Filtration

This technique is used for the separation of macromolecules and particles, but only 31-76% dye is removed from this method. For reuse of treated wastewater for sensitive process such as textile dyeing is not permitted but for washing, rinsing etc where salinity is not a issue, the treated wastewater can be reused. UF can be used in combination with biological reactor, as pretreatment process for RO, and for metal hydroxide elimination (Naveed *et al.,* 2006). Polyvinyl chlorides (PVC), polytetrafluoroethylene (PTFE), polysulfone, acrylic copolymer, polypropylene, and nylon-6 are the various polymeric materials which are used for the formation of ultrafiltration membranes.

Nano-Filtration

This technique is used for the decoloration of effluents from the textile industries. Nanofilteration membranes are able to retain divalent ions, dyeing auxiliaries, organic compounds with low-molecular weight, hydrolized reactive dyes, large monovalent ions and they are normally made of aromatic polyamides and cellulose acetate. Nanofilteration and reverse osmosis membranes are manufactured by inorganic materials including carbon based membranes, ceramics, and zirconia. 5 to 30 Gross Flow per Day (GFD) is the flux rates for nanofilteration. By single nanofiltration, amount of removal of color greater than 90% were reported. Toxic effects of high concentration of dye > 1.5 g/L and mineral salts > 20g/L in the dye household effluents regularly reported (Tang & Chen 2002). The discharge of treated effluents in water streams is approximately unfeasible due to accumulation of dissolved solids. Textile decolorization of effluents by nanofilteration is fairly satisfactory.

Reverse Osmosis

Hydrolized reactive dyes, many types of ionic compounds, and chemical auxiliaries are removed by this technique in a single step and high quality of permeate is produced. Careful pretreatement of influent must be done because reverse osmosis is sensitive to fouling like nanofilration. Reverse membranes are generally made up of aromatic polyamides, inorganic materials, and cellulose acetate. In comparison to conventional treatments, membrane processes in combination with physio-chemical treatment has several advantages, such as decreasing the consumption of fresh water and the cost for wastewater treatment, decrease of regulatory pressure, capability to recover materials, costs of waste disposal can be decreased due to small disposal volumes. Several cost-effective applications in textile industries are associated with membrane processes (Naveed *et al.,* 2006).

Adsorption of Dyes

Adsorption is considered as an important method over other conservative approaches for dye removal from wastewater (Aljeboree *et al.,* 2014). Physical and chemical forces are responsible for the attachment of dissolved molecules to the surface of adsorbent in the process of adsorption. Wastewater treatment by activated carbon is widely employed. Combined adsorption and ion exchange or simply adsorption process is responsible for the removal of dye using activated carbon. Cost of operation, availability of adsorbents at low costs, and low initial capital are the factors which makes the wide applications of adsorption process for the elimination of textile contaminants. Various properties such as mechanically stable, ecofriendly, suitable

pore size, less processing procedures, easy accessibility, economic, compatibility, higher adsorption capacity due to large surface area, and regeneration capacity should be consisted by superlative adsorbent for adsorption of dyes (Vakili *et al.,* 2014).

Agricultural by-product, natural and modified clay (Ahmadishoar *et al.,* 2017), polymeric sorbent (Popescu & Suflet 2016), activated carbon (Tze *et al.,* 2016), industrial by-product, chitosan-based adsorbent (Çınar *et al.,* 2017), and resin (Naushad *et al.,* 2017) are the various adsorbents which are used for the removal of colouring agents.

Adsorbents

The contaminant which is absorbed is called adsorbate and the phase on which it is getting adsorbed is called adsorbent (Yagub *et al.,* 2014). Adsorbent plays a very important process in adsorption process. Great adsorption efficiency, low cost, long life, great selectivity, and broad availability are the necessary properties for the good adsorbents. Nanomaterials, activated carbon, and several low-cost adsorbents are utilized as adsorbents for removal of contaminants from wastewater (Toor 2010).

Activated Carbon

It is mostly used adsorbent for the elimination of wide variety of dyes from the contaminated water. It is non-graphitic form of carbon, internally porous microcrystalline. Micropore structures, great adsorption capacity, large extent of surface reactivity, large surface area are the factors which makes the adsorbents efficient for dye removal but the cost of fabrication and regeneration of adsorbent is too high. Extra effluent is generated during the regeneration by means of refractory method which causes loss of removal efficiency of adsorbent due to 10%–15% loss of adsorbent (Adeyemo *et al.,* 2017).

Low-Cost Adsorbents

Soluble organic dyes from wastewater are transferred to the adsorbent which is highly porous and solid surface. Adsorption is most effective and economic process for decolorization of textile effluents or dye elimination. Temperature, interaction of dye/adsorbent, pH, surface area of adsorbent, size of particle, and contact time are the main factors for the adsorption of dyes. There is need for the low-cost adsorbents due to low regeneration capacity and high cost of adsorbents. These adsorbents must present in considerable amount in nature, need minimum processing, and must be effective.

There are three categories in which low-cost adsorbents are divided:

1. By-products of industries and agriculture wastes like sugar industry mud, wood sawdust, fly ash, coal ashes, teak wood bark, wood chips, peels (banana, pomelo, garlic, jackfruit), papaya seeds, grounded sunflower seed shells, coconut tree flower, rice husk, grass waste, ground nut shell powder, rubber seed shell, neem leaf powder.
2. Various bioadsorbents like microbial, biomass, and fungi.
3. Various natural materials like glass wool, clay.

Mixed results are shown by these adsorbents and in very few cases these have adsorption capacity larger than activated carbons (Teng & Low 2012, Servos 2014, Suteu *et al.,* 2011a, Nazarzadeh *et al.,* 2018).

CONCLUSION

Dyes are natural and synthetic materials which impart color to the products and make the environment more beautiful but it is considered as harmful and can contaminant the water streams. From the literature review it is observed that there is increase in production and use of textile dyes in last few decades which cause threat to the environment. Textile sector due to large consumption of water sources is found to be considered as an important area. The presence of dyes even in small quantity is toxic to environment and should be eliminated before entering into the water stream. By mechano-physico-chemical and biological treatment procedures, dye removal from textile effluents can be achieved. Removal techniques for dye effluents from wastewater have drawn considerable interest.

Adsorption is considered as a cost effective and efficient technique for the removal of dye effluents from wastewater and hence can generate high-quality treated effluent. This chapter highlights on the removal of dye effluents from wastewater by using nanotechnology.

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KEY TERMS AND DEFINITIONS

Dye: Dye is a colored substance which provides color to another substrate through chemical bond with the substrate.

Effluent: Effluent is an outflowing of water or gas to a natural body of water, from a structure such as a wastewater treatment plant, sewer pipe, or industrial outfall, etc.

4

Conjugated Polymer Light-Emitting Diodes

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Abstract
The development of organic light-emitting diodes (OLEDs) has attracted considerable interest in innovations for our daily life and future. They have promising applications in flat panel displays, energy-saving, eco-friendly, thinner and smaller in size, lightweight, and cost-effective fabrication process. For the development of OLEDs, numerous conjugated polymers have been studied due to their semiconductor nature, which is being associated with pi bond delocalization along the backbone of the polymer chain. Conjugated polymers are highly recommended for electroluminescent devices such as OLEDs. The chapter comprises basic knowledge of polymer light-emitting diodes, their construction, device function, and use of conjugated polymers in blue, red, green, and multicolored light-emitting diodes along with challenges and their future perspectives.

Keywords: Conjugated polymers, organic electronics, OLEDs, PLEDs, band gap, blue, green, and red emission region

4.1 Introduction

Light-emitting diode (LED) is a semiconductor light source that emits light in response to an electric current [1]. In semiconductors, electron recombine with holes, releasing energy in the form of photons [2]. The color of the light (corresponding to the energy of the photons) is determined by the

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Inamuddin, Rajender Boddula, Mohd Imran Ahamed and Abdullah M. Asiri (eds.) Polymers for Light-Emitting Devices and Displays, (77–98)

energy required for electrons to cross the band gap of the semiconductor [3]. Nowadays, organic light-emitting diodes (OLEDs) have attracted considerable attention of researchers, scientists, and industrial aspirants and bring innovation to our lives due to its unique properties such as low-cost, wide viewing angle, flexibility, lightweight, low power consumption, and thin panel thickness [4–8]. OLED device architecture includes the use of an organic carbon-based film which is made up of some conjugated polymers, sandwiched between two charged electrodes. These electrodes are the transparent anode (generally glass) and the other is a metallic cathode [9]. OLEDs have smart features of ultra-thin and fine image-quality along with lightweight as self-emitting devices [10]. Nowadays, they are very familiar to general consumers and civilians due to their uses in smartphones like Samsung's Galaxy series as well as in the manufacturing of large TV displays [11]. OLED can be fabricated by small molecules or polymers. The former can be fabricated by vacuum deposition method and polymer organic light-emitting diodes (PLEDs) are generally developed by solution deposition method [12, 13]. The latter method has attracted wide attention due to its ease of preparation and low cost [14]. The process of fabrication of PLEDs can be carried out at room temperature so that organic flexible substrate can be a platform for device fabrication [15]. This technology allows polymers to fabricate full color PLED pixels by various printing methods or techniques like dye diffusion [16], laser-induced thermal transfer [17], screen printing [18], inkjet printing [19, 20], and patterning with the photolithographic process [21, 22]. In the comparison of small molecules OLEDs, these patterning methods make PLEDs more useful in the larger size and high-resolution display [23]. For PLEDs, three colors, i.e., red [24], green [25], and blue [26] used for full-color display for which various types of conjugated polymers have been proposed and synthesized.

Conjugated polymers are commonly referred as "Organic Macromolecules" having conjugation of the single and double bond in their polymer backbone chain that makes them intrinsically conducting in nature [27]. In these organic macromolecules, the overlapping of p-orbitals takes place resulting delocalized π-electrons system which is responsible for unique optical and electronic properties [28]. In conjugated polymeric chain, injection of hole and electron *via* π (bonding) and π^* (antibonding) can create a self-localized excited state by delocalization of charge in valence and conduction bands which on emission can decay radiatively and revealed outstanding potential in electroluminescent devices [29]. The generation of charge carriers such as polarons, bipolarons, and solitons are responsible for the conduction mechanism [30].

These conjugated macromolecules show changes in electrical and optical properties when doped or functionalized by chemical species [31]. A numerous variety of conjugated polymers have been developed and evaluated since 1977, since the discovery of electrical conductivity in polyacetylene discovered [32]. These materials include polyanilines [31, 33] and their derivatives such as poly(o-phenylenediamine) [34, 35], polyluminol [36, 37], and some other polymers like polypyrroles [38], polynaphthylamines [39–41], polythiophenes [42], polyanisidine [43], polycarbazoles [44–46], polyphenylenevinylene (PPV) [47], and their derivatives [48], polyphenylenes [49], polyfluorenes [50], and polyaryleneethynylenes [51]. These have attracted numerous industries and academics for a different type of optoelectronic applications. Conjugated polymers have drawn considerable attention due to their strong fluorescence emission [52], excellent hole transport ability [53], flexibility [54], and solution processability [55–57]. Numerous reports have been published regarding enhancement of processability of conjugated polymers by blending or composite formation [58–61].

Conjugated polymers which are processable by solubility are the most promising candidate for optoelectronic devices such as LEDs [62]. Enhanced solubility and processability of conjugated polymers help in preparing an emissive electroluminescent thin film of organic compound which emits light in response to an electric current in optoelectronic devices [63, 64]. Chemical structure and extended conjugation in such type of polymers provides controlled morphology, enhanced solubility and processability for using them in OLEDs *via* preparing an emissive electroluminescent thin film of organic compound which emits light in response to an electric current [65]. In addition, extended conjugation also provides a low band gap as a functional property for these applications [66].

4.2 History, Classification, and Characteristics of Polymer OLED Material

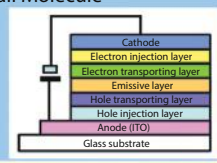
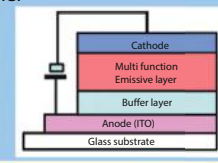
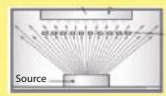
In Cambridge University, a group worked on conjugated polymers and found electroluminescence in these materials in 1989 [67]. In this finding, the device had a very short lifetime of some minute and very weak external quantum efficiency (EQE) of 0.1%. Some of the companies worked on the progress of polymer OLEDs material and optimization of these devices fastly such as Sumitomo Chemical Co. Ltd, Cambridge Display Technology (CDT), Dow Chemical and Covion, etc., and the result of the research was

achieved as several tens of thousands of hours long lifetime and high EQE of about 5%~10%.

OLEDs material can be broadly classified into two groups on the basis of emissive materials which includes small molecules based OLEDs and polymer-based OLEDs [68, 69]. Small molecules-based OLED can be fabricated by the vacuum deposition method [70] and polymer-based OLED can be developed by the solution deposition method, Table 4.1 [71]. The polymer material can be conjugated or non-conjugated further for the fabrication of OLED while dendrimers play the role of intermediate of polymers and small molecules, Figure 4.1. The multilayer device structure is used in small molecule OLEDs, and so there is a requirement of more amendments in chemical structures in addition to solubility while polymeric material to form OLEDs is willingly soluble by ink solvents and makes it a useful material for wet process or printing process discussed earlier in Section 4.1.

Copolymerized or modified conjugated polymeric materials work without a multilayer structure in OLEDs [72]. In these devices, one of the most important parameters in emission color and this is controlled by incorporation of emissive moieties into the polymeric backbone, which is generally a wide band gap structure [73].

Table 4.1 Comparison of small molecule LED and polymer LED *(Reprinted from Chizu Sekine et al., 2014 Sci. Technol. Adv. Mater. 15, 034203).*

	Small Molecule	Polymer
		
Process	Dry process (Vacuum evaporation) 	Wet process 
Patterning	Shadow mask	Printing (IJ etc.)
Structure	Complex layer structure (5-6) →Complex process	Simple layer structure (2-3) →Simple process, scalable
Material	Separated function	Integrated function
Issue	Layer structure complexity Difficulty in mask patterning	Performance (esp. LT) Patterning technology

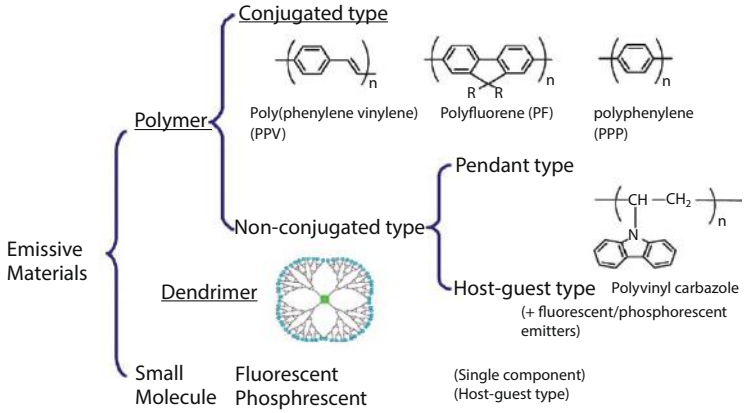


Figure 4.1 Classification of polymers according to emissive materials. (Reprinted from Chizu Sekine *et al.*, 2014 *Sci. Technol. Adv. Mater.* 15, 034203).

4.3 Polymer OLED Device Construction and Working

An OLED is a 100- to 500-nm-thick solid-state semiconductor device and about 200 times smaller to human hair [74]. The structure of OLED comprises a cathode, an emissive layer, a hole injection layer and an anode. In OLED there is an interlayer sandwiched in between cathode and anode electrodes [75]. The interlayer is composed of an organic layer in which the delocalization of pi electrons takes place and make this layer conductive in nature [76]. These materials are known as organic semiconductors due to the conductivity between conductors and insulators [77]. In organic semiconductors, their HOMO (highest occupied molecular orbitals) and LUMO (lowest unoccupied molecular orbitals) are considered as valence and conduction band present in the inorganic semiconductor [78]. An interlayer between hole injection and emissive layer makes an improvement in the device structure as well as in its performance due to cross-liking properties of the interlayer [79]. In polymer OLEDs, an interlayer is responsible for the enhancement in the emission efficiency. This layer is placed in between the hole injection layer and the emission layer. The function of this layer is hole-transporting as well as electron and exciton blocking. In summary, this layer is responsible for the separation of the hole injection layer and emission zone, as well as due to its electron blocking property, it accumulates electrons at the interface of the interlayer [80]. However, modern

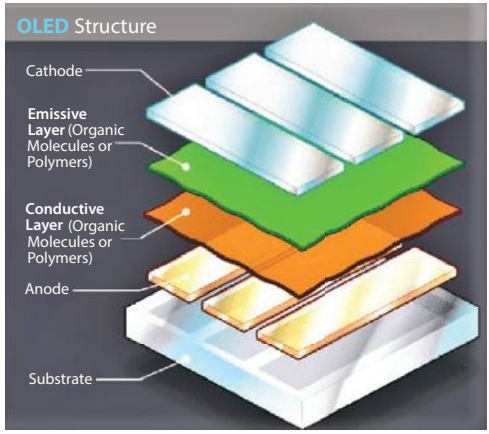


Figure 4.2 The basic OLED device architecture. Source: https://electronics.howstuffworks.com/oled1.htm.

OLEDs are fabricated by a very simple bilayer structure having a layer of emissive material and other is conductive material [9]. The basic OLED structure is shown in Figure 4.2.

Polymer OLEDs device performance is based on its emission efficiency and its lifetime. Its emission efficiency was discussed by Tokito and his labmates [81] and expressed as:

$$\Psi = \Upsilon.n_{e-h.}\Psi_{ph}.(1 - Q) \tag{4.1}$$

In the above equation, Ψ stands for electroluminescence efficiency, Υ stands for carrier balance for electron and hole, Ψ_{ph} stands for photoluminescence efficiency, and Q stands for quenching factor. It can be stated by the equation that by improving carrier balance for electron and hole, by enhancing photoluminescence efficiency and recombination rate or by suppressing cathode quenching, device performance can be improved in terms of electroluminescence efficiency.

4.4 Blue Light-Emitting Diodes

Various types of conjugated polymers have been proposed for blue light-emitting diodes which were highly soluble and reveled strong blue fluorescence or emit blue light in 350–440 nm range without any excimer

formation on longer wavelength [82–85]. For blue OLED, some phenylene chains have been polymerized by meta linkage and displayed 4.69 cd A^{-1} efficiency [86].

In this regard, carbazole is a rigid plane biphenyl monomer having a wide band gap along with its high flexibility and high luminescent efficiency which helps in modification of the molecule skeleton for its use as a key chromophore in OLEDs [87, 88]. These are extensively used in the development of highly competent blue light-emitting diodes as a key role of host and charge-transporting materials [89]. By derivatives of carbazole, Morin [90] and his coworkers developed light-emitting diodes by electron and hole transport molecules, i.e., 2-(4-biphenylyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole and N,Ń-diphenyl-N,Ń-bis(3-methylphenyl)-1,1′-biphenyl-4,4′-diamine, respectively, which showed electroluminescence in 424–432 nm wavelength (blue region) with Al and indium tin oxide as the electrodes. They also developed 2,7 carbazole based blue light-emitting copolymers with some other highly aromatic comonomers by Yamamoto or Suzuki cross-coupling reactions. These high molar mass modified with substituent species were highly water-soluble and amorphous in nature as well as these showed good redox properties and thermal stability for their application in layer blue light-emitting diodes [91].

Numerous works have also been reported on polyfluorenes that is also a blue light-emitting material [92]. Although, polyfluorenes exhibited promising features, literature suggested the tendency of forming excimers and aggregation which caused shifting of emission spectra towards longer wavelengths or showed bathochromic shift and decreases fluorescence quantum yields [93]. To remove such type of problems, scientists and research have done a number of studies and done functionalization by bulky side substituents or copolymerization with other monomers or by introduction of lithe spacers amid the chromophores [94–98]. Oligo(9, 9-dihexyl-2,7-fluorene ethynylene)s were synthesized by Tsutsui *et al.* [99] for extraordinary photoluminescence having high quantum yields as well as high oxidative and thermal stability for their use in OLED application. Chan *et al.* [100] developed poly(9,9-dihexyl-2,7-dibenzosilole) by copolymerization of monomers dibromo and bis(boronate) which showed better efficiency in a single layer light-emitting device in comparison of polyfluorene.

4.5 Green Light-Emitting Diodes

Seino and his labmates developed a green organic light-emitting device (OLED) whose power efficiency was too high (100 lm W^{-1}). This was

achieved *via* energy transfer from an exciplex and it was 1.6-times higher than green thermally activated delayed fluorescence (TADF) OLEDs [101]. Tanaka *et al.* [102] developed highly efficient green organic light-emitting diodes (OLEDs) using a conjugated polymer dipyridylphenyl moieties and fac tris(2-phenylpyridine)iridium, $Ir(ppy)_3$ as a phosphorent emitter and yield 29% at 100 cd/m^2 and 26% at 1000 cd/m^2 external quantum efficiencies which were too high and lead to 133 lm/W and 107 lm/W ultra high power efficiencies at 100 cd/m^2 and 1000 cd/m^2 respectively. A highly efficient green OLED was fabricated by using 9,9-diarylfluorene-terminated 2,1,3-benzothiadiazole derivative in Ku's lab [103] which revealed EQE (ηext) of 3.7% and maximum brightness at 168,000 cd m^{-2}. Zhu and his coworkers [104] proposed green and blue-green phosphorescent OLEDs based on tetraphenylimidodiphosphinate and iridium complex. These were highly efficient, due to shorter excited stated lifetime and better carrier transport ability along with good electroluminescence performance. 3′,5′-di(carbazol-9-yl)-[1,1′-biphenyl]-3,5-dicarbonitrile was used as a host material for green thermally activated delayed phosphorescent and fluorescent OLEDs by Cho *et al.* [105]. This materials showed high quantum efficiency close to 25%. Chen [106] and his coworkers achieved highly efficient green phosphorescent OLEDs by 1,3,5-Triazine derivatives as new electron transport-type host materials. A dicarbazole-triazine hybrid bipolar host material was developed in which dicarbazole moiety is electron donor and triazene is electron acceptor. This device was highly efficient green phosphorescent OLEDs having maximum efficiency of up to 20.0% [107].

4.6 Red Light-Emitting Diodes

Red OLEDs have an emitting layer comprising of one material during their initial development. Okada *et al.* [108] developed a highly efficient complex for red OLED by using 1-phenylisoquinoline. The complex revealed emission peak in the red region, i.e., 598–635 nm, the quantum yield of 0.17–0.32 and lifetime of those complexes ranged 1.07–2.34 μs, respectively. Jung and his labmates [109] reported red organic light-emitting devices (OLEDs) by incorporating various donor-acceptor moieties in polymeric backbone which showed emission at 637–677 nm and highest brightness of 8,300 cd m^{-2} with 4.46% maximum EQE at 7 V, the current efficiency and the power efficiency was found 3.43 cd A^{-1} and 1.64 lm W^{-1}, respectively. 3-2-(3,3-dicyanomethylene-5,5-dimethyl-1-cyclohexylidene)

vinyl-N-naphthyl-carbazole(NCz-2CN)and3,6-bis(2-(3,3-dicyanomethylene-5,5-dimethyl-1-cyclohexylidene)vinyl-N-phenyl-carbazole (PCz-4CN) which are derivatives of carbazole were used as donor-Л-acceptor for obtaining red OLEDs by Fu *et al.* [110]. They emit in red region 630–666 nm and maximum luminance of 4,110 cd/m^2 attained at 15 V. The current efficiency was found 2.09 cd/A while maximum luminous efficiency was found at 0.49 lm/W.

4.7 Multicolor Light-Emitting Diodes

Bouillud *et al.* [111] presented conjugated polymers based on fluorene with the incorporation of thiophene and phenylene moieties in their copolymer having outstanding properties of tunability of the electroluminescent properties. By changing the composition of comonomers, it has the ability to change their emission from blue to green or yellow. They also suggested hole injection and hole transport phenomena by the addition of an insulating buffer layer as well as the hole transporting material into the material. This electroluminescence efficiency was increased from 4.5 to 125 cd/m^2 by incorporation of N,N'-diphenyl-N,N'-bis(3-methylphenyl)-1,1-biphenyl-4,4'-diamine as the hole transporting layer and LiF as an insulating buffer layer.

Wong and his coworkers [112] studied the use of conjugated and non-conjugated polymeric backbone in terms of synthesis, physical properties, sample quality, and device performances for blue, green, and red OLED materials (Figure 4.3), while Chou *et al.* [113] prepared universal bipolar host by phosphine oxide and two carbazole groups for blue, green, and red phosphorescent OLEDs which was highly efficient.

4.8 Advantages of OLEDs over Other Liquid Crystal Display

OLEDs revealed many advantages with other conventional liquid crystal displays (LCDs) such as polymer OLEDs that show different colors such as red, green, blue (RGB) as well as white too which is important to many applications [114, 115]. OLEDs are biodegradable. An OLED display can be many times lighter, more flexible, and thinner compared to LCD, as well as it can display deep black levels because it works without a backlight [116]. These are much brighter as compared to LCD.

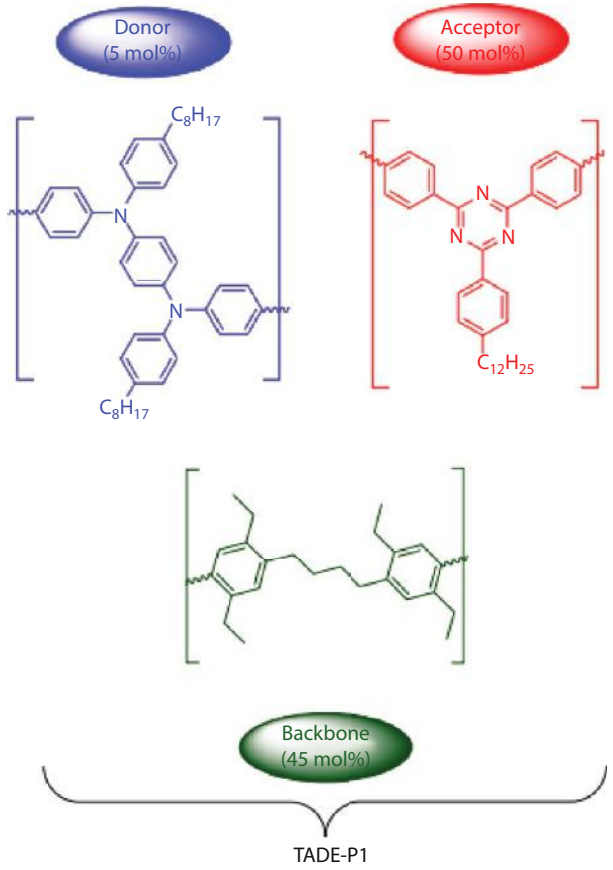


Figure 4.3 Functionalized conjugated polymer having donor (5 mol.% triphenylamine), acceptor (50 mol.% 1,3,5-triazine) and backbone (45 mol.%) with an insulating n-butyl link (*Reprinted from Michael Y. Wong, 2017, Journal of Electronic Materials. 46, 6246–6281).*

These have the active light-emitting capability as well as the OLEDs are driven by the direct current with 10-V approximate voltage [117]. They are also highly efficient in a light color so that full-color display can be realized easily and in place of early vacuum display devices, these are all-solid-state devices [118]. In addition, they have a lithe information display technology with low energy consumption and high light-emitting efficiency [119]. These devices have outstanding light-emitting properties and temperature features which least affected by temperature fluctuations and faster response time. They are easy to prepare at a very low cost [120].

4.9 Applications of OLEDs

In 2003, Kodak has used OLED in the fabrication of its first digital camera [121]. OLEDs are widely being used in the latest smartphones, DVD players, digital cameras, digital watches, etc., due to its high flexibility and foldability which helps in saving space and weight [122]. After this, numerous companies have used this technology in their products including Nokia [123], Samsung [124], etc. Since the year 2019, OLED screen is readily used in many mobile phones including Honor view 10, Nokia 6.1 plus, Samsung Galaxy A8+, Vivo V15 Pro, Gionee S11S, OnePlus 7 Pro, etc., and in TV such as Sony Bravia Android Smart OLED TV KD-55A8G, LG Smart TV OLED55C8PTA, METZ Android OLED TV M55S9A, etc. OLEDs have also applicable in high-end television systems, flat-panel displays, computer monitors, some pocket-size systems like digital cameras, portable gaming consoles, media players, android phones, and mini-screens [125–127].

These are also widely used in various multiple-input output wireless optical channels [128]. Some other applications of OLED are shown in Figure 4.4.

4.10 Challenges and Future Possibilities

OLED has a wide area of applications in different areas, but still, there are many challenges involved in this technology such as its is costly in

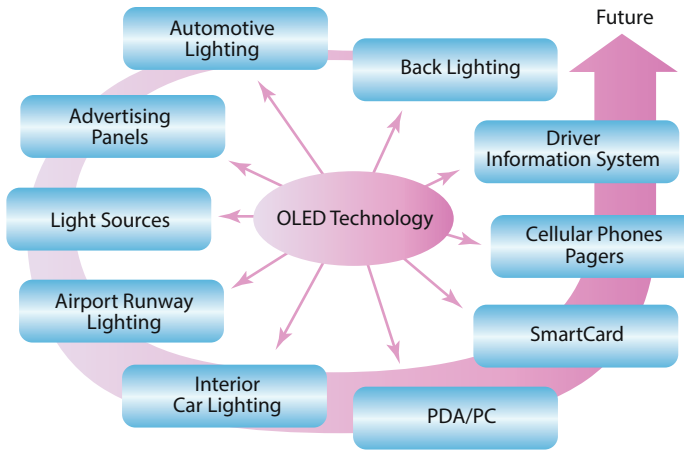


Figure 4.4 Applications of OLED. Source: https://www.elprocus.com/oled-display-technology-architecture-applications/.

comparison to LCD or LEDs. There is still a lack of a broad range of products incorporating OLEDs. Light efficiency is still low and compared to other display devices, their lifetime is shorter. Red, green, and white LEDs give longer lifetime but the blue OLED revealed a limited lifetime of 1.6 years. Technology is highly sensitive to water so can be damaged by moisture. When OLEDs compared with LCD in direct sunlight, these show worse scenario. In the future, these problems can be resolved by using various types of technologies and conjugated polymers. OLEDs can be used for curved display in the future as well as transparent displays entrenched in windows. The property of flexibility of OLEDs maybe uses in roll to roll manufacturing process which allows flexible display architecture. Flexible, stretching, and self-healing materials need to incorporate for OLED device fabrication that can also improve barrier layers to protect OLEDs from moisture and oxygen. By removal of triplet exciton from conjugated polymer backbone could expressively enhance the device stability, specifically at the initial stage of pouring, i.e., *via* the introduction of additive which quenches lead the high efficiency and device lifetime. For this, various features of polymers could be introduced in single polymer *via* its copolymerization, doping, medication, or *via* functionalization of monomers then copolymerization.

4.11 Conclusion

Great progress has been done in the synthesis of conjugated polymers for OLED device fabrication. By modification, copolymerization, doping, and other techniques, those materials are being prepared which helps in applications of electron transport materials to improve the device fabrication and performance of OLEDs. The efficiency of the OLED device is dependent on charge injection, charge transport, and emission. The combination of phosphorescent emitters and conjugated polymers is very important to achieve high efficiency. For this point of view, many functionalized or copolymerized conjugated polymers have been investigated having various features in a single polymeric material as conjugated polymers having delocalized pi electrons in their backbone possess brilliant charge carrier transport properties so by incorporation of various moieties conjugation length could be controlled or tuned for further improved modifications in OLEDs.

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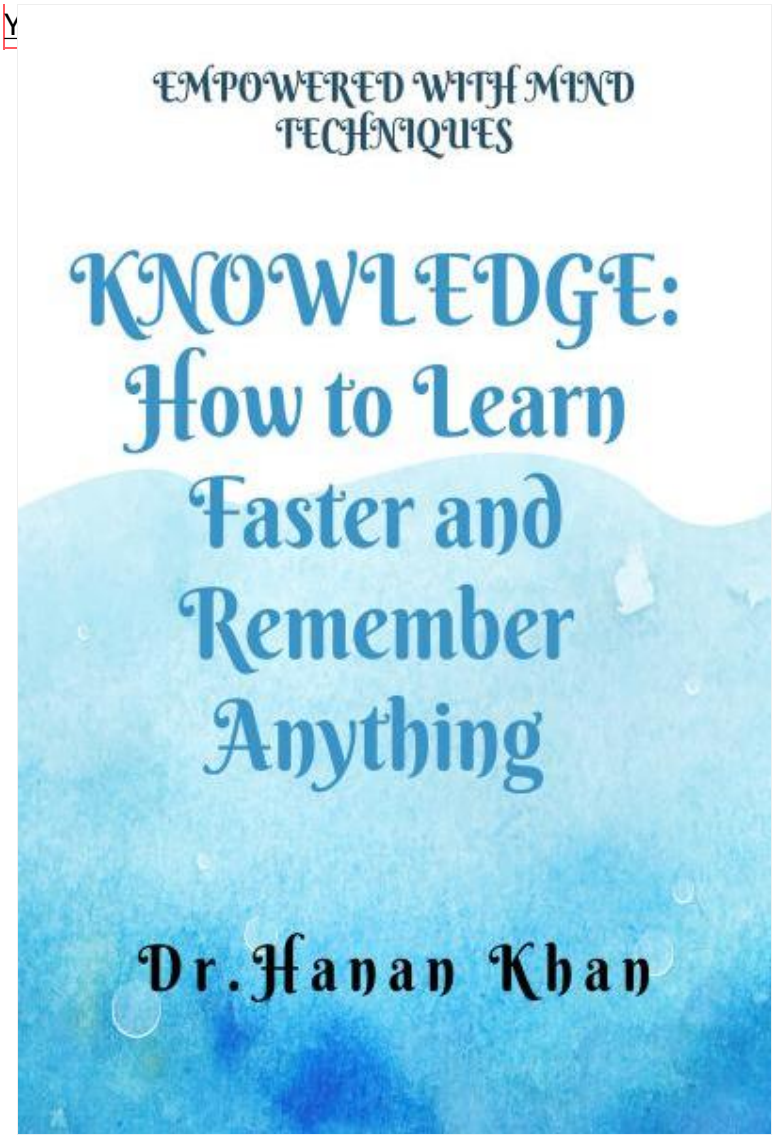

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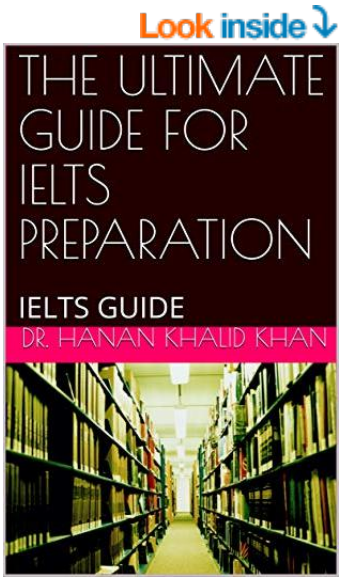

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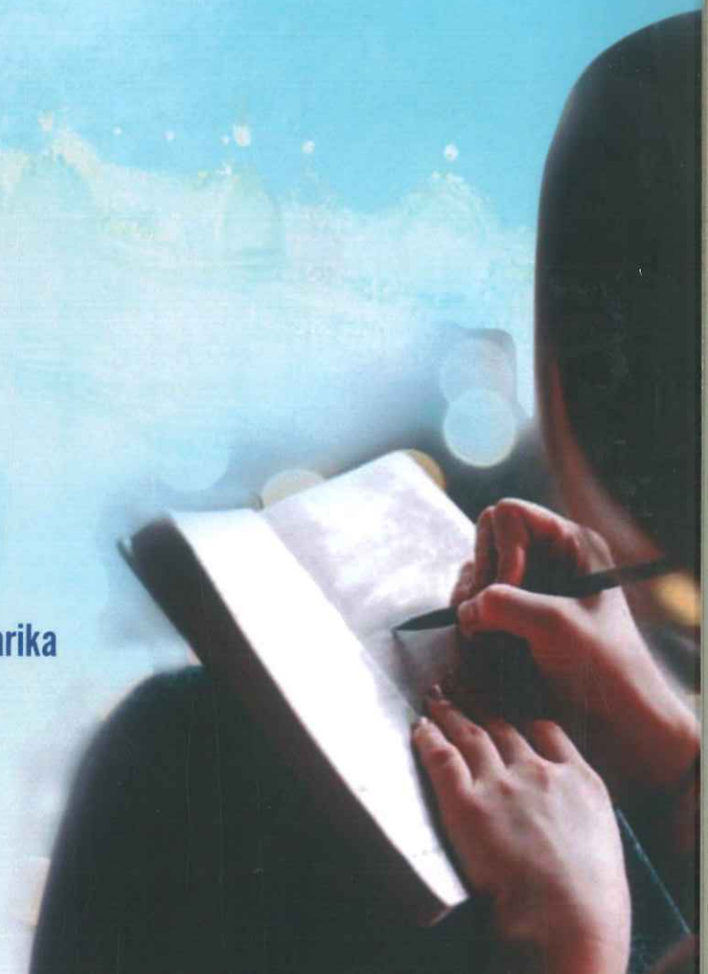

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The Issue of Identity, Hybridity and Assimilation in the Diasporic Poems of Sujata Bhatt

Rashmi Maniar, Hanan Khalid Khan and **Lavanya Paluri**

More women poets are leading to present the world in its multi-dimensions, in various ways, in Indian writings in English. In other words, they give us a complete understanding of human nature without leaving out any aspect of life. Sujata Bhatt is a well-known name among Indian women poets who write in English. She is an Indian diaspora poet who expresses herself through poetry. She uses her experiences on three continents creatively in her writing, which is rooted in multiculturalism. Sujata Bhatt's diasporic experience does not stifle her creativity; rather, it provides her with a range of viewpoints that broadens her comprehension of life's complexities. Trans-cultural migrants have become a kind of psychological refugees in this age of accelerated globalisation, as a result of crossing complex geographical and cultural boundaries. They strive to forge a sense of stability – a sense of identity – while stuck in the confluence of pluri-cultures. Her poetry engraves a homing impulse while simultaneously denying fixed-source discourses.

The picture of a home that is located at a distance – with reference to both space and time, is at the heart of the diaspora concept. For Diasporans, home is the point of origin where they come together to form their identity. While there are those who believe the two are separate, there are others who believe they are not. In academic assessments of diaspora communities, the impression of 'home' and 'homeland' is significant. The importance of home (land) in the emergence and evolution of the diaspora idea is enormous, even today. This picture of the original house is created in the mind of the first owner. generation, as well as in the diasporic consciousness of the first, second, or third generations of migrant workers Contemplation and recollection are embedded in a homeland, from which the concept of home emerges. As a result, home is a place where one lives; it is a concept that is infused with thoughts, emotions, and fantasies. Diasporans live in the mythical homelands of their forefathers

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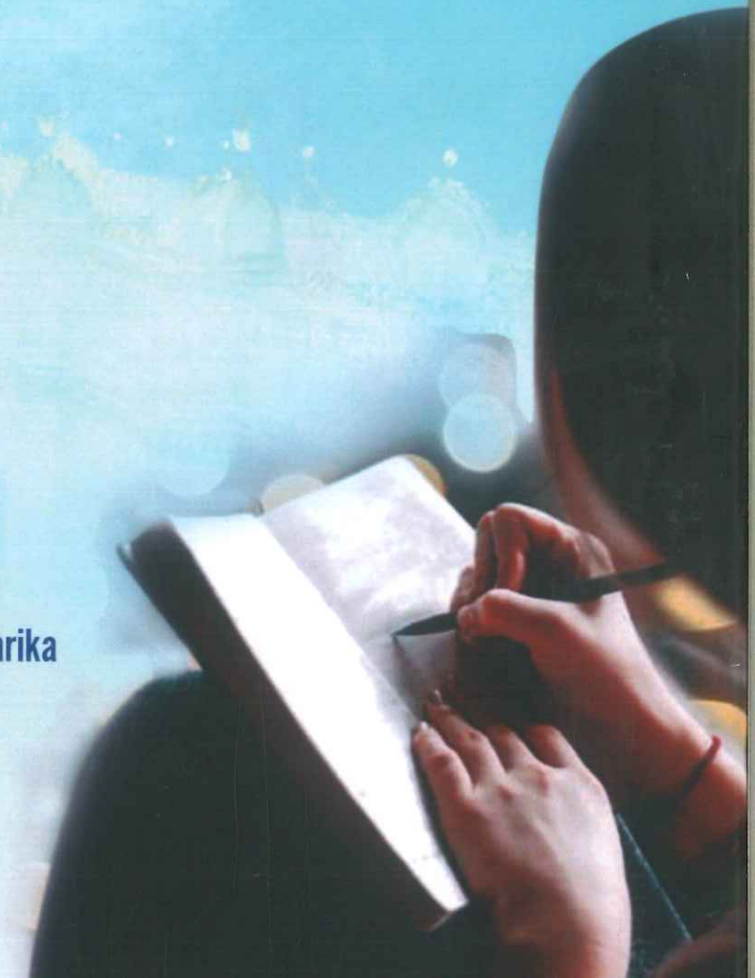

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Identity Conflicts in Diaspora Communities

Priya Raghav and **Vandana Kaushik**

The concept of 'Diaspora' refers to the physical dispersal of the Jews all over the world from Palestine. The Webster's dictionary defines Diaspora as people settled far from their ancestral homelands. The double consciousness that people from most diaspora communities face has led to the emergence of hybrid identities. However their fate like *trishanku* is conflicted. This is something that has been well documented in literature and films. When confronted with an alien environment there are those for whom home becomes an imaginary utopian dream. The anguish to find one's roots and origin comes from being rejected as an outsider or the other. The desire of belonging somewhere, the desire of an individual to claim a country as his/her homeland is inherent in everyone. Diasporic communities are in that in between space where they are caught up between two cultures, two languages, two nations and a fractured identity. They can neither belong to the country they originated from nor can they completely assimilate with the new one. Like Salman Rushdie writes, 'Imaginary Homelands' is all about the feeling of belonging nowhere. Thus in this paper I will try to map out how complex and significant the idea of identity is for diasporic communities specifically in context of globalisation.

Introduction

The story of the Indian diaspora can be traced back to the colonial period, when the British sent Indians across their empire for various purposes. Indians worked as indentured laborers, civil service workers, or small merchants for the British. The aftermath of World War II, saw Indians migrating to various parts of the world for work, education and a host of other reasons. The Indian Diaspora is a generic term used for referring to people who have migrated from the territories that are currently within Republic of India. It encompasses NRIs (Non-resident Indians) and PIOs (Persons of Indian origins). The Indian Diaspora is estimated to be over thirty million. The importance of Indian Diaspora is significant, as it has brought economic, financial, and global benefits to India. The Indian Diaspora currently constitutes a powerful, and in some respects unique, force globally.

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ISBN: 978-91-987581-0-8
ISBN-10: 9-19-875810-1
DIP: 18.10.9198758101
DOI: 10.25215/9198758101
Price: kr 100

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INDEX

ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.001

PROBLEMS OF DEVELOPMENT OF LOWER-CLASS WOMEN

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❖ ABSTRACT:

Women have made significant contributions in many ways to the agricultural system of agricultural India. Men as well as their rural economic activities have a huge role to play. But women do not get as much wages and respect as male farmers or workers. In particular, lower-class women in many cases play a major role in the family production system and economic activities. In many cases they participate in economic activities as a complement to the family. But in terms of Indian census or other criteria, women have been repeatedly neglected. That is why we see that even if women participate in a large number of economic activities, or do a lot of work as a complement to men, in many cases they are not considered as workers. As a result, women are being identified as unemployed in economic terms. This research article highlights the barriers to women's develpoment and why they are neglected.

Keyword: *Agricultural system, Obstruction of women, Peasant-workers, Humiliation of women*

Indian lower-class women have been engaged in various manufacturing and financial occupations since ancient times. In ancient India, ‘Shudra’ women engaged in various financial activities, including animal husbandry and agriculture, and shared the financial responsibilities of the family with their husbands. There are many instances where the responsibility of repaying the debt of the husband fell on the wife. It is mentioned in Kautilya's Arthashastra.[1] Lower class women have saved upper and middle class families from being employed in various financial

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occupations and have also helped in maintaining economic balance in the society.

The vast majority of women workers employed in various sectors of the Indian economy still come from the lower castes. Although upper-middle class women are now employed in various productive and financial jobs, they are only a fraction of the female workforce.[2]According to the 1991 census, 51.56 % of males and 22.73 % of females in India are workers who are engaged in various productive activities in the economy of the country. And according to the 2001 census, 52% of male workers and 26% of female workers, the percentage of female workers here is much less than that of male workers. Because many women engaged in productive work have been shown as unemployed in the census report. These workers are further divided into 'non-workers' and 'marginal workers'.Those who have been employed for 183 days or 6 months in the previous year are 'mainly employees' as defined in the census report. And those who were employed less than 183 days in the previous year are 'marginal workers'.

Table-1
Percentage of all India Women & Men, 1991 & 2001

Men 1991	**Women**	**Men 2001**	**Women**
Workers 51.56	Workers 22.73	Workers 52.0	Workers 26.0
Mainly workers 50.62	Mainly workers 16.48	Mainly workers 87.3	Mainly workers 57.3
Marginal workers 0.94	Marginal workers 6.25	Marginal workers 12.7	Marginal workers 42.7

[Source: Census of India, 1991, Series:8 Paper 1 of 1991, Supplement; Census of India 2001, Series 1, Primary Census Abstract, Total Population.]

Table-1 shows that between 1991-2001, the percentage of female 'mainly workers' increased slightly more than 3 times, but the percentage of female 'marginal workers' increased almost 7 times.And in 2001, the rate of female 'marginal workers' (42.7 %) was three and a half times that of male 'marginal workers' (less than 183 days a year as temporary and contract workers) (12.7 %). This means that most of the female workers

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are contract and temporary workers, whose work has no security. There is also no doubt that a large proportion of women workers belong to Scheduled Castes/Scheduled Tribes and Other Backward Classes, although the latest accurate average figures for the whole of India are not available.A quote from the National Sample Survey (1977-78) is pertinently quoted here, *"The workforce participation rate among the SC/ST women is much higher compared to women from other castes and there is evidence of higher incidence of casual labor amongst these women."*[3]

Table-2
Percentage of Women & Men Workers of North-eastern India

Region	Men **1981**	Women	Men **1991**	Women	Men **2001**	Women
All India	52.67	19.67	51.56	22.73	51.9	25.6
Arunachal	58.63	45.67	54.21	39.61	50.6	36.5
Meghalaya	53.96	37.49	49.09	36.69	48.3	35.1
Mizoram	52.54	37.72	54.37	43.94	57.3	49.5
Nagaland	52.58	43.20	48.61	39.25	46.7	38.1
Manipur	46.40	39.48	45.36	37.50	48.1	39.0
Sikkim	57.22	37.61	53.60	52.74	59.4	38.4

[Source: Census of India, 1991, Series8: Paper 1 of 1991, Supplement; Census of India 2001, Primary Census Abstract, Total Population.]

Everyone knows more or less about the hard work of Scheduled Caste (Indigenous) women.Table-2 shows that the average rate of women workers is much higher than the average of women workers in the hill states of north-eastern India inhabited by tribals. In 1991, Meghalaya had the lowest rate of female workers among the 5 indigenous hill states, at 36.69 per cent. But even this lowest rate is much higher than the average rate of female workers in India (22.73%). The highest female worker rate in Sikkim is 52.74 %. This rate is almost equal to the percentage of male workers there (53.60%) and more than double the average rate of female workers across India. However, it is noteworthy that the average rate of female workers in Sikkim has increased significantly between 1981 and 1991. Between 1991 and 2001, the number of male workers in India increased slightly, but the rate of female workers increased significantly. In 2001, the female labor rate (49.5%) was highest in Mizoram. Thus, a large proportion of working women in this country are employed in 96%

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of the unorganized sector, of which agriculture and agric-related manufacturing are the major sectors.

Table-3
State-wise percentage of Women & Men Workers rural areas, 1981, 1991 & 2001

State		Farmer			Agricultural workers		
		1981	1991	2001	1981	1991	2001
Andhrapradesh	Men	45.08	39.07	34.30	31.46	37.29	34.20
	Women	25.71	24.55	27.40	62.02	63.23	53.60
Bihar	Men	51.92	50.82	37.20	33.69	36.13	42.70
	Women	26.73	33.05	24.20	65.61	60.12	62.70
Gujrata	Men	54.15	49.49	44.50	23.72	24.57	3.30
	Women	34.61	35.48	33.30	53.74	49.84	34.70
Hariyana	Men	55.48	49.78	46.90	19.15	23.52	12.80
	Women	59.39	57.17	51.90	25.72	29.04	12.70
Punjab	Men	48.81	46.11	39.08	28.12	30.32	19.90
	Women	09.72	28.03	16.10	42.59	34.09	14.30
Orissa	Men	56.91	54.52	44.40	24.70	25.37	30.00
	Women	26.26	27.77	30.60	57.21	57.50	37.20
Tamilnadu	Men	43.82	37.82	31.70	30.95	35.89	30.06
	Women	28.50	24.63	29.20	60.07	59.80	46.30
West Bengal	Men	42.87	40.84	30.05	31.79	30.00	27.10
	Women	18.09	20.22	14.30	48.44	45.47	30.00
India	Men	55.03	51.61	45.20	24.19	24.19	23.10
	Women	36.94	38.58	41.50	50.36	48.43	35.60

[Source: Census of India, 1991, Series:8. Paper 1 of 1991, Supplement; Census of India 2001, Series 1, Primary Census Abstract, Total Population.]

According to the 1991 census, 80% of rural workers are engaged in agriculture, which accounts for about half of the national income. There was no significant change in 2001 either. And most of the women workers are associated with this agriculture. But the surprising thing is that the actual evaluation of the contribution of women in the agricultural economy has not been done even today.[4] Table-3 shows that in 1991, 87.01% of female workers in rural areas were involved in agricultural

ISBN: 978-91-987581-0-8

production, while 78.09% of male workers were involved in agriculture.In other words, the employment rate of female workers is much higher than the employment rate of male workers in agriculture in rural areas. But 38.58 % of the women workers engaged in agriculture are farmers and 48.43 % are agricultural workers. Among the male workers, 51.61 % are farmers and only 26.48 % are workers. In other words, the percentage of female workers in agriculture is almost double that of 48.43 % of male workers (26.48). In 2001, the percentage of males (45.) was less than that of females (41.5). The percentage of female agricultural workers (35.6) is much higher than the percentage of male workers (23.1).

It is to be noted here that even if a person is a landless shareholder or supervises the cultivation without any cultivation, he is considered as a farmer in the census report. He has been caught as an agricultural laborer if many people work on the land only for exchange of wages.[5] Many times when men in rural areas are engaged in various alternative jobs in urban areas, women are the ones who supervise the cultivation with the help of laborers and grow crops on the family land. According to the definition, these women also fall into the category of wage farmers. However, according to Table-3, in the three decades of 1981, 1991 and 2001, the main position of women in agriculture was as laborers, not as farmers.

There are, of course, many differences in the rates of agricultural labor in different states, such as in the employment of different castes and classes. In rural areas of Andhra Pradesh, Bihar, Orissa and Tamil Nadu, in 1981 and 1991, more than 55% of women workers were laborers. In 2001, more than 50 per cent women workers were employed in Andhra Pradesh.The percentage of women workers in Bihar was the highest (62.7 %). In fact, the percentage of women workers largely depends on the economic status of different states, class differences and the rate of female education.

The percentage of women workers in West Bengal in 1981 and 1991 was 48.44% and 45.47% respectively. In 2001, West Bengal had 14.3 % female farmers and 30 % laborers. Compared to other states, the percentage of women farmers and laborers is moderate.However, many of these women workers are marginal workers who have the opportunity to work 183 days a year or less for six months. Most of the female workers work only during the growing season, usually from April to July. Other

ISBN: 978-91-987581-0-8

times they have to look for alternative jobs. And for this purpose, women often have to move to urban areas.

Usually men plow the land, level the land, irrigate, apply chemical fertilizers, and sometimes sow the seeds. The cleaning of weeds, re-planting of seedlings, re-planting of green manure, dung manure, harvesting of crops, taking of crops home by head, sifting of crops, sorting are usually done by women.[6] The work of clearing weeds and planting seedlings elsewhere is generally considered to be the work of women.These two things are not usually done by men. However, sometimes men also do other work specific to women.

However, one thing to note is that according to the definition of the census report, women engaged in domestic work fall into the category of 'non-workers'. As a result, many women involved in agricultural production have been left out of the 'workers'. But a lot of women's agricultural work falls into housework and general household chores.[7]The percentage of women workers is bound to be much higher than the rate shown in the census report if women are involved in these activities related to home based agriculture. Thus it can be said that the census has devalued the work of women as agricultural laborers.

Many of the women's work in agriculture are housework. For example, women usually do housework, drying, warehousing, drying hay, as well as cooking for wage laborers in a farming family.In other words, in a farming family, a lot of work related to farming belongs to women's household. But these household chores directly involved in agriculture are not considered productive work in the census and these workers are called 'non-workers'. But there is no denying that these 'unemployed' or unpaid women have a special role to play in increasing agricultural production.

It has been seen that the exchange value of different work based on home is a lot.If the work related to farming is done standing in the field, it will be 'employed', and if the work related to production is done within the family, it will be housework and 'unemployed'. Needless to say, it is not reasonable to accept such an argument. But through this the contribution of women in agricultural production is being underestimated. There is no denying that the less time men have to work in the field and the less fruit they produce as a result of not doing these things in the

ISBN: 978-91-987581-0-8

family, the greater the contribution of these women to agricultural production.

Besides, women have to cook for the whole family at home, gather wood, leaves or fuel for cooking, deliver food to the field for men, etc. There are also many other household chores such as caring for cows and calves, feeding, etc.[8] The labor and time spent by women in these activities to keep the agricultural economy alive is no less valuable. If men did these things instead of women, both agricultural production and family income would be less.However, the position of these women in the agricultural economy is 'non-workers' and their identity as unpaid workers.

Table-4
State-wise percentage of Women & Men Workers, 2001

State	Farmer		Agricultural workers	
	Men	Women	Men	Women
Andhrapradesh	11.4	7.1	59.1	79.2
Assam	32.7	36.8	11.0	18.0
Bihar	08.7	06.6	74.0	84.0
Gujrata	10.9	09.9	31.0	53.9
Hariyana	07.4	09.2	36.7	53.2
Kerala	01.8	01.4	30.9	39.0
Madhyapradesh	28.7	24.0	35.3	53.6
Maharastra	12.6	13.4	35.2	61.7
Punjab	04.0	3.4	39.1	36.4
Orrisa	21.9	10.7	39.7	57.9
Tamilnadu	11.1	09.1	50.6	69.4
West Bengal	20.9	12.9	35.0	45.7
India	21.0	18.1	39.2	57.4

[Source: Census of India, 2001, Primary Census Abstract, Total Population SC/ST.]

It is also worth mentioning that the role of Scheduled Caste women in agricultural production is evident in Table-4. According to Table-4, the percentage of scheduled men and women involved in 2001 work in India is 60.2 % and 75.7 % respectively. But it should be noted that only 18.1 % and more than 57 % of the scheduled women are agricultural laborers. Among the states, except Assam and Rajasthan, the rate of female farmers is much lower than the rate of scheduled male farmers and the rate of

ISBN: 978-91-987581-0-8

female workers is much higher than that of male workers. In other words, even among the Scheduled Castes, the predominance of women workers is more than that of men.

Most of the Scheduled Caste/Scheduled Tribe women are not allowed to work on their own family lands and are forced to work in other lands for wages. Lack of own family land, extreme poverty and lack of alternative employment are responsible for this. And this is why Scheduled Caste/Scheduled Tribe people, especially women, are arbitrarily exploited and oppressed by landowners. In the plain states, there is a shortage of female farmers compared to males and a large number of female laborers, but in the hilly areas inhabited by the tribals, another picture is observed. Here men and women are almost equally involved in farming. Among the inhabitants of the hill country there is still a custom of clearing the forest and making land in some places. Although these tasks are usually performed by men, in some cases women and children are also involved. In addition, women do the work of clearing weeds and sowing seeds, harvesting crops, sweeping crops, uprooting tree trunks and carrying loads of burnt wood elsewhere. There is also work to be done until the crop is stored in a specific room made of leaves.[9] When women are engaged in these activities, men are again engaged in burning trees in new lands or clearing the land for cultivation. So it can be said that women are involved in work on par with men. Even women are seen plowing the land.

❖ CONCLUSION:

Therefore, in the context of this discussion, it can be said that slave laborers belonging to Scheduled Castes/Scheduled Tribes are the most miserable among the workers in the agrarian economy. Moreover, despite the abolition of the slave labor law in 1976, in practice, the status of slaves and workers is less in states other than Kerala and West Bengal.The money and resources provided for the rehabilitation and technology of slave labor are so scarce that the workers who have been legally released from slavery have to return to the old landlords and lenders because of their poverty. And not only the returning male workers, but also the female workers have to work with the male workers as slave workers.[10]

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.002

EDUCATIONALLY BACKWARD: SIGN OF POVERTY

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❖ ABSTRACT

Education is a tool for empowerment. Access to quality primary education is a major concern in India. Education is an imperative area that is essential for the progress and development of individuals, society, and nations. Individuals, who are residing in the conditions of poverty often encounter various impediments within the course of the acquisition of education and development of literacy skills. The impact of poverty on education is mainly considered unfavorable, but measures are required to get implemented to alleviate the barriers that arise due to poverty within the course of the acquisition of education.

'Poverty is man-made, not God-given' is a famous saying in the world. . Even after 73 years of independence the people of India particularly weaker sections, vulnerable and poor experience every day the basic amenities of life. Tendulkar Committee and Ranga Rajan Committee reports reveal that more than 70% of the people in India are still impoverished. Noble economist Amartya Sen transformed the development agenda by re-conceptualizing poverty as a matter of capabilities such as literacy and access to health care rather than a lack of income.

Education provides a foundation for eradicating poverty and fostering economic development. It is the groundwork on which much of the economic and social well-being of the citizens is built. Education is the key to increasing economic efficiency and social consistency, by increasing the value and efficiency of the labor force and consequently raising the poor from poverty. This paper is aimed at contextualizing the role of education in advancing economic development and thereby alleviating poverty.

Keywords: *Backward classes, Impoverished, Illiteracy. Poverty, Unemployment.*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

Children belonging to poverty-stricken families, who lack the basic resources and necessities live in an unsafe and polluted neighborhood, they are deprived of environments that are supportive of learning. Poverty has adverse effects on the cognitive development of individuals. The increasing standardization, de-skilling, and control of the teacher's work are viewed to have unfavorable effects upon the education of the students, who have undergone multiple deprivations because of poverty and social disadvantage. The children, who reside in the conditions of poverty have slower cognitive and social development and are deprived of physical or mental health. For the poverty-stricken and most socially excluded children, like those from the traveling community, the lack of culturally appropriate education can make these difficulties even larger. So, it is inevitable that children belonging to the families that are living in poverty will experience different challenges at school to those faced by those children coming from families that are not living in poverty or are well off." "The families, who belong to deprived, marginalized and socio-economically backward sections of the society, usually experience problems in getting their children enrolled in schools, instead, they compel them to work and contribute in the sustenance of living conditions. These individuals have recognized the significance of education, but their major problem that proves to impede within the course of the acquisition of education is lack of resources. Poverty is regarded as an impediment within the course of social, cultural, economic, political, and educational development. In the present world, education is regarded as important in the elimination of the conditions of poverty.

Other Backward Class (OBC) "is a collective term used by the Government of India to classify castes that are educationally or socially disadvantaged. It is one of several official classifications of the population of India, along with General Class, Scheduled Castes, and Scheduled Tribes (SCs and STs). "The indirect effect of education on poverty is important concerning human poverty, the reason being, as education improves the income, the fulfillment of necessities becomes manageable and increases the living standards which means, decline in human poverty. The education indirectly helps in the accomplishment of basic needs like water and sanitation, utilization of health facilities, shelter, and it also affects the women's behavior in reproductive decision making and family planning."

ISBN: 978-91-987581-0-8

❖ FACTORS OF POVERTY:

The causes of poverty are many and complex. Various factors contribute the poverty i.e. economic factors, social factors, and geographic factors. The financial backwardness, low productivity, low income, poor infrastructure facilities, lack of institutional credit, inequalities in income, and indebtedness et., constitute economic problems causing poverty. Apart from economic factors, illiteracy, high population growth, immobility of people, unemployment, discrimination, social exclusion, traditions, and custom are considered as social factors. Geographical factors like natural calamities, droughts, unfavorable climatic conditions, the absence of natural resources, etc. play a crucial part in making communities relatively poor.

❖ SIGNIFICANCE OF EDUCATION:

Education assists in the development of knowledge and skills amongst individuals. With the acquisition of knowledge and development of skills, they can acquire various types of employment opportunities. The individuals, who are educated and possess adequate knowledge will be able to enhance their wages and hence lead to the elimination of poverty, therefore, the higher the level of education, the lesser will be the number of poverty-stricken persons. The direct impact of education on reducing poverty is through the increase in wages.

Fulfillment of Basic Necessities – The fulfillment of necessities is essential for individuals, belonging to all categories and backgrounds. An educated person can fulfill the basic requirements of housing, food and nutrition, civic amenities, health, cleanliness, education, and other requirements. They generate awareness amongst themselves to create means to meet their basic needs and requirements."

❖ CONSTITUTIONAL OBLIGATIONS OF THE STATE:

Poverty should be addressed by the state because it is painful not only for the poor but for the larger society of which they are part. When Sen viewed the concept of impoverishment in capabilities approach, in comparison to Sen, the other major exponent of the capabilities approach Martha Nussbaum has devised a list of capabilities, which she believes in integral to a free and just society. She seeks to make education compulsory on the basis that is a function rather than a capacity

In the preamble, Justice is not seen as un-dimensional, viewed as having implications across political, economic, and social spheres. Economic justice implies the ultimate eradication of poverty, equal

opportunities, and fair wages. Improvement in impoverished status in society can be done only by educating them, providing work, and inculcating awareness about themselves.

Article 38 of the Indian Constitution enjoins upon the State to strive to promote the welfare of the people by securing a social order in which justice, social, economic, and political shall inform all the institutions of national life and to minimize inequalities in income, status, facilities, and opportunities not only amongst individuals but also amongst groups of people.

Article 39 directs the State inter-alia to secure to the citizens the right to adequate means of livelihood; that the ownership and control of material resources of the community are so distributed as best to subserve the common good; that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment; that the children are given the opportunities and facilities to develop in a healthy manner and conditions of freedom and dignity and that childhood and youth are protected against exploitation and moral and material abandonment.

Article 43 of our Constitution has also adopted as one of the Directive Principles of State Policy that: "The State shall endeavor to secure, by suitable legislation or economic organization or in any other way, to all workers, agricultural, industrial or otherwise, work, a living wage, conditions of work ensuring a decent standard of life and full enjoyment of leisure and social and cultural opportunities. ". This is the ideal to which our social welfare State has to approximate in an attempt to ameliorate the living conditions of the workers

Under Article 340 of the Indian Constitution, the government must promote the welfare of the OBCs. “The president may by order appoint a commission consisting of such persons as he thinks fit to investigate the conditions of socially and educationally backward classes within the territory of India and the difficulties under which they labor and to make recommendations as to the steps that should be taken by the union or any state to remove such difficulties and as to improve their condition and as to the grants that should be made, and the order appointing such commission shall define the procedure to be followed by the commission. A commission so appointed shall investigate the matters referred to them and present to the president a report setting out the facts as found by them and making such recommendation as they think proper.”

ISBN: 978-91-987581-0-8

❖ NATIONAL COMMISSION FOR BACKWARD CLASSES:

"India's National Commission for Backward Classes is a constitutional body (123rd constitutional amendment bill 2017 and 102nd amendment 2018 in the constitution to make it constitutional body) (Article 338B of the Indian Constitution) under India's Ministry of Social Justice and Empowerment established on 14 August 1993. It was constituted according to the provisions of the" National Commission for Backward Classes Act, 1993

❖ RESERVATION POLICY:

"The Mandal Commission adopted various methods and techniques to collect the necessary data and evidence. To identify who qualified as an "other backward class," the commission adopted eleven criteria which could be grouped under three major headings: social, educational, and economic.

Social:

- Castes/classes considered as socially backward by others
- Castes/classes which mainly depend on manual labor for their livelihood
- Castes/classes where at least 25 percent females and 10 percent males above the state average get married at an age below 17 years in rural areas and at least 10 percent females and 5 percent males do so in urban areas.
- Castes/classes where participation of females in work is at least 25 percent below the state average.

Educational:

- Castes/classes where the number of children in the age group of 5–15 years who never attended school is at least 25 percent above the state average.
- Castes/classes when the rate of student drop-out in the age group of 5–15 years is at least 25 percent above the state average
- Castes/classes amongst whom the proportion of matriculates is at least 25 percent below the state average

ISBN: 978-91-987581-0-8

Economic:

- Castes/classes where the average value of family assets is at least 25 percent below the state average
- Castes/classes where the number of families living in kutcha houses is at least 25 percent above the state average
- Castes/classes where the source of drinking water is beyond half a kilometer for more than 50 percent of the households
- Castes/classes where the number of households having taken consumption loans is at least 25 percent above the state average.

The Right of Children to Free and Compulsory Education Act,2009(RTE) was enacted in 2009 to provide free and compulsory education to all children between 6 and 14 years of age. It was subsequently amended in 2014, 2015, and 2017. The legislation follows from the 88th Constitutional Amendment of 2002 that recognized the right to education as a fundamental right. It directs the central and state governments as well as the local authorities to work together to ensure that all children (aged 6-14) have access to quality elementary education free. It holds the relevant governments responsible for the availability of funds, infrastructure, teachers, syllabi, and so on. Interestingly, the Act requires all private schools to reserve 25 percent of their seats for students who live in the vicinity and are from the weaker sections of society. It prohibits unrecognized schools from practice, bars charging capitation fees or donations for admission, and forbids children from being expelled, held back, or required to pass a board exam till the completion of elementary education.

❖ CONCLUSION:

India has long struggled with its past. The same goes for a large part of the population of India, those that have historically been less well-off and have yet to be able to take full advantage of the modern systems in place across the country. Deep-rooted prejudices and practices have been difficult to weed out, even with the intensive studies and judgments in place. With progress being made in one direction, a small portion of those that are being catered to can be observed hoarding the resources and creating a further layered entrenchment of the haves and have-nots. Systemic implementation of the vast number of recommendations made by the intensive studies done across the last half-century is yet to reach its peak, signaling administrative lethargy even today. India should enact

ISBN: 978-91-987581-0-8

single-window comprehensive legislation dealing with all issues related to economic policies to overcome the pathetic situations by the impoverished. Progress of the Nation will not alone accomplish much unless it is combined with measures designed to promote the participation of the poor community initiative in the implementation of education policies backed with a strong coalition of the poor could make a significant difference. Therefore, to successfully attain the goal of reduction of impoverishment set by the 2030 agenda for millennium sustainable development, it is required to make innovative ideas, systems, and action plans from the perspective of integrating poverty reduction, human rights, and development.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.003

ACHIEVING SUSTAINABLE DEVELOPMENT THROUGH ENVIRONMENTAL MANAGEMENT IN NORTHEAST INDIA WITH SPECIAL REFERENCE TO ASSAM

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❖ ABSTRACT:

From the 2nd half of the 20th century, the issue of sustainable development became a matter of international concern. The environmentalists, statesmen, policy makers, and organizations for environmental protection, have much concern to the matter of achieving sustainable development as it is related to the survival of humans as well as all other living beings. In the modern age of science and technology, industrialization has assumed a key position in the development of a country. Just for the sake of environmental protection, no nation can stop industrialization at the cost of progress and development. For speedy development, industrialization has to be expanded. In this juncture, it is believed that sustainable development can be achieved through environmental management, i.e., mobilization and holistic and efficient use of natural resources. Proper planning, management and use of resources can be helpful in removing a country's poverty to a greater extent and will be helpful in maintaining ecological balance.

India's northeastern region is endowed with vast natural resources supplemented by topical, subtropical and temperate climate. It is expected that by holistic utilization of these resources sustainable development can be accelerated in this region.

This paper attempts at studying the issue of sustainable development and environmental management in the context of North East India with special reference to Assam.

Keywords: *Environmental management, sustainable development, resources, Northeast.*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

One of the biggest challenges facing the world is environmental degradation supplemented by numerous factors. India is also no exception. From the 2nd half of the 20th century at various levels such as policy making, environmental agencies and voluntary societies, the issue of sustainable development has gained much importance. In simple term, sustainable development stands for the providing materials, goods and services and use of natural resources to the present generation without compromising the needs of the future generations.

In the modern age of science & technology industrialization has assumed key position in the development of a country. To provide food, clothes and shelter to the masses every country is heavily dependent on industrialization. The state of industrialization has categorized the world countries as developed, developing and underdeveloped. In agriculture, contribution of industrialization in bringing out "Green Revolution" in real sense is immense by providing utensils, fertilizers, pesticides, cold storages, transportation and irrigation facilities to increase food production, sugar, milk, medicines, a variety of luxury items, jute, leather, chemicals, cement etc. have lifted living standards of human being to a significant level. However, industrialization has played havoc into our environment and existing natural resources. On the other hand, air, water and soil pollution are gifts of industrialization. Natural forests are dwindling causing drought, flood, siltation of rivers, dams, reservoirs. In this juncture a quarry arises- should the industries be banned? But it is true that no nation can stop industrialization at the cost of its progress and development. What we need to do is the planning for the management of environment and conservation of natural resources for a secured future and sustainable development.

❖ OBJECTIVES OF THE STUDY:

The present study endeavors at addressing the following objectives-

(i) to study the idea of management of the environment,
(ii) prospects of environmental management for sustainable development in Assam as well as Northeast India,
(iii) to make some recommendations for environmental management to ensure sustainable development.

ISBN: 978-91-987581-0-8

❖ METHODOLOGY:

The present study is analytical in nature based on secondary sources. Various reference books, journals, articles and websites have been consulted pertaining to the study. All possible efforts have been made to make the study objective and meaningful. Personal observation of the author is also taken into account.

Keeping in mind the objectives, the present study is divided into three parts- Theoretical framework, environmental management in northeast India, and conclusion and suggestion.

❖ THEORETICAL FRAMEWORK:

Environmental planning and management can be defined as the initiation and operation of activities to direct and control the acquisition, transformation, distribution and disposal of resources in a manner capable of sustaining human activities, with a minimum disruption of physical, ecological and social processes. It also implies successful utilizations of the environmental resources and solution of the environmental problems. Followings are the goals and objectives of environmental planning and management-

i. Decrease the entropic effects of economic activities throughout our economic system.
ii. Protect public health and safety and the natural ecosystem from improper handling of resources and residuals.
iii. Stabilize and perpetuate the socio- economic system.
iv. Provide this protection at minimum economic cost (so that management resources are not wasted).
v. Provide these services in as just and equitable a manner as possible.

The nations across the globe are in competition for achieving of their own economic growth and for establishing its hegemony in the international arena. For the fulfillment of the aspirations, all the nations have been paying attention towards the process of industralisation by using available resources without any judicious consideration. During the past few decades, the rapid growth of population and industralisation all over the world have created excessive pressure on the natural resources and thereby total environment of the globe. Human –centric self-centered and aggressive approach of development has damaged the balance of nature at a large extent. This tendency of modern men has caught the attention of the environmentalists, scientists, academicians, social

ISBN: 978-91-987581-0-8

workers, policy makers and planners to make the issue of environmental degradation and sustainable development.

The vital importance of the proper management of India's land resources was realised when an exhaustive paper entitled "A charter for the land" was published in "The Economic and Political Weekly" of March 31, 1973. But even after the initiative taken by the then Prime Minister Mrs. Indira Gandhi, little emerged except a directive to State Governments that they should set up State land use Boards under the chairmanship of Chief Ministers. Even recommendations of N.D. Tiwari Committee on the Environment (1980) to set up a Central Land Commission to serve as a policy planning coordinating and monitoring agency "for all issues concerning the health and scientific management of our land resources" failed to find acceptance. The 6th Plan document and the 7th Plan had nothing more to do with the problem.

However, the serious ecological and socio-economic crisis was soon realised and the Central Government constituted three new bodies – (1) the National Wastelands' Development Board(1985) charged with the responsibility of the mounting a massive afforestation programme with the help of the people, (2) the National Land Use and Conservation Board(1986), which was expected to formulate a national policy and a perspective planed for the conservation, development and management of the land resources of the country, and (3) as apex body called the National Wasteland and Land Use Council(1983) which has all Chief Ministers as its members and over which Prime Minister presides.

The National Youth Policy of 2014 has very sincerely considered the participation of the youth in all vital areas for the transformation of social life and protecting the environment. It has emphasized on the promotion of social values for the protection of future of Indian society in specific and global society in general. It has emphasized on sensitizing the youth about the protection and improvement of the environment and developing compassion for the living creatures.

❖ ENVIRONMENTAL MANAGEMENT IN NORTHEAST INDIA:

Northeast India has an image of dense, evergreen, and inexhaustible forests of precious timber, exotic wildlife, home to numerous tribal communities and hides-out of armed insurgents. It is also

ISBN: 978-91-987581-0-8

known for its mountains and hills, turbulent rivers, flooded plains, proud and brave hill communities and colourful craftsmen of the river valleys. The region holds the world's record of highest rainfall at a place and also has the wettest zone (Cherrapunji & Mawsynram is in Meghalaya) in the world. It exports its famous Assam tea all over the world. Among its exotic wild species of mammals, one –horn rhino is also a unique creature of its own type. The region is known for quick growth of vegetation because of heavy and recurrent precipitation. Though covered with forests all over the hills and plains, the 'states' as such have limited forests under their direct control and bulk of the forests is under the customary authority of the communities, especially in the hill areas, a right guaranteed by the Indian constitution.

When one glances at the topography of NER, it is indeed a panoramic view and an awe- inspiring landscape, each unit having distinct features of its own. With the fascinating and fabulous environment of this region, it is said that rich potential wealth of mineral resources is lying untapped, ready to be exploited for the people's benefit. Accordingly, the Geological Survey of India (GSI), a Government of India establishment, has taken up the challenge of conducting survey in the scattered area of the region. The findings are quite encouraging. Parts of *Mokokchung, Longleng and Tuensanj* districts of Nagaland have rich deposits of petroleum oil. In the Barail range of Assam, there is thick and well-bedded sandstone (80%) and a thin band of shale (20%) with coal seam (1-2 meter thick) (www.meghelayatimes.into/index.php.cfm). All along the foothills of Assam- Arunachal, scientists have found evidences of rich mineral deposits. These are concentrated in the Sonitpur district of Assam and West kameng districts of Arunachal Pradesh. Sedimentary rocks found in *Ngopa, Khazawl, Champhai and Serchhip* districts Mizoram. The areas which have substantive resources are. Rich deposit of coal and limestone are found in the Upper Assam and the states of Meghalaya. Coal reserves in Meghalaya are estimated to be 63,880 million tones.

Industralisation in the region has not developed successfully and even small-scale industries have not been feasible due to lack of adequate economic infrastructure like transportation, communication and market accessibility. The region's economy remains primarily agricultural. Primitive farm practices of slash and burn cultivation is still practiced in many hill areas, while traditional single farming in the plains continues.

ISBN: 978-91-987581-0-8

The Northeastern region has the vast potentiality to produce conventional energy. A major problem with thermal power generation is that of air pollution by stack exhausts. Electrical energy generation by hydro-electric power is non-polluting and uses a renewable source of energy. However, there are several problems associated with the construction of dams on natural waterways. The construction of such dams alters the downstreams ecology as well as that in the lake area behind the dam. Huge areas get submerged. Flora, fauna or any agricultural produce of this land get affected. People and towns in this area have to be removed and reallocated, causing disturbances and sometimes hardships. For example, in their study on Lower Subansiri Hydel dam, Vagholikar and Ahmed found the 'dam submergence zone' falls in the eastern Himalayas. This is an important part of Indo-Myanmar biodiversity hotspot, one of the 25 hotspots in the world, and houses Endemic Bird Areas (EBA) identified by Birdlife International. The 3436 ha of forests to be submerged comprise crucial wildlife habitats and project also envisages building of over 70 km of roads in the region. The submergence area includes four reserve forests in Arunachal Pradesh and one in Assam (Tale Valley Sanctuary, Tale Valley RF, Panir RF, Kamala RF, and Jiadhol in Arunachal Pradesh and Subansiri Reserved Forests in Assam). These are all primary forests with rich wildlife. The submergence area is in the midst of a rich biodiversity zone and part of contiguous forests. The area is also part of an important elephant corridor (Vagholikar and Ahmed, 2003: 26)

Forests play a vital role in influencing our environment and the atmosphere. In the states of N.E. India, the area under forests is much higher than the national average. It is 82.21 percent in Arunachal Pradesh, 30.20 percent in Assam, 77.87 in Manipur, in Meghalaya it is 69.70 percent, Mizoram 86.99 percent, Nagaland 85.83 percent and in Tripura it is 54.79 (Basic Statistics of NER, 2012). Initially forests take carbon dioxide from the atmosphere in the process of photosynthesis and provide us oxygen. A number of forest products become precious assets to our day-to-day life. To fulfill the requirements of industrialization and increasing population forests have paid heavily. Due to indiscriminate deforestation, soil erosion, landslides, siltation of rivers, dams and reservoirs, flood and drought have become common problems of the region.

In the year 2011, the Government of India through the Ministry for the Development of North-Eastern Region (DoNER), Environmental

Management Framework was made for the states of Mizoram, Nagaland, Sikkim and Tripura by initiating "North East Rural Livelihood Project". It focuses on supporting various livelihood activities to increase and sustain income of the poor, especially women in these states. The aim of this programme is to provide alternative livelihood to shifting cultivation as shifting cultivation mainstay of the people in Mizoram and Nagaland and tribal dominated hilly areas of Tripura. On the other hand, subtropical climate of Sikkim not favourable for sustain means of livelihood.

❖ CONCLUSION AND SUGGESTIONS:

For achieving sustainable development, it is felt that environmental management could play a big role. As the region is endowed with vast resources proper utilisation of such resources can bring desired development without compromising the needs of the future generations. In this direction, following suggestions can be made for sustainable development.

1) Environmental planning, management and awareness needs to be created through formal and informal education among all sections of the society. In this venture along with the government, NGOs could play a big role in educating the people in creating awareness and holistic use of natural resources.
2) Massive programmes aimed at the natural regeneration of non-agricultural lands by protecting them against unrestricted grazing should be adopted so as to save the country from recurring and increasing severe floods, drought, growing depletion of the productive capacity of its land resources and stupendous soil run off losses it suffers. Soil conservation works must also be undertaken on all eroding lands irrespective of whether these are under agricultural or other uses. The amelioration of waterlogged and saline lands, the protection of good agricultural lands against diversion to urban uses, the maintenance of the fertility of overworked agricultural soils and the vigorous conservation of whatever, natural forests are still left to us must also figure prominently in a comprehensive programme of land management.
3) Proper emphasis should be given on conservation and plantation of medicinal plants. The subtropical state of Northeast India is the home of a variety of medicinal plants. The states are losing its economic benefit due to lack of awareness and research in this

direction. So, there is an urgent need for conservation and development of agro-technology for the medicinal plants.

4) Agro based industry can be set up in the region for sustainable industry which has economic viability as well as environment friendly. For example, it may be mentioned that Meghalaya is the second ginger producing state next to Kerala in India. Hence ginger processing units can be set up which is an aspect of agro based industry. Soft beverage producing factory could be set up as the state produces an adequate number of bananas throughout the year.
5) Horticultural corps may be a boost for economic potential as being environmentally friendly.

For that micro irrigation programme should be undertaken by the government.

6) Instead of big Hydel project, more small size hydro projects are called mini hydel or micro-hydel, which can be built on small streams and even on canals in the region especially Assam which has a good number of rivers and receives adequate rainfall. It is feared that construction of a big dam will compromise the future of the region as the region is situated in the high Semitic zone.
7) All kinds of waste whether generated during extraction of raw materials, the processing of raw materials, residential, institutional or commercial should transform to productive one. For that desired plan, policy and scientific approach is necessary. The International Conference on Waste Management (1-2 April,2016), namely RECYCLE,2016, conducted by the Indian Institute of Techonology Guwahati addressed the issue of major environmental problems caused by Solid and Liquid waste management. It aimed at making proper strategies and necessary infrastructure for organized waste management.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.004

POPULATION OF INDIA AND PROBLEMS OF OVER POPULATION

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❖ ABSTRACT:

In the world India is one of the densely populated countries. It has about 15% of support to the world population and India's land area is 2.4% of the world land area. In 1950-51 India's population was 361 million. According to 2001 census it was 1,027 million. In the world, India is the second most populated country. It was nearly a fifth of the world's population. The Indian census carried out in 2011 the population of India was exactly 1,210,193,422, which means India has crossed the 1-billion mark. According to the revision of the World Population Prospects In 2019 the population stood at 1,352,642,280. According to UN data In 2020 India population is estimated at 1,380,004,385 people at midyear.

On Monday, December 6,2021The current population of India is 1,399,346,585. In the total world population, India population is equivalent to 17.7%. India ranks number 2 in the list of countries by population. In India the population density is 464 per Km^2. The urban population is 335% it is equal to 483,098,640 people in 2020. Assamese, Bengali, Gujarati, Hindi, Kannada, Maithili, Marathi, Malayalam, Odia, Punjabi, Telugu, Tamil and Urdu are official spoken language in India.

The world's population is increasing mainly due to increases in agricultural productivity and medical advancements. Brazil, China and India add more to their woes by neglecting substantial increases in their populations. Many people are already aware of overpopulation due to social and environmental problems, but only a few are aware of its adverse effects on health. It's not just India's struggle, China and Brazil are also coping with the ramifications of overpopulation.

***Keywords**: India Population distributed by States and Union territories, highest population Countries, highest and lowest growth rate in 2021, Problem and steps to control the overpopulation in India.*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

India is a large country and most people are ignorant and illiterate who live in backward areas. India has more than 50% of its population below the age of 25 in 2020 and more than 65% below the age of 35. The average age of an Indian is 29 years compared to 37 for China and 48 for Japan.

India has more than two thousand ethnic groups, and every major religion is represented, as are four major families of languages are Indo-European, Dravidian, Austro-Asiatic and Sino-Tibetan languages as well as two language isolates the Nihali language spoken in parts of Maharashtra, and in parts of Jammu and Kashmir people spoken the Burushaski language. 1,000,000 people in India are Anglo-Indians and 700,000 United States citizens are living in India.

The population growth rate depends on the difference between the birth rate and the death rate. In India can largely be explained by variations in birth and death rates. The death rate continued to fall over the entire plan period. But the birth rate continues to remain high by current standards. As a result there has been a net addition to the size of the population. India's demographic trends during the last five decades reveals that the death rate has fallen much faster than the birth rate.

In India, the sex ratio has been estimated a number of methods and data set including the National Family Health Surveys (NFHS), the Decennial Censuses (DC), the Sample Registration System (SRS), the Civil Registration System (CRS), and the Health Management Information System (HMIS).

The sex ratio was 940 females for 1000 males in 2011 and 944 females for 1000 males in 2016. In the last century this ratio has been showing an upwards trend for the last two decades after a continuous decline. In 2011–2013 the Sample Registration System was revealed through a population census with that the sex ratio of India was 909 females per 1000 of males. It has skewed downwards from then, in 2013–2015 recording 900 females and 896 females in 2015-17 per1000 of males. Furthermore, that survey conducted with the SRS also showed Chhattisgarh as the highest sex ratio at 961, Haryana was recorded the lowest at 831. However, sex ratio has moved into a positive direction. According to the latest round of National Family Health Survey 2019-21 India has 1,020 females per 1,000 males.

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INDIA POPULATION PYRAMID IN 2020

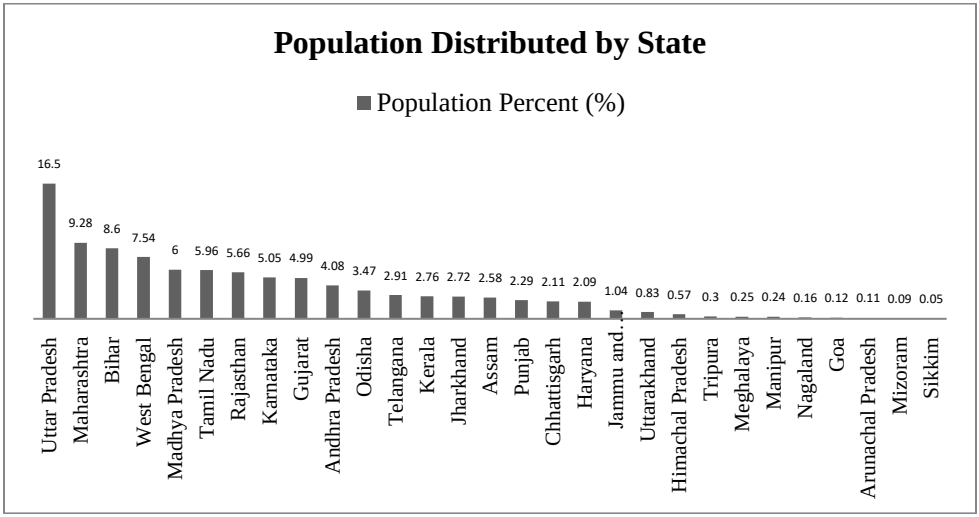
Population	1,392,700,250 (April, 2021)
Growth rate	1.1% (2020)
Birth rate	18.2 births/1,000 population (2020)
Death rate	7.3 deaths/1,000 population (2020)
Life expectancy	70.03 years (2020)
• male	68.71 years (2020)
• female	71.49 years (2020)

POPULATION DISTRIBUTED BY STATES

Rank	State	Population	Percent (%)
1	Uttar Pradesh	199,812,341	16.50
2	Maharashtra	112,374,333	9.28
3	Bihar	104,099,452	8.60
4	West Bengal	91,276,115	7.54
5	Madhya Pradesh	72,626,809	6.00
6	Tamil Nadu	72,147,030	5.96
7	Rajasthan	68,548,437	5.66
8	Karnataka	61,095,297	5.05
9	Gujarat	60,439,692	4.99
10	Andhra Pradesh	49,386,799	4.08
11	Odisha	41,974,218	3.47
12	Telangana	35,193,978	2.91
13	Kerala	33,406,061	2.76
14	Jharkhand	32,988,134	2.72
15	Assam	31,205,576	2.58
16	Punjab	27,743,338	2.29
17	Chhattisgarh	25,545,198	2.11
18	Haryana	25,351,462	2.09
19	Jammu and Kashmir	12,541,302	1.04
20	Uttarakhand	10,086,292	0.83
21	Himachal Pradesh	6,864,602	0.57
22	Tripura	3,673,917	0.30
23	Meghalaya	2,966,889	0.25
24	Manipur	2,855,794	0.24
25	Nagaland	1,978,502	0.16
26	Goa	1,458,545	0.12
27	Arunachal Pradesh	1,383,727	0.11
28	Mizoram	1,097,206	0.09
29	Sikkim	610,577	0.05
	Total (India)	1,210,854,977	100

Source: Census 2011 & UIAI for 2021 Estimates

ISBN: 978-91-987581-0-8



India is a federal union comprising 29 states and 7 union territories. Uttar Pradesh is the largest state by population & Goa is least populated state in India. Let's have a look at the population of States & Union Territories. As per the Unique Identification Authority of India, India's population is 1,371,360,350 approx in 2020. India's 2020 population is estimated at 1,380,004,385 people at mid-year according to UN data.

In India the most populated state is Uttar Pradesh. Uttar Pradesh, Maharashtra, Bihar, West Bengal, and Madhya Pradesh are top 5 populated states in India. In 2011 Maharashtra is at 2nd Spot, but Bihar with a higher growth rate approx 20% is very close to Maharashtra by 2023-24 it will be at the second spot. **India's Population is estimated in 13, 75,586,000 or 1.38 Billion** according to the Census Population Projection Report in 2022.

Almost half of the country's population lives in these five (Uttar Pradesh, Maharashtra, Bihar, West Bengal, and Madhya Pradesh) highest populous states and the 10 most populated states of India contribute 74% of India's population. During this decade Bihar has the highest population growth rate.

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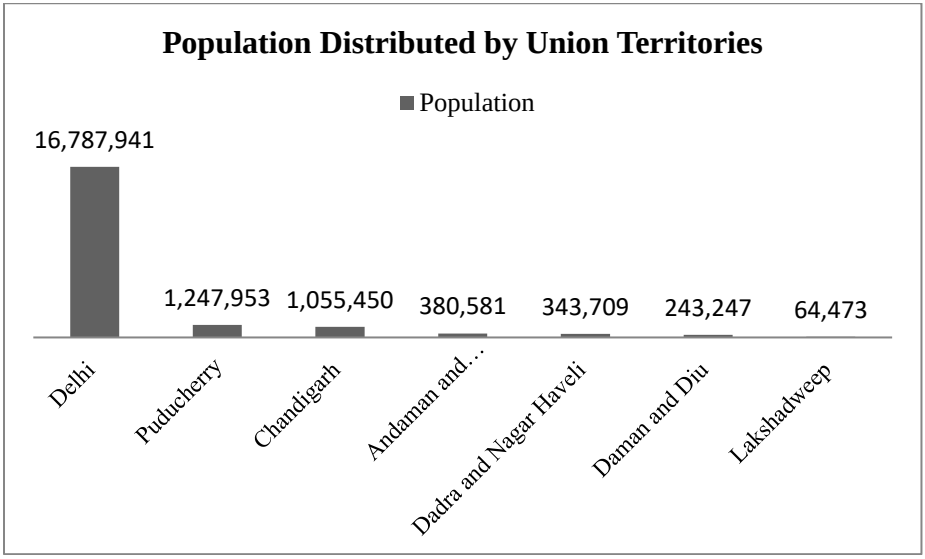
POPULATION DISTRIBUTED BY UNION TERRITORIES

Rank	Union territories	Population	Percent (%)
1	Delhi	16,787,941	1.39
2	Puducherry	1,247,953	0.10
3	Chandigarh	1,055,450	0.09
4	Andaman and Nicobar Islands	380,581	0.03
5	Dadra and Nagar Haveli	343,709	0.03
6	Daman and Diu	243,247	0.02
7	Lakshadweep	64,473	0.01

Source*: Census 2011, UIAI & Census Population Projection report*



STATES WITH HIGHEST GROWTH RATE 2021

Rank	States	Growth Rate
1	Bihar	18.16%
2	Jharkhand	16.71%
3	Haryana	16.36%
4	Madhya Pradesh	16.35%
5	Rajasthan	15.54%
6	Gujarat	15.49%
7	Chhattisgarh	15.48%
8	Uttar Pradesh	15.11%
9	Uttarakhand	13.02%
10	Assam	12.16%

Source: Census 2011 & UIAI for 2021 Estimates

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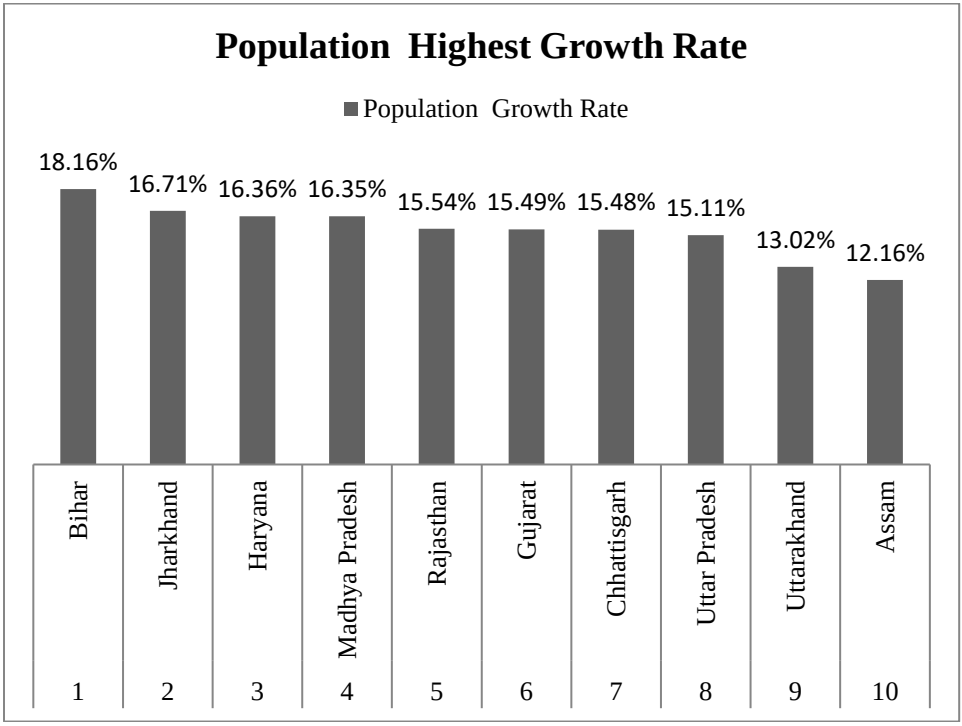


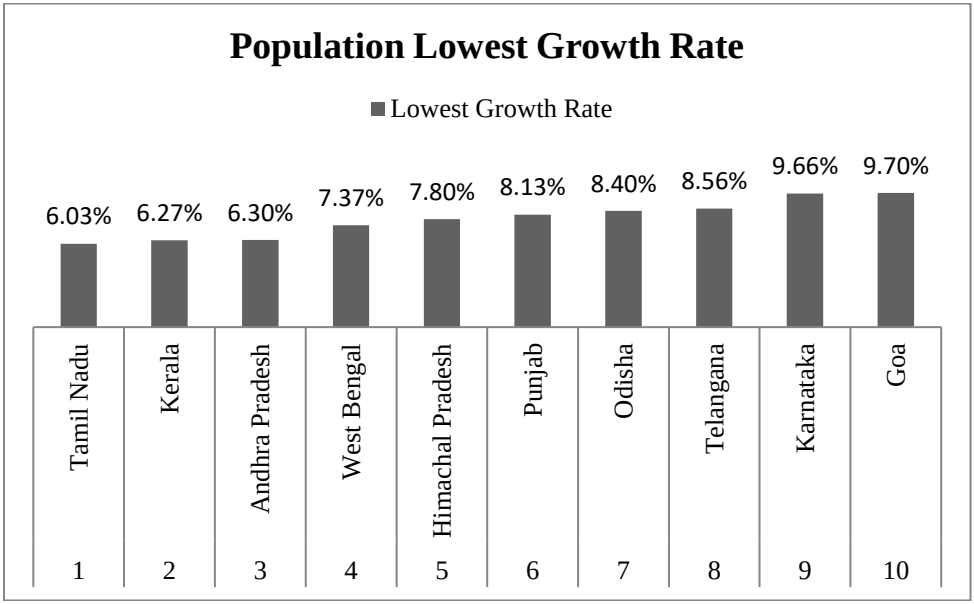
As per estimates in 2011-2021India's growth rate is approx 12.56%. Bihar has the highest population growth rate 18.16% during 2011-2021 followed by 16.71% Jharkhand and 16.36% Haryana.

INDIAN STATES WITH LOWEST GROWTH RATE 2021

Rank	States	Growth Rate
1	Tamil Nadu	6.03%
2	Kerala	6.27%
3	Andhra Pradesh	6.30%
4	West Bengal	7.37%
5	Himachal Pradesh	7.80%
6	Punjab	8.13%
7	Odisha	8.40%
8	Telangana	8.56%
9	Karnataka	9.66%
10	Goa	9.70%

Source: Census 2011 & UIAI for 2021 Estimates

ISBN: 978-91-987581-0-8



As per estimates, in 2011-2021 India's growth rate is approx 12.56%. Ten States have grown at a rate below 10%. In the 2011 census, most of the South & Western Indian States have a growth rate below the national average and in 2021 also they have a low growth rate. Tamilnadu (6.03%) is a state with the least growth rate followed by Kerala (6.27) and Andhra Pradesh (6.30).

❖ COMMON CAUSES LEADING TO OVER POPULATION IN INDIA ARE:

- Still the birth rate is higher than the death rate. We have been successful in declining the death rates but the same cannot be said for birth rates.
- Due to the population policies the fertility rate and other measures has been falling but even then compared to other countries it is much higher.

Our countries which are leading to over population in the above causes are interrelated to the various social issues.

❖ IMPACTS OF HIGH POPULATION:

Due to overpopulation our country scenario is not good, even after 67 years of independence.

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- **Unemployment**

It is very difficult to generating employment for a huge population in India. Every year the number of illiterate persons increases. The unemployment rate is thus showing an increasing trend.

- **Utilization of Manpower**

The number of jobless people is on the rise in India due to economic depression and slow business development and expansion activities.

- **Infrastructure Facilities**

Unfortunately development of infrastructural facilities is not keeping pace with the growth of population. The result is lack of communication, education, housing, healthcare, transportation etc. There has been an increase in the number of overcrowded houses, traffic congestion, slums etc.

- **Utilization of Resource**

Forests, land areas, water resources are over exploited. There is also a scarcity of resources.

Then it causes production decreased and costs increased. Food production and distribution have not been able to catch up with the increasing population and hence the costs of production have increased. The major consequence of over population is Inflation.

- **Distribution of Income**

In the face of an increasing population, there is an unequal distribution of income and inequalities within the country widen.

❖ PROBLEMS ON OVER POPULATION:

- **Universal Marriage System and Early Marriage**

Even though the marriageable age of a girl is legally 18 years, the concept of early marriage still prevails and getting married at a young age prolongs the childbearing age. In India also marriage is a universal practice and a sacred obligation , where almost every woman is married at the reproductive age.

- **Illiteracy and Poverty**

Poverty is the factor for the rapid growth of population. Impoverished families have this notion that more the number of members in the family, more will be the numbers to earn income. Some feel that more children are needed to look after them in their old age. Also, hunger can be a cause of death of their children and hence the need for more children. Strange but true, Indian still lags behind the use of contraceptives and birth control

ISBN: 978-91-987581-0-8

methods. Many of them are not willing to discuss or are totally unaware of them. Illiteracy is the another cause of over population

- **Age-old cultural norm**

Sons are the bread earners of the families in India. This age-old thought puts considerable pressure on the parents to produce children until a male child is born.

- **Illegal migration**

Last but not the least we cannot ignore the fact that illegal migration is continuously taking place from Bangladesh, Nepal leading to increased population density.

❖ STEPS TO CONTROL POPULATION IN INDIA:

- Increasing the welfare and status of women and girls.
- Spread of education and sex education
- Increasing awareness for the use of contraceptives and family planning methods.
- Encouraging male sterilization and spacing birth.
- Free distribution of contraceptives and condoms among the poor
- Encouraging female empowerment.
- More health care centre for the poor
- Major steps which have been already implemented but still need to be emphasized more control population.
- A bold population policy should initiate Government of India, politicians and policy-makers so that the economic growth of the country can keep pace with the demands of a growing population.
- Experts are hopeful that by increasing public awareness and enlisting strict population control norms by the Government will definitely lead the way for the country's economic prosperity and control of the population.
- In the global world India's strengths in various fields cannot be ignored, whether it is in science & technology, medicine and health care, business and industry, military, communication, entertainment, literature and many more.

The above steps can play a major role in controlling the population.

❖ CONCLUSION:

Really India is not over-populated because it is a vast country with plenty of natural resources. These resources have not been fully used as yet. The most serious obstacle to the economic development is India's

rapidly growing population. It is not possible to reduce the existing size of population. But it is possible to slowdown the rate at which population is increasing. In spite of the fact that the population policies, family planning and welfare programmes undertaken by the Government of India have led to a continuous decrease in the fertility rate. The overall development of the country and rise in per capita income can go a long way in reducing the rate of increase in population. Already the death rate has fallen to a very low level. There is no scope for reducing it further. But the birth rate continues to be high by current standards. Therefore, in future India's population will be a function of birth rate alone. Excess population is itself a symptom of over-population. This problem is becoming more and more acute day by day due to rapidly increasing population by about 22 million persons a year. So, India is over-populated. It's time for all global forums to provide effective solutions in order to resolve this problem.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.005

IMPACT OF GLOBALIZATION ON POVERTY AND INEQUALITY IN INDIA

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❖ ABSTRACT

There are conflicting views about whether globalization has increased or reduced poverty. Proponents of globalization state that economic progress has been rapid in those countries where globalization has been given priority. Due to the increasing economic cooperation among the countries, progress has been made everywhere, which has benefited all the citizens. This has reduced poverty all around. The opposition side says that there can be no bigger lie than this. They say that the World Bank is the only institution providing statistics on poverty. Its president, says that in the last 20 years (from 1980 to 2000), the number of poor has decreased by 200 million. But on the other hand, the first sentence of the World Development Indicator 2001 is that "1.2 billion out of the world's 6 billion people live on less than a dollar a day". This number was the same in 1987 and it was the same in 1998 as well. The paper tries to produce an analysis on impact of globalization on poverty and inequality in India.

Keywords*: Globalization; Poverty; Inequality; Malnutrition.*

❖ INTRODUCTION

In fact the figures given by the World Bank are misleading. In the nineties, the World Bank has made changes in the basis of the assessment of poverty itself. The poverty criterion has been changed from $1.08 per day to $1.08 per day. Earlier, the assessment was done on the basis of PPP computed in 1985 whereas now the computation has been done on the basis of PPP of 1993. For this reason the two rates cannot be compared and the propaganda of poverty reduction is misleading. The new $1.08

ISBN: 978-91-987581-0-8

condition has reduced poverty in 71 of the 94 countries. In China it is 14 percent and in India it is 9 percent.[1] They say that if we compare poverty in both the old and new rates, then the situation becomes as follows –

BASIS	POVERTY RATE ON OLD BASIS	POVERTY RATE ON NEW BASIS
Sahara South African Region	39.1	49.3
South America Continent	23.5	15.3
West Asia/North Africa	4.1	1.9

The World Bank has also changed the base in such a way that the reporting period of some items has been increased from seven days to 30 days. Along with this, the estimate is high in the computation of PPP and there is a difference between the actual survey. In China, it has been estimated on the basis of estimates only in some cities because there the government refused to conduct a comprehensive survey. India had also refused to participate in the 1993 survey, due to which the calculation has been done on the basis of the 1985 survey itself. The number of people below the poverty line in these two countries is so much that they can have an opposite effect on the world indicator.[2]

Different criteria have also been suggested by the World Bank and by other agencies, depending on which lack of things they would consider as poverty. One premise is that those under $1.25 should be considered poor. Some consider the other two dollars to be necessary to meet the minimum requirement. If 2 dollars is considered, then in 1991 the number of poor will be 2.2 billion. It is necessary that the criterion of poverty should be such which is acceptable to all and it should not be changed for a long time in this or on the basis of survey, so that comparative study can be done.[3]

In this sequence, another parameter is also considered. This is a state of malnutrition. Many studies have been done in this. Malnutrition can be considered as another form of poverty because today there is no ignorance about what are the nutritional elements, which are necessary to be consumed, but to get them economic condition comes in the way. The study is conducted by the Food and Agriculture Organization in relation to

ISBN: 978-91-987581-0-8

malnutrition. The updated report pertains to the period 2012-14. According to this, 800 million people in the world are suffering from malnutrition. The number of these in India is 164 million. In the report of the period 1990-92, the number of malnourished was stated to be 84 crore. This shows that the number has not decreased significantly.[4]

Contrasting opinions are also seen on the condition in which the distribution of income is going on within the countries. There are many types of basis for its assessment such as a). Gross National Product - converted into dollars on a PPP basis; b). Computation by assigning weights to each country on the basis of population; c). the top ten percent of the population compared to the lower ten percent of the population; or d). On the basis of National Income Account. The results will be different in all of these. Then it should also be noted that the value of the dollar has increased in the last decades, as in India in the 1970s, the dollar was equal to eight or nine rupees, whereas today it is around 60. It has to export more goods to pay back the debt. These loans are not repaid on PPP basis but at market rate only.[5]

There is also no consensus among economists about the computation of inequality. There are three methods of computing this –

1) Comparison of the highest and lowest tithe with the middle, also known as the Gini ratio, on the basis of which the disparity among countries has increased (i.e. rich countries have become richer, poor countries more poor).
2) If the entire national income is taken together and each country is treated as equal (India=Uganda), the disparity has increased.
3) Poverty has not increased or decreased if the comparison is made on the basis of population weight.

Some people point out that even though the percentage increase is the same, the actual distance increases, e.g. a one percent increase on $30,000 becomes $300, but a five percent increase on $4000 will also mean $120, which means that the actual difference from the previous $ 26000 increases to $ 26180.

While the average output in the bottom twenty countries during 1960-62 was $212, in the richest countries it was $11,417. (Both figures are based on 1995 dollar price); at the same time, in the period 2000-02,

these figures have increased to 267 and 32,339 dollars respectively. The percentage increase is 26 and 83 percent respectively.[6]

On the other hand it is also argued that there is no importance of comparison of countries among themselves. There is no point in computing the inequality. It should be seen that income is increasing in all countries. The basic question in his view is what the state of inequality within the country is. In this regard, in the 2012-13 study of ESCAPE (Economic and Social Commission for Asia Pacific) of 40 countries of Asia, it has been said that the birth ratio of income inequality in India has increased from 30.8 to 33.9 between 1990 and 2019. . In China these figures are 32.4 and 42.1 and in Indonesia 29.2 and 38.1. Inequality in India has increased but not reduced, it is clear. It is to be seen that India has come a little later in the race of globalization. It can be said that income inequality has increased or at least not decreased due to globalization.[7]

It is generally seen that the rich people of developing countries want to imitate the developed countries in everything. Even their laundry soap should be the same as that used in developed countries. Corruption is used to reach this position. Due to this the whole system of the developing country gets affected. Another effect of this is the migration of people with higher education from developing countries to developed countries. This drain of talent has the opposite effect on the progress of developing countries. It is a profitable deal for developed countries because they get talented people cheaply. We have seen in the past about the claim that globalization is the best way to reduce poverty and inequality, but it can be said that at least this makes the difference clear.

One of the arguments in favour of globalization is that the mutual trade of countries is increasing. The World Bank has conducted a study in which all the countries have been ranked in terms of globalization. The top one-third of countries with more globalization were found to be making more rapid economic progress than the rest. This study is about the difference between 1977 and 1997. One drawback of this study is that countries that showed rapid progress had very low GDP in the base year. Therefore the percentage increase appears to be very high. In macro economies such as China and India, the percentage growth will be less. Globalization in both these countries has also happened at its own slow pace and still there are protective restrictions in them. There are also such

ISBN: 978-91-987581-0-8

countries as Japan, South Korea and Taiwan, which have increased trade only by keeping their economy limited. When he became rich, he took steps to be liberal as is happening in China now.

It is necessary to reflect on what are the reasons behind not being able to remove poverty and inequality. The construction industry is growing in developing countries, but it is seen that as the production in the construction industry increases, its contribution to the gross output decreases. The reason for this is the rapid growth in the service sector. For this reason, the World Bank has also given up talking about the contribution of the construction industry and the emphasis is being laid on the matter of human needs. If the role of the construction industry is limited, what could be another reason? The value of exported goods is decreasing in comparison to the value of imported goods. Due to this, the amount being received by the import-export difference to the developing countries is getting reduced, due to which inequality or poverty is being affected. Many African countries which have an open economy but are largely dependent on exports have to face the adverse situation due to this policy.

It has been observed that most of the sales of the world's largest 500 multinational companies, which are called global, are being done in their home region - North America, Europe or East Asia. These companies are becoming area wide, not worldwide. High-income industries are flourishing only in developed countries. The cost of a skilled worker is 15 percent higher in Germany but it is still a leader in the construction industry. One reason for this is that the contribution of labour is now comparatively less. The relation of second production has become more than the technical knowledge available in the firm, so it is unprofitable to keep more salary people also. Contact with other advanced industries of its level in the developed area also becomes easy. In this way production with less technical knowledge is done in low cost countries and high cost, in which dividend is high, is done in developed areas. Due to this, there is no equality in the mutual inequality among countries due to globalization.[8]

Due to the above reasons and due to migration, developing countries are able to come forward only in less technical areas and globalization cannot be helpful in eliminating inequality. On the other hand, the prices of goods with advanced technology can be kept high, which has to be paid by the developing countries only. Because of this,

only developed countries are getting the benefit of globalization. One aspect of this can also be traced to research going on in technology. Except Japan, this is happening only in western developed countries. Countries like China and India still have to depend on foreign investment. In China, only Taiwan and other foreign technology is being used in production.

There are some other things also worth considering. Information technology is expanding as an alternative to the construction industry. In this, education and technical knowledge are more important. With this, financial services are also expanding. This situation increases the risk of financial flight overnight. A few years back in East Asia, due to this a serious situation had arisen. For this reason, continuous monitoring becomes necessary. It is true that development is necessary to improve the economic condition of the people. In this, the developing countries where cheap land and cheap labour are available, will have their contribution. The time of self-contained economy has passed. But at the same time it is necessary to try to reduce the inequality within the country and among the countries, which is not happening right now. For this, first of all, the methods of computation have to be changed so that only the work of entertainment is not done, but the real progress can be known. Lest the economy be going in the opposite direction like climate change. For this, instead of importing, it will be necessary to give importance to the expansion of indigenous industry. In this the state will have to make a policy of proper national interest. The World Trade Organization will also have to work in such a way that instead of mutual exchange, more facilities are provided to the developing countries.

Globalization is characterized as the seamless cross-border exchange of goods, services, capital, technology, ideas, information, legal systems and individuals. With the increase in globalization it was expected that the benefits of development would reach every section of the society, but at least from the examples of developing countries there is enough evidence that globalization has not resulted inequitable growth.

- **Globalization and increasing inequality**

Globalization has promoted inequality based on gender, class, caste, region, religion and ethnicity in India.[9]

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For example:

- **Metropolis-Satellite Linkage:** Resources from extremely backward and tribal areas are being increasingly exploited for the development of more developed areas. For example the case of mining in Niyamgiri hills by Vedanta group.
- **Income inequality:** According to Thomas Piketty, income inequality in India has reached its highest level since the year 1922.
- **Inequality in national wealth:** Over the past two decades, foreign development aid from rich countries to poor countries is $50-80 billion a year. Over the same period, about $500-800 billion of illicit funds are transferred from poor countries to rich countries each year.
- **Labour Inequality:** Globalization has created a high demand for cheap labour to increase profits. More than 90 percent of Indian workers are employed in the unregulated unorganized sector.
- **Caste and religion based inequalities:** Globalization and consequently better access to resources of creamy layer or rich people in particular caste category have increased inequalities within caste sub-groups.
- **Impact on Agriculture:** With measures like Green Revolution in agriculture, the rich farmers became richer while the poor farmers failed to get its benefits. Small and marginal farmers account for 85% of India's population and more than 2,00,000 farmers have committed suicide since 1997.
- **Environmental inequalities:** Large scale transportation, use of technology, water bodies polluted by industrialization, expansion in non-sustainable practices etc. are some of the common consequences of globalization, which is worsening the ecological situation by making poor areas more vulnerable.

❖ CONCLUSION:

Globalization has also intensified human trafficking. Thus, it has transformed human beings into commodities which are being bought and sold in international markets. It should be noted that globalization increased various benefits such as better standards of living and better medical facilities, but globalization induced poverty and inequalities have also created unsafe conditions for millions of people.

ISBN: 978-91-987581-0-8

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.006

CAUSES OF POVERTY AND GOVERNMENT SUPPORT TO THE POVERTY IN INDIA

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❖ ABSTRACT:

India is said to be the second largest populate country in the world (1,407,547007- current population- taken at 3:11pm, 21st December 2021), next to China (1,446,238,767- current population- taken at 3:13pm, 21st December 2021). The population is increasing in India, every second and also the birth rate is higher than the death rate. The death rate is considerably reduced in India, but the same cannot be taken for the birth rate. The population is increasing in India because of the early marriage and the girls are married at the reproductive age, as compared to other countries. It is said that poverty also leads to the growth of population as the people think that they need more people to fetch income for the family, and also of the fear that children would die because of hunger. Illiteracy is another factor for the raise in the population as people are not aware of the use of condoms and other preventive measures which are introduced by the government. Objectives of the chapter are (i) to present the Indian population and reasons for poverty, (ii) to present the causes of poverty and (iii) to present steps taken by the government to eradicate poverty in India. This chapter concluded that the poor people are unaware of government schemes and

ISBN: 978-91-987581-0-8

benefits, because the aim of the plan may reach if the beneficiary are aware and utilize in an effective manner.

❖ INTRODUCTION:

India is said to be the second largest populate country in the world (1,407,547007- current population- taken at 3:11pm, 21st December 2021), next to China (1,446,238,767- current population- taken at 3:13pm, 21st December 2021) . The population is increasing in India, every second and also the birth rate is higher than the death rate. The death rate is considerably reduced in India, but the same cannot be taken for the birth rate. The population is increasing in India because of the early marriage and the girls are married at the reproductive age, as compared to other countries. It is said that poverty also leads to the growth of population as the people think that they need more people to fetch income for the family, and also of the fear that children would die because of hunger. Illiteracy is another factor for the raise in the population as people are not aware of the use of condoms and other preventive measures which are introduced by the government. It is said that the women are forced to give birth to children until a male baby is born in their family. The illegal migration is entering into India from Bangladesh, Nepal and from Sri Lanka. The increase in population leads to unemployment, increase in the cost of products, decreased production, unequal income distribution. All these factors lead to the increase in poverty among the people of India. Though the government of India has taken many steps to reduce the population of India by increasing the marriage age of woman to 21, the status of women and girls, empowerment, sex education, family planning, free distribution of condoms among the poor, male sterilization, births spacing, health centers etc for the reduction of population. The main reason of poverty in India may be concluded with the reason of great increase in population. Let us discuss the causes of poverty in India, which is considered to be the main reason for India to be a backward economy. The government has made lots of steps to reduce the poverty of India right from the independence, but hasn't shown a success for the eradication of the same.

❖ OBJECTIVES:

1) To present the Indian population and reasons for poverty.
2) To present the causes of poverty.
3) To present steps taken by the government to eradicate poverty in India.

ISBN: 978-91-987581-0-8

❖ CAUSES OF POVERTY:

It is said that India is rich country inhabited with poor people. The saying emerged as the Indian **resources are under-utilized** such as the water resources are not properly channelized for irrigation, in turn affects the agriculture and the production of the country. As **agriculture** depends hugely on the rainfall which always fails in the seasons, if the water resources are properly taken for agricultural purposes would help India to grown in agriculture. The next is the export of iron ore to other countries like Japan which is not up to the economies, instead that should be done as finished iron products would help the economic development of our nation. As India has got more than 20% of forest resources, the minerals if taken out of it would make the nation grow for the eradication of poverty. We are quite rich in our resources but the problem here is, that it is not utilized properly in the right channel.

The next reason for the poverty of India is that the one fifty of total income of the nation is held by 1% of the Indian population in the year 2021, while its just 13% of the income is held by the last 50% of the Nation's income. Since the **national money is in the hands of a very few people**, the rest of the population is going without any money. Here is a saying that rich becomes richer and the poor becomes poorer. In daily life, messages in newspapers, televisions, journals, articles stating the poverty in India and steps to eradicate the same, but we always lack in taking the first step of wiping of the hunger of the people who are living below the poverty line. The 70% of the population is living in the village, where people depend much on agriculture. Moreover, the flood, famine, cyclone and earthquake also affect the agriculture in our country. Most of the people are illiterate and more than 45% of the Indian population is labour force. The scholars who graduate every year expecting a job is also left without a decent job and also the unemployment is rising in a huge rate. An UN report says that the India of huge population, more than 300 million people living in poverty with no healthy food, hygiene drinking water, sewage, electricity and education. The country is having huge industrial groups and the consumer markets are regulated by few monopolies in the country.

The money that is locked in the Swiss Bank, by the depositors of Indian also made the country poor. Since it is not evenly distributed among the people of India, some are left empty handed in our nation. Though government is taking lots of steps to bring out the money from the bank goes in vain. **The black money**, for which the tax is not paid affects the financial system in the country. Black money is the money which is

earned by means of illegal activities or the money for which the tax is not paid. This money which is got in the form of cash, not taxed, cannot be spent for the development of the economy, instead could be used for underground businesses, that naturally affects the money rotation in the nation, inturn leads the poverty of the people. The Indian government is spending on rural welfare scheme, helps in reducing the national poverty. It is targeted that by the government in eradicating the poverty for all people who live in extreme poverty by the year 2030.

The use of new technology in agriculture is very less in many states of the country unlike in the states of Punjab and Haryana. This will provide more employment opportunities for the poor and the increase in the production of food grains. But since the people depending on agriculture are not rich enough to take loans and to repay the same. Since the usage of technology is not been adopted in the states of Assam, Orissa, Bihar, Madya Pradesh and East Uttar Pradesh, the poverty is also in the increasing phase in India. As a result, the poverty triumphs to a larger extent. Moreover, the Indian government has neglected the public sector investment in agricultural sector, the irrigation system fails to fulfil the need of the agricultural lands, if were adopted would have raised productivity, employment and income for the people who depend on agriculture. So, agriculture has to depend heavily on rainfall which is insufficient for the productivity and the reduction of poverty.

Another important and the leading cause of poverty is the rapid increase in population in our country. Population in India is increasing since 1951 with 36 crores to 140 crores by the end of November 2021, that is more than 80 crore people have been added to the Indian population in the past 70 years since independence. Due to this reason, the available land for per person is decreasing, and the people don't have sufficient land to produce output and fetch income out of it. In this case, the person who is earning in the family is much burdened because he has to carry the whole responsibility of the family members. This leads to lower per capita consumption expenditure which is not enough for meeting the basic needs of a human being, resulting in lower standard of living of the people, lowers savings and investment, lesser employment opportunities, resulting in unemployment. All the above affected the national income and resulted in poverty. In a country, which increases the savings and investment for the capital formation for the development of the nation is reducing, the steps taken for the reduction of poverty is also in a declining phase.

The problem of under and unemployment in the Indian economy is another important reason for the prevalence of poverty in our nation.

ISBN: 978-91-987581-0-8

When the educated graduates are paid less for the qualification, underutilisation of their skills, job and part time. The increase in the unemployment and the poverty are growing together. The unemployment, growing population, excess labour force, low income, low capital formation, low productivity and poverty. In India, a poor cannot sustain with hunger for a longer period, so he takes up a job whichever is available, even getting a low remuneration. The poor, though work very hard for longer period of time, still unable to earn enough money to meet the basic needs.

❖ STEPS TAKEN BY THE GOVERNMENT TO ERADICATE POVERTY IN INDIA:

Government has introduced minimum payment every month for the people living under the poverty line. The minimum requirement is provided by the government by way of ration shops, ensuring the minimum needs of the poor there by solving the poverty problem atleat in a minimum rate.

1) Integrated Rural Development Programme

The integrated rural development programme was introduced in the year 1978–79 and universalized from 2nd October, 1980. Aim of this programme is to provide support to the rural poor in the form of subsidy and bank credit for productive work opportunities through successive plan periods.

2) Jawahar Rozgar Yojana /Jawahar Gram Samriddhi Yojana (JGSY)

The above two schemes National Rural Employment Programme (NREP) and Rural Landless Employment Guarantee Programme (RLEGP) were merged in the year1989, under Jawahar Rozgar Yojana (JRY). The purpose was to generate good work prospects for the unemployed in rural areas by creating economic infrastructure, community and social assets. The old scheme started again with a new name as Jawahar Gram Samriddhi Yojana (JGSY), mainly for rural economic infrastructure programme with the purpose of employment generation.

3) Employment Assurance Scheme

This scheme was launched in the year 1993. It mainly covers drought-prone, desert, tribal and hill area blocks. In the year1997-98, it extended to several other blocks. Employment assurance scheme was planned for creating employment opportunity in the form of manual work when there is no agricultural season. It was expected to lead to the creation of robust economic and social infrastructure and address the needs of people.

ISBN: 978-91-987581-0-8

4) Food for Work Programme

In the year 2000, the Food for Work Programme was started as a component of EAS. It was started with some major drought-affected states, namely Maharashtra, Rajasthan, Orrisa, Gujarat, Himachal Pradesh, Madhya Pradesh, Uttaranchal and Chhattisgarh. The main aim is to enhance food security through wage employment.

5) Sampoorna Gramin Rozgar Yojana:

The new Sampoorna Gramin Rozgar Yojana (SGRY) Scheme was started in 2001 was the mix of old JGSY, EAS and Food for Work Programme. The primary aim of the scheme was the generation of wage employment, creation of good economic infrastructure in rural areas as well as food provision and nutrition security for the underdeveloped.

6) Rural Housing – Pradhan Mantri Gramin Awaas Yojana (PMGAY)

PMGAY is a government flagship programme, created for providing housing for the Indian rural poor. A similar scheme for urban poor was launched in 2015 as Housing for All. For BPL population, similar program was launched by late PM Rajiv Gandhi, known as Indira Awaas Yojana which was one of the major flagship programs.

7) National Old Age Pension Scheme (NOAPS)

NOAPS came into effect from the year 1995, providing pension to old people above 60, who does not have any means of subsistence is the main aim of this project. It is provided by the central government. The implementation of this scheme in places is given to panchayats and municipalities.

8) National Family Benefit Scheme (NFBS)

NFBS was started in the year 1995 and is sponsored state governments, under community and rural department. They provide certain amount to a member of family who becomes the head of the family after the death of its primary breadwinner.

9) National Maternity Benefit Scheme

NMBS provides certain amount grant mother in three instalments. The women must be older than 19 years. It is normally provided eighth to twelfth weeks before the birth of child. And in case of the death of the child, the women can still avail it.

10) To accelerate economic growth

The government tried to impart various methods for accelerating economic growth. They really expected that the poor will be raised above the poverty line with the various growth measures. While efforts were made to accelerate economic growth but they fail as they applied capital-

ISBN: 978-91-987581-0-8

intensive technologies of the Western Countries. Our nation is more on the road to the labour-intensive path of economic growth. Hence, fiscal and monetary were adopted that provide incentives for using labour-intensive techniques.

11) By agricultural growth and poverty alleviation

One of the most important factors is agricultural growth that can help reduce poverty. As per reports of Montek Ahluwalia commission (former member of Planning Commission), it brought clearly that agricultural growth and poverty are inversely related. As higher the agricultural growth is, it leads to lower poverty ratio.

12) By speedy development of infrastructure

The speedy development of infrastructure, an important measure is to generate employment opportunity and raising their productivity. Infrastructure development involves construction of buildings, roads, highways, ports, telecommunication, power and irrigation. It encompasses mainly construction work which is again labour-intensive thing.

13) By accelerating human resource development

In addition to infrastructure development, poverty can also be reduced through human resources development. HRD requires better investment in areas of educational facilities such as schools to promote literacy, vocational colleges and technical training institutes to impart skills to the people.

14) By accelerating the growth of non-farm employment

Rural areas are of special importance for the reduction of poverty and growth of non-farm employment opportunities. This type of employment can be created in sales, marketing, transportation, handicrafts, dairy farming, forestry, food processing and other agricultural products, repair workshops, etc.

15) By giving access to assets

After independence, faster rate of population increase has led to greater sub- division and fragmentation of agricultural holdings. Lack of employment opportunities in factories, industries and non-farm sectors has deteriorated the conditions of agricultural labour and self-employed small farmers.

16) By giving access to credit

Credit availability for the poor and underprivileged on easy terms can create better living conditions. Small farmers can gain access to dynamic resources such as better seeds, good fertilizers, etc. Construction of minor irrigation channels such as wells and tube wells can be accelerated.

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17) By proper public distribution system (PDS):

From the studies, it came out that households spend nearly 80 per cent of their income on food. Hence, an effective way of raising rural incomes and to ensure food security to the poor households, the government should work on an assured supply of adequate quantity of food-grains.

18) By direct attack on poverty

The government realised in the early 70's that it is going to take a long time for economic growth to generate enough employment opportunities for the needy people in our country.

❖ CONCLUSION:

Government should provide all the facilities to all, people need comfortable, safe and secure life. But based on the people income and financial background rich people are getting better commodities and good life. Poor people working to earn money to push a day, very next day again they have to earn to live. Government is working on to provide basic facilities, shelter and medical facilities to all people, especially for poor people. In this chapter, the authors have given some steps taken by the government to eradicate poverty in India. Poor people are unaware of government schemes and benefits, so the aim of the plan may reach if the beneficiaries are aware and utilize the schemes in an effective manner.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.007

ISSUES AND CHALLENGES OF POVERTY, MICROFINANCE AND WOMEN EMPOWERMENT: REALITY CHECK FROM IMPHAL EAST DISTRICT, MANIPUR

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❖ ABSTRACT:

The problem of poverty and inequality seem to have taken precedence over the problem of growth, and over the years the community involvement and the concept of self-help were felt most required for the success of these efforts. Poverty is comparable to the disease of cancer that one who has infected with has to sustain discomfort until his death. Solutions to the alleviation of poverty lie in generation of self-employment opportunities. Such opportunities can be created by bringing at least one member of every BPL family into the fold of SHG. In such context of growing importance of SHGs. Hence, search for newer approaches and instrument of poverty alleviation continues. In this context, self help Groups (SHGs) and microfinance have emerged as an innovative and potential instruments for poverty alleviation. Hence, Self-Help Groups are realized to be a proven model/methodology to address the issues of poverty alleviation

Keywords: *Poverty Alleviation, Microfinance, NGOs, SHG-Bank Linkage*

❖ ISSUE OF POVERTY:

Poverty is a serious social phenomenon due to unproportionate ratio between total population and resources currently available in the economy.The proposition is so serious that it deprives their fundamental freedoms of choice and action, face extreme vulnerability to ill health and exposed to ill treatment by the institution of the state and society and are powerless to influence key decision affecting their live. Poverty is

comparable to the disease of cancer that one who has infected with has to sustain discomfort until his death. To quote the reference of Amartya Sen, "People must not be allowed to become so poor that they offend or are hurtful to the society. It is not so much the misery and plight of the poor but the discomfort and cost of the commodity which is crucial to this view of poverty. We have a problem of poverty to the extent that low income creates problems for those who are not poor. The solution to the problem of poverty in general of any economy is considered achievable by consistently rising levels of economic growth and development. In the words of W.C. Peterson, 'Economic growth involves an increase over time in the actual output of goods and services as well as an increase in the economy's capability to produce goods and services'. It has been recognized that successful development requires comprehensive, multifaceted, and properly integrated mandate. In addition, another problem of an economy is poverty amid plenty and it becomes the world's greatest challenge. Efforts are on persistently mainly in underdeveloped and developing countries to contain the prevailing phenomenon in the world. Hence, all over the world, in many different ways, countries have tried to rolled back poverty and improved in the recent past, may be in terms of global wealth, global connection and technological capabilities. However, due to uneven distribution of these gains makes the gap between countries, regions and peoples widen causes difficult to build the conditions for sustained, equitable growth in the world.

Of the World's 6 billion people, 2.8billions- almost half- live on less than$2 a day, and 1.2 billion-a fifth-live on less than $1 a day, with 44 percent living in south Asia .In rich countries fewer than 1 child in 100 does not reach its fifth birthday, while in the poorest countries as many as a fifth of children do not .And while in rich countries fewer than 5 percent of all children under five are malnourished, in poor countries as many as 50 percent are.

The average income of in the riches 20 countries is 37 times the average in the poorest 20 countries ─ a gap that has doubled in the past 40 years. And experience in the different parts of the world has been very diverse.[3]. How can we find out about the implementation factors that triggered success and foster those approaches on a global scale to shrink poverty in many parts of the world where it remains widespread?

It is indeed necessary to build a strategy to meet the challenge of reducing poverty through the force of global integration and technological advancement to serve the interest of poor people.

ISBN: 978-91-987581-0-8

Poverty is commonly understood as the condition of having little money and few material possessions. Not all agree on the undesirability of poverty, with a number of spiritual traditions emphasizing the virtue of voluntary renunciation of material goods, and disavowing the logic of accumulation. In international and community development literature however, poverty has the additional meaning of deprivation of basic needs. While some seek to define poverty in economic terms, others consider social and political arrangements to be intrinsic to poverty. Debate on the causes, effects and measurement of poverty directly influences the design and implementation of poverty reduction programs and is thus important to the fields of international development and public administration.

Economic aspects of poverty may include material need, typically including the necessities of daily living (food, clothing, shelter, and health care). Poverty in this sense may be understood as a condition in which a person or community is deprived of, and or lacks the essentials for a minimum standard of well-being and life. These essentials may be material resources such as food, safe drinking water, and shelter. Poverty also describes a (persistent) lack of wealth and income, or wealth and income disparities.

Social aspects of poverty link conditions of scarcity to aspects of the distribution of resources and power in a society. These aspects of poverty may include access to information, education, health care, social status, political power, and the opportunity to develop meaningful connections with other people in society. Poverty may also be understood by those who experience it as an aspect of social relationships and need, including social exclusion , dependency , and diminished capacity to participate in society, including as a result of being deprived of access to education and information.

The World Bank's "Voices of the Poor," based on research with over 60,000 poor people in 60 countries, identifies a range of factors which poor people identify as part of poverty'[4]. These include

- precarious livelihoods
- excluded locations
- physical limitations
- gender relationships
- problems in social relationships
- lack of security
- abuse by those in power

- disempowering institutions
- limited capabilities, and
- weak community organizations.

Critics argue that some measures reflect pejorative and sometimes racialized colonial stereotypes of poor people as powerless victims, and passive recipients of aid programs.

Poverty elevation is still an unfinished agenda of under developed countries/developing countries of the world in general and India in particu

About 260 million people both in rural and urban areas were officially estimated as living below poverty line at the turn of the new millennium.The magnitude of the continuing poverty is reflected in the fact that a significant chunk of our population are deprived of basic developmental need like schooling, housing, water, health, sanitation and electricity . It needs proposes a strategy for attacking poverty in three ways: Promoting opportunity, facilitating empowrment, and enhanching security5.

- Promoting opportunity: Poor people consistently emphisis the centrality of material opportunities.This means jobs ,credit, road, electricity, markets for their produce ,and the schools, water,sanitation, and health services that underpin the health and skills essential for work.
- Facilitating empowerment: The choice and implementation of public actions that are responsive to the needs of poor people depend on the interaction of political,social, and other institutional processes.Access to market opportunities and to public sector services is often strongly influenced by state and social institutions,which much be responsive and accountable to the poor people.
- Enhanching security: Reducing vunerablity to economic shocks, natural disasters, ill health, disability, and personal violence is an intrinsic part of enhancing well-being and encourages investment in human capital and in higher-risk, higher return activities .

There is recognition of the fact that impact on poverty and deprivation must be ended as soon as possible. Many governments all over the world pursue economic planning as a means to way out of the problem of poverty. Increase in GDP or GNP is considered to the measuring rod for the progress of the economy and consiquently for the rolling back from poverty level of the ecomomy.

ISBN: 978-91-987581-0-8

Experience of all over world in the recent years had seen that there has grown disillusionment both in rich and poor countries about the pursuit of growth as a main socio-economic objective.This view has echoed again and again at the United Nations World Summit for Social development held at Copenhagen in March1995 . The problem of poverty and inequality seem to have taken precedence over the problem of growth. In this connection, Mahbubul Haq (former minister of planning , Pakistan) expressed, "We were taught to take care of our GNP as this will take care of poverty.Let us reverse this and take care of poverty as this will take care of the GNP.[6] Search for newer approaches and instrument of poverty alleviation continues. In this context, Self help Groups (SHGs) and microfinance have emerged as an innovative and potential instruments for poverty alleviation and socio-economic empowerment of the poor. Experience of micro credit delivery through SHGs many countries reveals that poor and humble persons make investment wisely and earn returns. However, the flow of financial assistance to them was too marginal to enable them to cross the poverty line.

The essence to create a grassroot organisational base to enable the down trodden people to come together, to analyse their issues and problems themselves, and to fulfil their needs was strongly advocated. In fact, experience shows that some of the successful group-based participatory programmes have made significant improvement in the conditions of living poor women.

The concept of self-help group has gained its significance, especially after 1976 when Prof. Mohammed Yunus of Bangladesh began experimenting with micro-credit and women SHGs. A strategy was made in Bangladesh with a sense of economic eradication in poverty eradication 'by empowering the poor women'. SHGs (small informal associations) were created for the purpose of enabling members to reap economic benefit out of mutual help, solidarity and joint responsibility. The benefits include mobilisation of savings and credit facilities and pursuit of group enterprise activities. The group-based approach not only enables the poor to accumulate capital by way of small savings but also helps them to get access to formal credit facilities. These groups by way of joint liability enable the poor to overcome the problem of collateral security and thus free them from the clutches of moneylenders. The joint liability not only improves group members' accessibility to credit, but also creates mechanisms like peer monitoring leading to better loan recoveries . Besides, some of the basic characteristics of SHGs like small size of membership and homogeneity of composition bring about cohesiveness

and effective participation of members in the functioning of the group. In general, SHGs created on the above lines of functioning have been able to reach the poor effectively, especially women and help them obtain easy access to facilities like savings and credit and empower them. Studies reveal that certain elements become crucial or critical for the successful formation and functioning of the groups. These include voluntary nature of the group, small size and homogeneity of membership, transparent and participative decision-making and effective use of funds for micro-enterprise creation. Regular meeting of the members fosters meaningful relationship among them and issues other than thrift and credit, issues on gender and social problems also get a platform for discussion. Micro finance is a cost effective tool to fight against many dimensions of the poverty challenge. The response of various microfinance initiatives, especially in Indian context, has been broadly on the following two lines[7].

1) Creation of alternative delivery mechanism for the poor: The main aim of microfinance intervention in this regard is to help the poor to reduce the difficulties they face with the bank or money lenders by creating separate institutions which can fully understood and appreciate their needs.The idea is to create pro-poor agencies or institution which can deliver financial service to the poor.
2) Reforming the formal agencies: The reforms include adapting methods and innovations tried out by NGOs and other microfinance agencies. The fast growing SHG-Bank Linkage Programme in India is one such example of the response from the formal agencies in reforming their earlier days.

❖ THE IMPORTANCE OF SELF HELP GROUPS (SHGS) IN POVERTY ALLIVAITION THROUGH ACCESSING MICROFINANCE:

The SHGs-bank linkage programme has emerged as the largest microfinance out reach programme in the world, and is also the most cost effective and fastest growing micro-finance initiative over the world. Micro-finance or a small loan is a helping hand to the poor in the fight against poverty.The High Power Task Force set up by NABARD in November 1998 defines “micro finance as provision of thrift, credit, other financial services and products of very small amounts to the poor in rural ,semi-urban areas for enabling them to raise their income levels and improve living standard”. Empirical evidence has shown that women as a group are consistently better in promptness and reliability of repayment. Targeting women through SHG programme have been a very effective

ISBN: 978-91-987581-0-8

method of ensuring that the benefits of increased income accrue to the general welfare of the family, and particularly of children. At the same time, women themselves benefit and achieve higher status when they are able to get new income.

It would be useful here to discuss the importance of microfinance as a tool for poverty alleviation. There may be various medium of micro finance, however, the most prominent and dominent among them has been through the medium of SHGs. In 1992, National Bank for Agriculture and Rural Development (NABARD) gave a fillup to the movement when it started the SHG-Bank linkage programme. This was the first major attempt to link the financial institutions with the informal groups, thereby, linking them with the market.

The term micro finance and Self Help Group(SHG) is very closely related and is considered as two sides of the same coin.The SHG represents the demand side of the system and microfinancing sector i.e. the banking sector represents the supply side .The ideal situation of the system is the equilibrium position, where the supply match the demand.The evolution of ideas in relation to credit delivery system has some parallel to the evolution of thought on economic growth and development .The idea is that in macro level credit should be delivered adequately to meet the growth process in the economy and in micro level the emphasis shifted to ensure the credit went to all segment of soceity.In order to meet these twin objectives, the expansion of organised banking is encouraged by every admistrative set up in an economy.The reality is, despite of expansion of organised banking system deep into the rural areas,a very large number of the poor continue to remain outside the fold of the formal banking system.The formal banking system with its systems and procedures was found to be inaccessible to the poor. Therefore, it is needed to find a new delivery machanism which would meet the requirments of the poor and down trodden, particularly, the women folk in the soceity. In India, during 1991-92, NABARD launched 92 pilot projects on linking SHGs with Banks, in various parts of the country. In July 1991, RBI advised the banks to participate in the pilot project and to extend finance to SHGs as per the norms and guidelines of NABARD. In February 1992 detailed guidelines were issued to the commercial banks, explaining the modalities of the pilot project. Later the scheme was made applicable to RRBs and Cooperative Banks in May 1993. The NABARD guidelines to banks for implementation of the pilot project allowed ample flexibility to the participating banks to innovative responses and observed variations in the grassroots level situations. It aimed at providing credit to

ISBN: 978-91-987581-0-8

the informal SHGs of rural poor, through the banking system, with minimal documentation and simplified procedures.

This intended to build the trust and confidence between banker and the poor group of people and encourage banking activies in a section of population that formal financial instution usually found reluctance to cover in their fold. For the SHG system developed and promoted by NABARD, they took the initiatives for linkage between SHGs and NGOs on the one hand, and the banks on the other. Several models of SHG-Bank linkage programme were tried out. As a result of these experiments, three most commonly used Models throughout the country came into existence.

❖ MODELS OF BANK LINKAGE

In order to deliver credit to the SHGs, NABARD has introduced three models under SHGs bank linkage programe as given below:

- **Model I,** the SHGs are to be organised and promoted directly by Banks without any assistance from any NGOs. The bank provided credit in bulk directly to the SHG, which might be an informal or formal body. The SHG, in turn, would undertake on-lending to its members, on terms and conditions agreed upon mutually among them. NABARD provided refinance assistance to the lending Bank. In this Model there is no involvement of NGOs
- **Model II**, NGOs act as an organiser and promoter of the SHGs, and then referred those SHGs to the Bank for lending directly either to the SHGs or to individual members. Here, NGOs stand as support to both the Banks and the SHGs, for monitoring and evaluation of the projects, proper functioning of the SHGs, repayment of the loans, training to members of SHGs, etc. NABARD provides refinance to the lending Bank.
- **Model III,** the SHGs are to be facilitated and promoted by NGO and then referred to the Bank for linkage, and the Bank finance directly to the NGO for on-lending to the SHGs. The NGO is fully responsible for making sure repayment of the loan to the Bank, with proper monitoring and evaluation of the projects of the SHG, and training of members of SHGs. NABARD provided cent percent refinance to the lending Bank.

The Self Help Group (SHG) which is defined as a homogenous group of poor people, voluntary formed to save small amounts within their earning and to mutually agree to contribute to a common fund which is on–lent to members for meeting their credit needs, either for consumption or income generating activities, on terms and other conditions mutually

ISBN: 978-91-987581-0-8

agreed upon by the group member. Later on the group approaches the banks for lingkage programme for assisting larger fund for operation of productive purposes. Such an approach of financing operation have benefited both for the borrower and the banks.

Over 90% of the groups have been set up by women which enables amelioration of the socio-economic conditions of their families and also brings enormous social change by empowering them. The thrift habit among the poor has been propagated as never before. The poverty alleviation process has been hastened on account of proper utilization of the saving and loans by the group members. The loan recovery rate of over 95% showed that the SHGs could use the bank credit effectively and in a responsible manner.

Another impact evaluation study by NABARD (2001) had found that 86% of the members of SHGs belong to the weaker sections . On account of the SHGs-Bank Linkage Programme the value of the assets of the group members had increased by 59%.There was a threefold increase in the average annual savings of each member and doubling of borrowings per annum. Besides, the members had improved their communication, learnt handling problem situations and there was a general increase in the level of self –confidence.

Through these three different SHGs bank linkages models banks are encouraged to make loans to the Self Helf Groups in certain multiples of the accumulated savings of the Self Help Group.The bank loans are given without any collateral and at market interst rates.They continue to decide the terms of loans to their own members. Since, the group own accumulated savings are part and parcel of the aggregate loans made by the group to their members, peer pressure insures timely recovery of loan. In most cases, there is a Self Help Promoting Institution/NGO which enables to the Self Help Groups to function effectively.

Self Help Groups brings about benefits both for the members, for banks and Self Help Groups Promoting Institutions or NGOs as indicated below:

For members:

- Discuss and help each other to solve common problems
- Collect and use own savings to make interest bearing small loans to each other
- Learn basics of financial intermediation
- Learn to appreciate others' needs and their own needs

- Start handling resources of a size much beyond their individual capacities.
- Realising that resources are scares and that have cost
- Learn that repayment is not difficult , with regular saving habit
- Use peer press use as and effective substitute for collateral security
- Win the confidence of the formal banking systemthrough mature financial behavior ,leading to futher access to need based funds

Learn to interact with the external environment in a meaningful way, leading to increase self esteem and confidence for Banks:

- Benefit from reduced transaction costs through economies of credit and

Learn to externalize credit supervision and servicing to the groups themselves

- Benefits from mobilization of small savings through groups , gaining access to low-cost funds
- Accept peer pressure within the Self Help Groups as an excellent substitute for the colleteral securities, leading to more than 95% repayments
- Get timely repayments leading to faster recycling of funds
- Recognize self helf groups as the appropriate medium for expansion of business of rural branches for wider coverage of clients
- Recognize the prospects of ripple effect in quality among their clients
- Building good well among the rural client
- Benefit from refinance facilities from NARBARD for better fund management.

For NGOs:

- Find SHGs as complimentary to their core functions
- Use the synergy of social and economic programmes for better impact on the poor
- Deepen and widen the outreach to the poor through creedit plus approach
- Gain recognition as socio-economic change agents
- Use the avenue for performing financial intemediation in underbanked areas
- Act as meaningful agents between banks and the poor

ISBN: 978-91-987581-0-8

- Perform the role of propagators of innovative financial services delivery approaches

❖ CONCLUSION AND OBSERVATIONS:

It is based on the available evidence and experience about the role of microfinance in poverty alleviation and large scale failure of both state and market to meet the savings, credit and insurance needs of the poor. Micro-financing: Shift from the traditional banking system Micro-financing has turned out to be an effective strategy for formal financing agencies. Group lending minimizes transaction cost and at the same time the members of a group can avail small loans through that group. The chance of mis-utilisation is minimal and there is assured repayment because of peer monitoring by the group. The group concept has enabled the rural poor to develop the savings habit and minimise extravagance. For the SHG members, the system has been found beneficial because of minimal procedural formalities, access to institutional credit without collateral offering, full autonomy in the selection of activity, and the availability of thrift for meeting urgent needs. The skill needed for filling the application forms and the absence of procedural formalities have made the programme customer-friendly. Besides, the flexible repayment schedule enables them to repay as and when it is convenient. The group will see to it that prompt repayment is made, as they are likely to get repeat loans. The micro-sized, supplementary income-generating activities pursued by the members defy the conventional standards of unit cost and unit size prescribed by banks and government departments. The smaller unit size allows women to pursue the activities in their spare time and contribute to the family's income. Right from the mid-eighties of the past century micro-finance has become a key strategy for poverty alleviation and empowerment of women in southern State of India. More than 90 percent of the (SHGs) groups in this region are women groups. In some areas, men groups and mixed groups also exist. There has also been an increase in the flow of funds for micro-enterprises through various promotional agencies. Though NGOs were the forerunners in this field, the early nineties marked a new era for micro-finance programmes in the State with the evolution of the Community Development Society (CDS) model women groups in various part of our country. Further the setting up of the poverty eradication programme of the various State Government has given a boost to the SHG strategy. There is a general tendency to consider SHGs as a panacea for all the ills of the rural community. This is evident from the mushroom growth of self-help groups in the country. In many

cases it has been a blind replication of success models without considering the intricacies involved in group formation and sustainability.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.008

CAUSES OF INCREASING POPULATION IN INDIA

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❖ ABSTRACT:

The total number of people living in a particular area in a particular time is known as the population. It is a summation of all the living organisms of the same group or species which live in a particular area. It includes the demographic and social characteristics like reproduction sex, caste etc.

The size of the population is always changing in response to fertility, mortality and migration. The actual size of the population can be explained on the basis of the particular place and in a particular time. The population is one of the important factors which helps to balance the environment, the population should in a balance with the means and resources. If the population will be balanced, then all the needs and demand of the people can be easily fulfilled, which helps to preserve the environment of the country.

Keywords: *Effect of over population, causes, Higher Risk of Disasters and Pandemics, Solutions, Population Policy.*

❖ INTRODUCTION:

Population Studies is broadly defined as the Scientific Study of human Populations. Major areas Studied include broad population dynamics; Fertility and family dynamics, health, aging and mortality and human capital and labor markets. Researchers in population Studies also focus on methodology. population Studies is an interdisciplinary area of study, Scholars from demography. Epidemiology, Sociology, economics, anthropology and Various other disciplines study populations.

ISBN: 978-91-987581-0-8

❖ POPULATION GROWTH:

is the increase in the number of people in a population. Global human population growth amounts to around 83 million annually or 1.1% per year. The Global Population has grown from 1 billion in 1800 to 7.9 billion in 2020. The UN Projected population to keep growing and estimates have put the total population at 8.6 billion by mid-2030. 9.8 billion by mid 2050 and 11.2 billion by 2100. However some academics out side the UN have increasingly developed human population models that account for additional downward pressures on population growth in such a scenario population would peak before 2100. A Popular estimate of sustainable population is 8 billion people. World human population has been growing since the end of the Black Death. Around the year 1350. A Mix of technological advancement that improved agricultural productivity and sanitation and medical advancement that reduced mortality have caused an exponential population growth. In some geographies, this has slowed through the process called the demographic transition. Where many nations with high standards of living have seen a significant slowing of population growth. This is in direct contrast with less developed contexts, where population growth is still happening. However the global human population is projected to peak during the mid 21st Century and decline by 2100.

Population growth alongside over Consumption is a key driver of environmental concerns, such as biodiversity loss and climate change, due to resource intensive human development that exceed planetary boundaries. International policy focused on mitigating the impact of human population growth is concentrated in the sustainable Development Goals which seek to improve the standard of living globally while reducing the impact of society on the environment.

❖ INDIA'S POPULATION:

The current population growth rate is 1 percent, which means India will add over 13 million people this year. In contrast the death rate is 7.21 per thousand. India's current population is estimated at 1.3 Billion. Nearly 17.7 percent of the world's population lives in India. We are catching up with China whose population is 1.4 Billion and has 18.47 percent of the global population. India is expected to surpass China as the world's most populous nation by 2024.

ISBN: 978-91-987581-0-8

❖ IMPLICATIONS OF POPULATION GROWTH:

India is not growing uniformly The latest National Family Health Survey (NFHS).

- The poorest wealth quintile has a TFR of 3.2 Children per woman.
- The second lowest wealth quintile has a TFR of 2.5 Children per woman.
- The richest wealth quintile has a TFR of 1.5 Children per woman.

This shows that population growth is more concentrated in economically weaker sections of society.
Population growth acts as a hurdle in addressing effectively the problem of poverty. Hunger and malnutrition and also in providing the better quality of health and education.

❖ CAUSES OF INCREASING POPULATION:

The two main common causes leading to over population in India

1) The Birth rate is still higher than the death rate.We have been successful in declining the death rates but the same cannot be said for birth rates.
2) The fertility rate due to the population policies and other measures has been falling but even then it is much higher compared to other countries.

The above two causes are interrelated to the various social issues in our Country which are leading to over population.

1) Early marriage and universal marriage system.

Even though the marriageable age of a girl is legally 18 years. The concept of early marriage still prevails. Getting married at a young age prolongs the child bearing age. Also in India marriage is a sacred obligation and a universal practice, where almost every woman is married at the reproductive age.

2) Poverty and Illiteracy

Another factor for the rapid growth of population is poverty impoverished families have this notion that more the number of members in the family, more will be the numbers to earn income. Some fell that more children are needed to look after them in their old age. Also hunger can be cause of death of their children and hence the need for more

ISBN: 978-91-987581-0-8

children. Strange but true, Indian still lags behind the use of contraceptives and birth control methods. Many of them are not willing to discuss or are totally unaware about them illiteracy is thus another cause of over population.

3) Age old Cultural norm

Sons are the bread earners of the families in India. This age old thought puts considerable pressure on the parents to produce children till a male child is born.

4) Illegal Migration

Last but not the least. We cannot ignore the fact that illegal migration is continuously taking place from Bangladesh and Nepal is leading to increased population density

❖ CONTROL OF INCREASING POPULATION:

Social measurs

1. Minimum age of marriage
2. Raising the status of woman
3. Spread of education
4. Adopt orphan children
5. Social security schemes

Economic measures

1. More employment opportunities
2. Providing incentives

Other measures

1. Medical Facilities
2. Spreading awareness

❖ CONCLUSION:

Rapid population growth is detrimental to achieving economic and social progress and to sustainable management of the natural resource base. But there remains a sizeable gap between the private and social interest in fertility reduction and this gap needs to be narrowed policies and programs that influence health, education, the status of women and the economic value of children in turn influence attitudes toward childbearing family planning and people's ability to control family size. Efforts to reduce fertility through explicit population policies, therefore should be integrated with policies to improve health, education and the status of women.

ISBN: 978-91-987581-0-8

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.009

POPULATION EXPLOSION AND ITS IMPACT ON ENVIRONMENT IN INDIAN SCENARIO

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❖ ABSTRACT:

In the past, population growth was to some extent limited due to death of children and short life span. But now a days population explosion, i.e. a rapid increase of human population is putting an incredible strain on the environment. While developed countries continue to pollute the environment and deplete its resources, developing countries are also damaging as well due to compliance of their industrial advancements and economical development. India is facing the problem of population explosion accompanied with environmental degradations such as deforestation, loss of biodiversity, air and water pollution, water crisis, land degradation etc. Unsustainable use of environmental resources by a section of the poor people to meet their livelihood is notably observed. Poverty may be one of the common causes of population explosion and environmental degradation. Proper socioeconomic status of the population must be maintained to restrict the exploitation of environmental resources. So, everyone should aware about the problem of unsustainable population growth associated with the environmental degradation.

Keywords*: Population explosion, environmental degradation, poverty, India*

❖ INTRODUCTION:

A population is defined as a group of individuals of the same species living and interbreeding within a given area. Members of a population often rely on the same resources, are subject to similar environmental constraints, and depend on the availability of other members to persist

over time. Demography is the study of the characteristics of populations. It provides a mathematical description of how those characteristics change over time. Demographics can include any statistical factors that influence population growth or decline, but several parameters are particularly important such as population size, density, age structure, fecundity (birth rates), mortality (death rates), and sex ratio (Dodge 2006). Large populations experience their own problems. As they approach the maximum sustainable population size, known as carrying capacity, large populations show characteristic behaviour. Populations nearing their carrying capacity experience greater competition for resources. Between 1959 and 2000, the world's population increased from 2.5 billion to 6.1 billion people. According to United Nations projections, the world population will be between 7.9 billion and 10.9 billion by 2050.

❖ TRENDS OF POPULATION GROWTH IN INDIA:

India, being a vast fertile country, situated in the southern-part of Asia. India is one of the oldest civilizations in the world, with a rich heritage and myriad attractions. The great urban culture of the Indus valley civilization, a society of the Indus River valley that is thought to have been Dravidian speaking, prospered around 2500 BCE. Population growth rate is the average exponential rate of growth of the population over a given period. It is expressed as a percentage. High fertility has been observed in many developing regions, coupled with low fertility in more-developed regions.80 percent of the global population now lives in less-developed nations. The combination of a continuing high birth rate and a low death rate is creating a rapid population increase in many countries in Asia, Latin America and Africa and people generally lived longer.

The first registered population census in India was conducted by British periodically from 1865, then in 1881 onward to the year 1947. Since from independence in 1947, a census has been conducted every 10 years, and the first census by Ministry of Home Affairs happened in 1951. The Indian population in 2021 is estimated to be 1.39 Billion (139 Crores), According to Unique Identification Aadhar India, updated December 2020, by mid of year 2020 the projected population is 1,370,508,600. With roughly one-sixth of the world's total population, India is the second most populous country, after China and US is the third populous country in the world. India is projected to be the world's most populous country by 2024, surpassing the population of China. It is expected to home to more than 1.5 billion people by 2030 with the current birth rate of 1 person per second and death rate every 1 person per 3 seconds and migrant rate every

ISBN: 978-91-987581-0-8

1 person per 2 seconds. Population explosion, which refers to the rapid and dramatic rise in population, is a major problem of India.

Migration is one of the major reasons of population explosion. Much of human migration follows a rural-to-urban pattern, and, as a result, the Earth's population is also increasingly urbanized. Population growth is the primary force producing large urban centres in developing countries. Only one-third of the world's population lived in cities in 1960. By 1999, the percentage had increased to nearly half (47 percent). The areas of rapid growth of population continue to be associated with net in-migration resulting from:

1) The development of manufacturing industries, mining, trade, and miscellaneous services, all leading to acceleration in the process of urbanization,
2) The development of irrigation and reclamation of land bringing about increased intensity and extension in farming, and
3) Infiltration from neighbouring countries, particularly from Bangladesh.

❖ ENVIRONMENTAL CHALLENGES DUE TO POPULATION EXPLOSION:

Population growth presents problems with respect to employment opportunities. The predicted flood of manpower cannot be totally absorbed by the organized sector; it is argued that the agricultural sector is the only one which can help the country during this period of high population growth. To support this large and rising population, India will need to rapidly increase its average crop yields 2-3 times the present level for a modest improvement process. The expected population growth will also have consequences on environmental deterioration and water supply contamination. The distribution of people around the globe has three main implications for the environment.

i) As less-developed regions cope with a growing share of population, pressures intensify on already dwindling resources within these areas.
ii) Migration shifts relative pressures exerted on local environments, easing the strain in some areas and increasing it in others.

iii) Urbanization, particularly in less-developed regions, frequently outpaces the development of infrastructure and environmental regulations, often resulting in high levels of pollution.

The utilization, overuse and misuse of physical resources (land, air, water, soil and minerals) increased manifold due to the growth of human population. So, population explosion may lead to following environmental degradations -

❖ DEFORESTATION:

Forests are an important natural resource of India. They have moderate influence against floods and thus they protect the soil erosion. Forests also play an important role in enhancing the quality of environment by influencing the ecological balance and life support system (checking soil erosion, maintaining soil fertility, conserving water, regulating water cycles and floods, balancing carbon dioxide and oxygen content in atmosphere etc. The total forest cover in India (2021) is **7,12,249** square kilometres which is **21.67%** of the total geographical area. India has added 3,976 sq km of forest cover from 2017 to 2019. The status of forest cover in India (2021) is as follows-

Types of forest cover	Description	Percentage of total geographical area (%)	Area (Square Kilometre)
Very dense forest	All lands with tree canopy density of 70% and above.	3.02	99,278
Moderately dense forest	All lands with tree canopy density of 40% and more but less than 70%.	9.39	3,08,472
Open forest	All lands with tree canopy density of 10% and more but less than 40%.	9.26	3,04,499
Scrub	Degraded forest lands with canopy density less than 10%.	1.41	46,297

Source:https://geographyhost.com/forest-cover-in-india-important-statistics/

As the population grows, more and more forests are cleared. The two most common reasons for deforestation are to make houses for increased number of people to live in, and to use wood as a fuel in the industries. Rapid industrialization, urbanization and over-exploitation have resulted not only in decline but also in permanent loss of forest cover to an alarming rate. The major driver behind all these factors is the uncontrolled

ISBN: 978-91-987581-0-8

population growth of humans which leads to the dramatic increase in the demand for wood and forest products.

According to UN Food and Agricultural Organization (FAO), deforestation is the conversion of forest to another land use or the long-term reduction of tree canopy cover below the 10% threshold. Forest areas around the world are majorly cleared for agriculture, logging, mining and large-scale developmental projects. The loss of forest cover happens for many purposes:

1. To clear space for the production of crops like wheat, maize etc.
2. To create a grazing pasture for animals reared to fulfil the rising demand for meat.
3. For logging purposes, i.e., to meet the demand for wooden products like furniture or the production of charcoal.
4. For mining purposes, as most of the precious resources like Oil, gold, diamond, copper etc are found in and around forests.

The common disturbances that were being observed during the field survey (2017–2019) include fire, grazing, fuel wood collection, forage removal, litter collection, collection of Non-Timber Forest Products (NTFPs), lopping, thatch collection, root collection, soil removal, etc. The forest's canopy cover plays a major role in regulating the global climate, with a carbon sink capacity of around 90-140 billion metric tons. With the current deforestation trends, the release of even the smallest portion can lead to acceleration in global warming.

❖ LOSS OF BIODIVERSITY:

`Rapid population growth also causes intangible damage like climate change, which is yet another important factor behind the deteriorating biodiversity & ecosystems.

`The chemicals used in the mining process also degrade the quality of soil and ends up in water bodies, polluting them and harming the riverine ecosystems. To meet the growing demands, agricultural expansion happened, terrestrial land use was changed. Almost 50 per cent of the global land area is used for agriculture, causing an estimated 80 per cent extinction threat to animal and bird species.

❖ AIR AND WATER POLLUTION:

Air pollution is not the only environmental damage being done by the increasing population. Now a days, water pollution is also one of the increasing problems due to the population explosion. Water is considered the essence of life. As in the case of air pollution, the increasing

population calls for increasing numbers of factories. These factories lead to various kinds of pollution, including water pollution. Also, India being an agrarian country, the water pollution also comes from pesticides used for agriculture. The increased population size is leading to increased pollution, which in turn is leading to a more hostile environment for human beings themselves.

❖ WATER CRISIS

India is suffering from one of the world's worst national water crises. In fact, it is considered the centre of the global water and sanitation crisis. More than 50% of the Indian population has no access to safe drinking water and about 200,000 people die every year for lack of access to safe water. While India's aquifers are currently associated with replenishing sources, the country is also a major grain producer with a great need for water to support the commodity. As with all countries with large agricultural output, excess water consumption for food production depletes the overall water table. Many rural communities in India who are situated on the outskirts of urban sprawl also have little choice but to drill wells to access groundwater sources.

India's water crisis is often attributed to lack of government planning, increased corporate privatization, industrial and human waste and government corruption. The 2018 Composite Water Management Index (CWMI) noted that 6% of economic GDP will be lost by 2050, while water demand will exceed the available supply by 2030. In addition, water scarcity in India is expected to worsen as the overall population is expected to increase to 1.6 billion by year 2050. To that end, global water scarcity is expected to become a leading cause of national political conflict in the future, and the prognosis for India is no different.

❖ LAND DEGRADATION

The land serves as storage for water and nutrients required for plants and other living micro-macro-organisms. The demand for food, energy and other human requirements depends upon the preservation and improvement of the productivity of land. The loss of arable land has been caused by a number of factors, many or most of which are tied to human development. The primary causes are deforestation, overexploitation for fuel wood, overgrazing, agricultural activities and industrialization. On the global basis, the soil degradation is caused primarily by overgrazing (35%), agricultural activities (28%), deforestation (30%), over exploitation of land to produce fuel-wood (7%), and industrialization (4%). Over the

ISBN: 978-91-987581-0-8

past fifty years, while India's total population increased by about 3 times, the total area of land under cultivation increased by only 20.27 percent from 118.75 million hectares in 1951 to 142.82 million hectares in 2001. Most of this expansion has taken place at the expense of forest and grazing land. Despite past expansion of the area under cultivation, less agricultural land is available to feed each person in India.

The spread of green revolution has been accompanied by over exploitation of land and water resources and use of fertilizers and pesticides have increased many folds. The extent of agricultural intensification and extensification is characterized by an increase in cropping and irrigation intensity and higher use of chemical fertilizers, pesticides and insecticides. The process of agricultural extensification and intensification is leading to land degradation, overexploitation of underground water resources, increased use of chemical fertilizers leading to eutrophication and water pollution. Due to the increasing cropping intensity, irrigation intensity and excessive use of chemical fertilizers, agricultural intensification results in water logging, salinization and alkalinization of croplands and eutrophication of water bodies and ill health of oceans and thus leads to reduction in biodiversity.

❖ POVERTY AND ENVIRONMENTAL DEGRADATION

The outcomes of high population growth rates are increasing number of people below poverty line, an increasing population density, and pressure on natural resources. The country's population growth and poverty are imposing an increasing burden on the country's limited and continually degrading natural resource base. The natural resources are under increasing strain, even though the majority of people survive at subsistence level. Human population growth leads to a decrease in per capita income growth, which tends to lead to an increase in poverty, which is in turn linked to poaching. It is a vicious cycle.

ISBN: 978-91-987581-0-8

Figure 1: Relationship between poverty and environmental degradation

Poverty is amongst the consequences of population growth and its life style play major role in depleting the environment. Poor people are forced to degrade forest resources to meet their fuel demands for cooking or for earning livelihood for their survival. The unequal distribution of resources and limited opportunities cause push and pull factor for people living below poverty line that in turn overburdened the population density in urban areas and environment get manipulated by manifolds, consequently, urban slums are developed in urban areas.

Currently, about 60 per cent or an estimated 812 million people of India live below the poverty line and if the population growth rate is not arrested or abated even now, the problem may wreck the country's social fabric, increasing the level of unemployment and under-employment even more and further affect the benefits of economic development being imparted to people at the lower strata.

❖ CONCLUSION:

Mahatma Gandhi once said, “The world has enough for everyone's need, but not enough for everyone's greed.” Only through sustainable living, sustainable development and sustainable population growth people can combat the threat and save the planet. Over the years, most of the governments have taken various steps to control the tremendous

ISBN: 978-91-987581-0-8

population growth. However, despite their efforts; the growth rate has accelerated tremendously. Sterilisation and other methods dealing with the issue do not found to be effective as a whole. The real and better solution lies in spreading awareness among people only by changing their attitudes and habits which has been deep rooted in their minds, attitudes and values. It should be known that population control will not come to an end of all the environmental problems, but it will minimise to some extent to eradicate such problems.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.010

SKILL DEVELOPMENT IN INDIA: NEED, CHALLENGES AND WAYS FORWARD

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❖ ABSTRACT:

skill of the Indian workforce in the age group of 15-59 and which was found to extremely low i.e. around 38% of the workforce are not even literate, 25% are having below primary Globalization, knowledge and competition have intensified the need for highly skilled workforce in both the developing and developed nations as it enables them to accelerate their growth rate towards higher trajectory. For Indiaor up-to primary level of education and remaining 36% has an education level of middle and higher level whereas only 10% of the workforce is vocationally trained (with 2% formal and 8% informal training). The study also found that both the Government and its partner agencies have undertaken various measures/initiatives for the effective implementation of the skill development system in the economy, but still development is critical from both socio-economic and demographic point of view. Therefore, the present paper attempts to study the present skill capacity, challenges in front of skill development initiatives in India along with their solutions. The skill capacity has been assessed in the form of general education and vocational training level faces a number of unresolved issues/challenges that need immediate attention of the policy makers. Hence, skill development initiatives of the government should focus on these obstacles and develop the programs accordingly to resolve these hurdles for the complete success of the skill development initiatives.

Keywords: *Skills Capacity; Challenges; Ways Forward; India*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

Globalization, knowledge and competition have intensified the need for highly skilled workforce in both the developing and developed nations as it enables them to accelerate the growth rate of their economy towards higher trajectory. Today all economies need skilled workforce so as to meet global standards of quality, to increase their foreign trade, to bring advanced technologies to their domestic industries and to boost their industrial and economic development. Thus, skills and knowledge becomes the major driving force of socio-economic growth and development for any country. As it has been observed that countries with highly skilled human capital tend to have higher GDP and per capita income levels and they adjust more effectively to the challenges and opportunities of the world of work.

For India, skill development is also critical from both socio-economic and demographic point of view. For the economy to grow at 8% to 9%, with the targeted growth rate of 10% for secondary, 11% for tertiary and 4% for agriculture sectors, a multi-faceted and highly efficient skill development system is imperative. Further, India is destined to be a contributor to the global workforce pool on account of demographic bonus, with the growth rate of higher working age population as compared to its total population and home to the second largest population (with a headcount of around 1.4 billion by 2025) in the world with distinct advantage of having the youngest population with an average age of 29 years as against the average age of 37 years in China and the US and 45 years in Western Europe (FICCI, 2014).

The broad objectives of the present paper are to study the present skill capacity, the various challenges in the development of effective skill system along with their ways forward for the success of skill development initiatives in Indian context. In order to this, the study is divided into the following sections: Section-II discuss the data and methodological issues; Section-III depicts the findings pertaining to present skill capacity, challenges and ways forward for the success of effective skill development programs in India and Section–IV conclude the study

❖ OBJECTIVES OF THE STUDY

1. To study the present skill capacity of India.
2. To study the challenges faced by skill development system in India.
3. To suggest possible solutions or ways forward.

ISBN: 978-91-987581-0-8

❖ DATA AND METHODOLOGY:

The proposed study mainly is descriptive in nature. It solemnly based on secondary data and information which is collected from the concerned sources as per need of the research. The relevant books, documents of various ministries/departments and organizations, articles, papers and web-sites are used in this study.

❖ FINDINGS / RESULITS:

India's transition to one of the largest and fastest growing global economies during the last decade has been a remarkable phenomenon. In order to sustain its growth trajectory, an efficient and continuous system of skill development for its workforce is critically imperative for India. Therefore, this section is devoted to portray the current skill capacity of India; the major challenges in the successful implementation of skill development initiatives along with their way outs or suggestions.

❖ PRESENT SCENARIO OF SKILL CAPACITY OF INDIA:

In order to capitalize the demographic dividend, India will need to empower its workers with the right type of skills. Thus this section depicts the present skill levels of the Indian workforce in the age group of 15-59 years in the form of their general educational levels and vocational training levels.

- The drop-out rates of educational institution was estimated to be 50% in the age group of 5-14 years and86% after 15 years of age and in contrast to this the participation rate of the workforce rises rapidly after 14 years of age and it results in a semi-literate workforce which finds it difficult to absorb higher form of skills.
- 38% of Indian workforce is illiterate, 25% has education below primary or up to primary level and remaining 36%has an education level of middle and higher level.
- 80% of Indian workforce does not possess any marketable skills.
- Only about 2% have received formal vocational training and 8% non-formal vocational training, thereby implying that very few new entrants to the work force have any marketable skills as compared to developed economies such as Korea (96%), Germany (75%), Japan (80%) and United Kingdom (68%). In-nutshell, it can be said that despite making considerable progress in terms of literacy, high incidence of illiteracy cripples the Indian workforce

even today. The above facts are a stark reminder that India's demographic dividend can rapidly convert into a demographic nightmare if skills are not provided to both new and existing workforce. Thus, there is a need for increasing capacity and capability of skill development programs.

- **Demand & Supply Mismatch:** The demand made by the industries and supply of labour-force mismatch leads to aggravate all types of skill development initiatives of the Government and its partner agencies as:

➢ The number of people formally trained in a year is only 1,100,000 by Ministry of Labour and Employment and approximately 3,200,000 trained by 17 other central government ministries.

- **Geographical Problem:** It is another serious problem plaguing the labor market and has a more serious impact in larger economies like India as the geographical set-up or outreach of the people for skills in India are uneven and in dismal share:

➢ The states with much higher economic growth rates have more new jobs with lower rate of labour-force while on the other hand; the states with slower economic growth rates have higher population growth rates with fewer new jobs. Thus laggard states need to rely on migrant workers so as to cope with this challenge.

➢ Majority of formal institutions are located in urban areas as compared to rural areas and even private sector institutions are also reluctant to operate in rural areas. Hence, large proportions of rural population do not have any formal vocational training institutions.

➢ Districts notified as backward have serious paucity of formal skill training as majority of skill development institutions in these locations emphasized only on basic livelihood skills and that is generally provided by NGOs or provided by other agencies as a part of social development programs. Therefore, these types of skills are often not formally assessed and as a result are not recognized for employment by industrial sectors.

- **Way forward:** Thus an ideal scenario is one in which supply of labour can be transformed into skilled workforce which is easily absorbed by the industrial-sectors. However, in India a small portion of labour force is actually undergoing for formal training.

ISBN: 978-91-987581-0-8

It has been observed that there are more people than the available jobs at the low skills level, while there are more jobs at the high skills level than those available for such jobs. This demand and supply mismatch indicates that there is a serious mismatch between the education and skills that the youth attain and what the labor market demands. Therefore, in order to create a people-centric approach for skill development, it is required that the skill development initiatives needs to be coordinated with demand and supply scenarios across geographies, industries and labour markets so that new skills required by industry or changes in supply of labour are speedily adjusted with adequate and efficient training programs.

- **Vocational Training:** India is progressively moving towards knowledge economy, where skills are widely recognized as the important lever of economic growth, but the perception about vocational education is still doubtful i.e. it is generally meant for those who fail to get admission in the formal system. Thus, it still need time to be considered as a viable alternative to formal education.

- As it was observed in India, around 90% of the jobs are skill-based i.e. they require some sort of vocational training whereas in reality only 2% of the population (in 15-25 years age group) enrolled for vocational training in India as compared to 80% inEurope and 60% in East Asian countries.

- The current capacity of vocational training is 31 lakh against an estimated annual capacity of 128 lakh workers whereas the overall national target of skilling is 50 corer of workers by 2022 i.e. India needs to impart vocational training to at least 300–350 million people by 2022 which is significantly lower than the government target of 500 million.

- Moreover, the private sector provide skill training as required by service sector mainly to educated youth (especially 12thpass) and largely in urban regions. Ultimately, hundreds of workers in unorganized sector do not get any kind of skill training which results in low productivity levels and employability gaps among majority of workforce.

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- Due to lack of awareness about industrial requirements and the availability of matching vocational courses, most of the prospective students in the country do not go for vocational education.

- **Skill development for women:** In India, women also form an integral and substantial part of the workforce; but the working percentage rate of women in total labor force is declining.
- The share of women workforce (between 25-54 years of age) is about 30% in 2010 as against 39% in 2000, which is quite below as compared to 82% in China and 72% in Brazil. All it depict the under-representation of women in the workforce and results in the wastage of the demographic dividend to India.

- **Private sector participation:** The current situation in respect to the participation of the private sector is as follows:
- The private sector is not involved adequately in curriculum development and policy formulation related to educational and vocational training.

- Mostly private sector institutes are located in urban areas therefore rural population remains lags behind. Furthermore, due to high cost of these institutes the weaker or disadvantaged section also unable to get proper skill training.

- **Multiplicity of Institutional Framework:** Over the past few decades, India has witnessed significant progress in the skill development landscape as various types of organizations have been set up both at national and at state level.

- Around 17 ministries,2 national-level agencies, several sector skill councils, 35 state skill development missions and several trade and industry bodies comes forward with a view to push the national skill development agenda.

- Given this mind-bogglingly complex institutional setup with overlapping and conflicting priorities and little co-ordination and standardization ultimately resulted in fragmented outcomes with limited impact.

- **Informal & Formal Sector Skill-Gap:** As the Government of India has set a target to impart the necessary skills to 500 million

people by 2022 in the Twelfth Five Year Plan, whereas in reality the country is facing a significant skilled manpower challenge over the next decade.

- In India, around 12 million people are expected to join the workforce every year whereas the current total training capacity of the country is around 4.3 million, thereby depriving around 64% entrants of the opportunity of formal skill development every year.
- Furthermore, out of approximately 0.4 million engineering students graduating every year in India, only 20% are readily employable.
- Around 93% of the Indian workforce is employed in the unorganized or informal sector, which lacks any kind of formal skill development training.
- Barely 2.5% of the unorganized workforce reportedly undergoes formal skill development in comparison to 11%of organized sector.
- In addition, only around 12.5%and 10.4% of the workforce in the unorganized and organized sectors, respectively, undergoes informal skill development. This indicates that around 85% of the work force in the unorganized sector d

- **Infrastructure Challenge:** One of the important requirements for the proper implementation of the skill and training development programs is the availability of the basic infrastructure for the same. It has been noticed that many skill development institutions suffer from lack of proper infrastruc

planning for skill development initiatives which incorporates local employment demand and skill requirements. Thus, it is imperative for the success of skill development system that market institutions work efficiently and well connected with educational and vocational training institutions. As the main objective of education and vocational training is employment. Therefore educational and vocational system has to be linked to the job market in such a way that it must be competent to provide relevant information about the growing employment opportunities, types of skills required by different jobs, and where and how the skills can be acquired. And this will ultimately lead to enhance the socio-economic relevance of education and vocational training along with strengthening the performance of the market institutions in the economy.

ISBN: 978-91-987581-0-8

❖ CONCLUSION:

To make India internationally competitive and to boost its economic growth further, a skilled workforce is essential. As more and more India moves towards the Knowledge economy, it becomes increasingly important for it to focus on advancement of the skills and these skills have to be relevant to the emerging economic environmentdemographic dividend, an efficient skill development

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.011

GENDER DIMENSION DEVELOPMENT IN INDIA: EMPOWERING WOMEN THROUGH THE VARIOUS EDUCATIONAL SCHEMES IMPLEMENTED BY THE GOVERNMENT OF INDIA

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❖ ABSTRACT:

Education not only makes women literate but it also acts as a tool for their empowerment. But In Indian society, basically in rural areas women are not getting the chance to attend any educational institutions. In traditional Indian society, sons are always considered as assets whereas, girls are considered as liability. So, spending money on their education is not considered as priority. They are only seen as a good daughter, a good mother or a good homemaker. Therefore, attending schools or getting education is also not possible for them due to the prevalence of various age old existing social evils, beliefs, taboos, religious faiths and so on. If they attend school or spend their time to get education, then who will look after the household chores? Moreover, if they become literate they might have been taking parts in various activities outside their homes or might have been asking questions regarding the existing patriarchy which are not at all considered to be "good". This will be considered as an 'immoral' act or a great 'sin'. In other words, they should be only a silent listener and should pay their full attention towards daily chores at home. But women can play a very important role in the upliftment of socio-economic development of a nation. So, it is very important for the government to consider education for female folk as a national issue and should spend fund on them to make them educationally empowered so to make India a true democratic country in reality. In this paper, the researcher wants to bring forth the various educational schemes for girl child as implemented by the Indian government for their empowerment.

Keywords*: Education, women, patriarchy, literate, empowered*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

"Be self-reliant, be industrious
Work, gather wisdom and riches
All gets lost without knowledge
We become animal without wisdom
Sit idle no more, go, get education."
(Go, Get Education- Savitri Bai Phule)

Women empowerment is a debatable topic of today's global world. In vedic period, women of India got equal status with that of men and thus this period produced scholars like Ghosha, Lopamudra, Maitreyi and Gargi. They were the epitomes of intellectual and spiritual attainments. But in the modern days, women have to fight for their various rights including educational right; most of the times, they are subjected to discrimination and violence in terms of their gender.

The Indian constitution has given utmost importance to provide equal status and opportunities for both men and women since it has been penned down. There are various Articles, Clauses, etc. in the constitution that clearly states about the provisions for equality among all the citizens of India as well as support for the weaker section of society which includes women, children, differently-abled persons, Scheduled Tribes (STs) and Scheduled Castes (SCs). For instance, the Article 14 of the Indian constitution grants all citizens equality before the law of the land. Article 15 states that the state shall not discriminate against any citizen on the ground of religion, caste, sex, etc. Again, Article 16 states that there should be equality of opportunity in matters of public employment irrespective of sex, religion, caste etc. Article 45 is upon the provision for free and compulsory education for children until they complete the age of fourteen years. Article 46 is on the promotion of educational and economic interests of the STs and the SCs and other weaker sections of the society.

Thus, it has been seen that the Government of India has been trying to support and give a good life to all its citizens, especially, the weaker section as mentioned above. So, women should be provided equal opportunities and education regardless of their caste, religion, etc. at par with men. Though these provisions are there in the constitution, but due to the weak economic base of our Indian society, parents prefer not to send their children, especially, their daughters to school. Instead, they would prefer either to send them to do manual labour so to earn little money or to sit for child marriage. Thus, The Right of Children to Free and

ISBN: 978-91-987581-0-8

Compulsory Education Act or Right to Education Act (RTE), 2009 aims to provide free and compulsory education for children between the age group of 6 to 14 years under Article 21A of the Indian Constitution. It aims to give education to all children of India irrespective of caste, creed, sex, religion, etc. under this particular age group. But in reality, it has been seen that for a girl child this 'free' and 'compulsory' education is like a distant dream to be achieved. From time to time the Indian government has been trying to formulate various effective educational policies, schemes, reforms, reservation, etc. to make their condition or status better in Indian society. But various statistical surveys show that these initiatives have failed to give a chance to access for girls to get enrollment in schools or to pursue for higher education. As a consequence, women are subjected to child marriage, child labour, rape, murder, molestation and so on or have to sit on the pavements for begging.

The Census Report, 2011 shows that women are lagging behind as far as literacy rates are concerned (Male-82.14%, Female-65.46%). Again, according to National Family Health Survey (NFHS-5) male literacy at India level in 2021 stands at 84.4% and female literacy stands at 71.5%. There may be various reasons in this male-female gap in literacy rates. In India, under the influence of patriarchy, the birth of a boy child is very welcoming with grand celebrations and merry- making gatherings. He is like an asset for the family and a lot of money has been spent on his upbringing. Whereas, a girl child is seen as a burden on the family and thus gets least importance regarding the expenses on her upbringing like rearing, health, education, etc. Moreover, most of the important decisions have been taken by a male member of the family. On the other hand, a female member is always thought to be good at taking care of the family members, begetting children as well as rearing them. Thus, her status is subordinated to that of a man in every aspect in the society. But as we know that a society is consisted of both man and woman. The growth of a nation equally lies on the hands of both of them. Thus, she should be given equal opportunities and status so to bring prosperity not only to the society but for the whole of the nation. Thereby, the various educational policies of India have given the priority to provide education to female folk so to change the age old tradition of 'abla nari' to an empowered woman.

❖ EDUCATION IN INDIA CONCERNING WOMEN EMPOWERMENT:

Before the independence of India, there were glorious examples of people who encouraged and fought hard for female education which could

bring dignity and respect for them. Among them, Savitribai Phule (1831-1897), the first lady teacher of India had made a tremendous revolution against the caste system of India as well as for the upliftment of women education. Chandraprabha Saikiani (1901-1972), brought a historic change regarding female education in Assam. Besides, Indira Miri (1910-2004), popularly known as Mereng had put her effort in promoting education in the North East Frontier Agency (NEFA).

After getting the independence from the British rule on August 15, 1947 Indian government got the chance to mould educational policies according to the needs and aspirations of its citizens. Since then, Education Department in the Centre has developed in a full-fledged Ministry under the Central Government. The setting up of the University Education Commission which is popularly known as the 'Radhakrishnan Commission' in 1948 was a major landmark to set goals and objectives for higher education in India. It was the first education commission of independent India. Along with its various aims of education, it has given due priority to women education also and thus it stated: 'There cannot be educated people without educated women'. After that the Secondary Education Commission was appointed by the Government of India on September 23, 1952 under the Chairmanship of Dr. A.L. Swamy Mudaliar which is popularly known as the 'Mudaliar Commission'. The main aim of this Commission was to study deeply the various problems of secondary education and to suggest measures for reforms on aims of education, teaching arrangements, the relationship of secondary education with primary and higher education and so on. For girl's education, it had provided same education as for the boys through co-education but there should be provision of home science teaching for girls. It has also recommended for opening of girls' schools in the areas where required. Then in the year 1964 the Government of India appointed an Education Commission under the Chairmanship of Dr. D.S. Kothari which is popularly known as the 'Kothari Commission'. The basic priority of this commission was on the progress of the nation with the means of education. Thus, the Education Commission opened its report as: *'the destiny of India is now being shaped in her classrooms. This, we believe, is no more rhetoric. In a world based on science and technology, it is education, that determines the level of prosperity, welfare and security of the people'.* The National Policy on Education (NPE), 1986 recognised the empowerment of women is possibly the most critical precondition for the participation of girls and women in the educational process. The main features of the implementation strategy on women has consisted of, 'to

ISBN: 978-91-987581-0-8

gear up entire education system to play a positive interventionist role in the empowerment of women; to encourage educational institutions to take up active programme to enhance women's status and further women's development in all sectors; to widen women's access to vocational, technical and professional education at all levels'. Following this policy, there came up Mahila Samakhya programme in 1988 which recognized that education can be an effective tool for women's empowerment. Besides, prior to these recommendations, educational panel of the Planning commission recommended on July 1957 that, 'A suitable committee should be appointed to go into various aspects of the question relating to the nature of education for girls at the elementary, secondary and higher stages and to examine whether the present system was helping them to lead a happier and useful life'. Thus, the Government of India appointed the national committee on women's education under the Chairmanship of Smt. Durgabai Deshmukh. Moreover, the National Council of Women was established in 1958 to ensure the equal rights of women in society. Its major concern has been on promoting women's education in India along with socio-economic empowerment.

❖ PRIMARY EDUCATION IN INDIA:

The Sarva Shiksha Abhiyan (SSA) is a flagship programme of Government of India for the achievement of Universalization of Elementary Education (UEE) in a time bound manner. It is being implemented in partnership with State Government to cover the entire country and address the needs of 192 million children in 1.1 million habitations. It was launched in 2001-2002 with the aim to provide useful and relevant elementary education to all children in 6 to 14 age group by 2010. It has a special focus on girl's education. In the Manual for Planning for Appraisal (2004) it has been surveyed that majority of girls, especially adolescent girls, are deprived of education owing to various factors such as distance to schools, domestic chores, sibling cares and so on. So, the role of SSA has been found immense as it not only focuses on girl's education but also to ensure the availability of primary schools within one kilometer of the habitation of residence of children and upper primary schools within three kilometers of the habitation. In addition, in 2003 the National Programme for Education of Girls at Elementary Level (NPEGEL) was launched and implemented in Educationally Backward Blocks (EBB) to address the needs of girls who are 'in' and 'out' of school. It has given importance on the prevention of girls from dropping out of schools at primary level. It follows up on girls' enrolment,

attendance and learning achievement by involving village level women's and community groups. Beside this, the Kasturba Gandhi Balika Vidyalayas have been set up in 2004 in educationally backward blocks where schools are at great distances and is a challenge to the security of girls which often compel them to discontinue their education. These are residential upper primary schools for girls where 75% is reserved for Scheduled Castes (SCs), Scheduled Tribes (STs), Other Backward Classes (OBC) and other minor communities and 25% is for the girls from the Below Poverty Line (BPL) families.

❖ SECONDARY EDUCATION IN INDIA:

As SSA has taken the responsibility of elementary education, Rashtra Madhyamik Shiksha Abhiyan (RMSA) has come up as a flagship scheme of Government of India in 2009 to enhance access to secondary education with quality improvement and equity. In its revised programme in 2013, it has given emphasis on the Girls Hostel Scheme and National Incentive to Girls specially to encourage girls in secondary level of education.

❖ HIGHER EDUCATION IN INDIA:

India has occupied world's third position in higher education system after China and the United States of America. The Rashtriya Uchchatar Shiksha Abhiyan (RUSA) is a centrally sponsored scheme, launched in 2013 to provide strategic funding to eligible State higher educational institutions to improve their quality of education and delivery of services to students. It has also taken a number of steps to promote women's education like opening of women colleges in states like Jammu and Kashmir, Himachal Pradesh, Manipur, etc. as well as creation of women's universities across the country to facilitate higher studies to women.

❖ BETI BACHAO BETI PADHAO (BBBP):

Beti Bachao, Beti Padhao (Save girl child, educate girl child) is a Central Government Sponsered Scheme by GOI. This scheme was launched on 22 January 2015 with the tagline 'The Happiness of a Nation lies in the Dignity of its Daughters' with the overall goal of the scheme to celebrate the girl child and enable her education. It was launched by honourable Prime Minister, Narendra Modi from Panipat, Haryana on the occasion of International Day of the Girl Child as a mark for the eradication of female foeticide against the issue of declining Child Sex

ISBN: 978-91-987581-0-8

Ratio (CSR) in India. It acts as a campaign of the Government of India that aims to generate awareness and improve the efficiency of welfare services intended for girls in India. Under this scheme there is an additional scheme, namely, Sukanya Samriddhi Account which encourages parents to build a fund for the future education and marriage expenses for their female child. This account can be opened at any Indian Post office or branch of authorized commercial banks.

❖ UDAAN: A PROGRAMME TO GIVE WINGS TO GIRL STUDENTS:

It is a project launched by Central Board of Secondary Education (CBSE) under guidance of Ministry of Human Resource Development (MHRD). It was launched to address the low enrolment of girl students in prestigious engineering institutions and engineering entrance examination. It is going to provide a platform for empowerment of girl students and will provide better learning opportunities for them. It will be acting like a support for the deserving girl students to pursue higher education in engineering programmes and would assist them to prepare for IIT-JEE examinations to crack through to the best technological institutes in the country while they would be in 11^{th} and 12^{th} standards.

❖ SAINIK SCHOOLS:

The Sainik School was established in 1961 by V.K. Krishna Menon, the then Defence Minister of India to rectify the regional and class imbalance amongst the officer cadre of the Indian Military and to prepare male students mentally and physically for entry into the National Defence Academy (NDA) and Indian Naval Academy (INA).Since then, it has been seen that there are 33 Sainik Schools all over India which have the provision for entry only for boys. But 75^{th} Independence Day of India, 15^{th} August 2021 has been like a red letter day for girl aspirants to enroll themselves in Sainik Schools. It was announced by honourable Prime Minister of India, Narendra Modi that the Sainik Schools will be opened for the enrolment of as well to fulfil their aims and to show their capacities in the field of defence. But before this historical announcement, Mizoram has already set the example to be the first state in India to enroll girl aspirants in Sainik Schools in 2018. It opens the doors of quality training of girl cadets at par with boys for their empowerment in defence sector also.

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❖ GOVERNMENT TECHNICAL UNIVERSITY FOR WOMEN:

Indira Gandhi Institute of Technology was established by Department of Training and Techincal Education, Govt. of Delhi, in 1998 as the first woman Engineering College in India. But this institute was converted to Indira Gandhi Delhi Technical University for Women (IGDTUW) in 2013 vide Delhi Act 09 of 2021, as a non- affiliating University to facilitate and promote studies, research, technology, innovation, incubation and extension work in emerging areas of professional education among women, with focus on engineering, technology, applied sciences, architecture and its allied areas with the objective to achieve excellence in these and related fields.

❖ CONCLUSION:

The above mentioned schemes and initiatives that have been taken by the Government of India for the upliftment of women has been gaining a good momentum for their empowerment to be independent in every aspect of our society. As free and compulsory education is there by dint of SSA, child labour has been diminishing day by day. Parents prefer to send their daughters to school instead of sending them for bonded labour under unruly masters. Moreover, RMSA and RUSA are also playing great role to provide education in secondary and higher level of studies. Thus, a large number of girl's enrolment has seen in secondary and higher levels of education instead of getting married and begetting children very early in life. As a consequence, they are getting 'wings' to excel in the field of education and to bring glory to our nation.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.012

DEVELOPED AND DEVELOPING ECONOMY MEANING AND CONCEPT

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❖ ABSTRACT:

Economic development is the process by which developing countries become developed economies. In other words, the process by which countries with low living standards become nations with a higher standard of living. Economic development also refers to the process by which health, welfare, and the level of education in general society improve. During development there is a shift in people from agriculture to industry, and then to jobs. The average life expectancy, for example, is one of the consequences of economic development. Improved productivity, higher literacy rates, and better public education, are also results. In Simple words economic development is about improving the quality of life. 'Improved living standards' refers to higher levels of education and learning, staff income, health, and years of life.

Keyword*: Economic Development, Enhanced Production, Literacy, Health, Lifespan.*

❖ INTRODUCTION:

- **Developed Economy: Definition and Concept.**

A developed economy is a sign of a developed country with a high level of economic growth and security. Common criteria for assessing the level of national development per capita income per household or product, industry standard, standard of living, and value of technology infrastructure. Non-economic factors, such as the Human Development Index (HDI), which measures national standards of education, literacy, and personal health, can also be used to assess economic or developmental status. The most common metaphor used to determine whether the economy is developing or developing is per capita gross domestic product

(GDP), although there is no solid basis for the economy to be considered as development or development. Some economists consider $ 12,000 to $ 15,000 per person's GDP as sufficient for a developed state while others do not consider a developed country unless the individual GDP is above $ 25,000 or $ 30,000. The highest GPA shares in 2019 were 65,111 US dollars. In lands where segregation is difficult, economists are turning to other factors to determine the state of development. Standard life measures, such as infant mortality and life expectancy, are effective although there are no set limits on these measures. However, most developed economies face the death toll of less than 10 per 1,000 live births, and their citizens live to be 75 years or older on average. Individual high GDP alone does not provide an improved economic situation without other factors. For example, the United Nations is still looking at Qatar, which has one of the highest GDP in the world in 2019 at $ 69,688, a developing economy because the country has extreme income inequality, lack of infrastructure, and limited education opportunities for wealthy citizens. Examples of developed countries include the United States, Canada, and most of western Europe, including the United Kingdom and France.

❖ DEVELOPING ECONOMY: DEFINITION AND CONCEPT:

The Developing economy also known as the less developed economy or is a nation with an underdeveloped industrial base, with a lower Human Development Index (HDI) compared to other countries. On the other hand, since the late 1990's, developing economies have been showing higher growth rates than developed ones. There is no general, agreed standard of what makes a developing country comparable to a developed country and which countries are eligible for these two categories, although there are areas that are referred to as GDP per capita compared to other nations. Also, the common denominator of a poorly developed economy should not be confused with a less developed country. Terms such as "emerging countries," "least-developed countries," and "developing countries" are often used to refer to countries that do not enjoy the same level of economic security, industrial development, and growth as developed countries. The term "third-world country" to describe the world today is considered old and invading. The United Nations Conference on Trade and Development notes that the less developed countries in the world are considered to be the most disadvantaged in their development — many of them for local reasons —

ISBN: 978-91-987581-0-8

and are at risk of poverty. "Proponents of globalization often claim that globalization contributes to the development of impoverished economies and to the development of improved living standards, higher wages, and the use of modern technology. These benefits have been proven primarily in the Asia-Pacific region. We have already said that globalization comes with obstacles and need to be considered when foreign investment enters a developing economy.

❖ DIFFERENCES BETWEEN THE DEVELOPED AND DEVELOPING ECONOMY:

- **GDP (Gross Domestic Product)**

In addition, developed countries have a much higher GDPS while less developed countries have a much lower GDPS. The GDP of developing countries, on the other hand, takes a median price between the two.

- **HDI (Human Development Index)**

Developed countries have very high HDI, while less developed countries have very low HDI. The HDI of developing countries, on the other hand, occupies a median value between the two.

- **Technology and Utilities**

People in developed countries have easy access to the latest technological advances, enjoy better health care, education, and other services, while people in developing countries may have access to technology, and health care, education, and other services are at a higher level. On the other hand, the vast majority of people in developed lands have no access to education, health care, or other basic services, and most do not have access to technology.

- **Quality of Life**

The standard of living in developed countries is high, while the standard of living in underdeveloped countries is very low. The standard of living in developing countries are somewhere in the middle.

- **Examples**

Norway, Denmark, Austria, the US, Switzerland, and Canada are some examples of developed countries. India, Indonesia, Nigeria, Saudi Arabia, Russia, and South Korea are some examples of developing countries.

ISBN: 978-91-987581-0-8

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ISBN: 978-91-987581-0-8
DIP: 18.10.9198758101.013

TOWARDS DEVELOPMENT IN POST PANDEMIC INDIA

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❖ ABSTRACT:

The Post Pandemic World needs to rise and shine. There is an urgent need of development. As usual, Women have taken a lead to rebuild their homes, their careers and their own self confidence. Women enter entrepreneurial careers to gain a sense of accomplishment and achievement, as opposed to their male counterparts, who start their businesses for the sake of growth opportunities and profit potential (Hillstrom). Covid-19 presents a proverbial golden opportunity for women entrepreneurs. Women from all sectors and segments of the economy are responding to this extraordinary shock with zeal, agility, and optimism. Vital ecosystem participants must step forward to support women in India and thus unlock this demographic asset. This chapter is an attempt to portray the Post Covid-19 scenario for women entrepreneurs, their trials and tribulations and ways to overcome the same.

Keywords: *entrepreneur, Covid-19, adversity, development*

❖ INTRODUCTION:

The word "entrepreneur" is derived from the French words "entrée" which means "to enter" and "prendre" which means "to take," which connotes "undertaker," but in common terms, entrepreneurs are those who start their own company. They are, nevertheless, the true geniuses who help to strengthen the economy (Rani, 1996). In any culture, the entrepreneur is a powerful force to reckon with. Entrepreneurs are people with a vision, they play a critical part in any country's economic growth (Vinze, 1987).

ISBN: 978-91-987581-0-8

Women are gaining more knowledge and competing equally with their male counterparts in every domain as a result of urbanisation and increased industrialisation. They contribute equally to economic development, whether in the organised or unorganised sectors, as a self-employed person or as an entrepreneur. Women's involvement in productive activities has risen steadily over the ages. However, they are primarily employed in the unorganised sector. (Vinze, 1987).

For women, entrepreneurship is an important option because it not only allows them to be financially independent, but it also allows them to pursue a variety of lifestyle options. It also encourages them to be self-determined and to speak out against discriminatory practises. According to some experts, greater female economic independence promotes geopolitical stability and world peace (Forbes).

Women entrepreneurs in India have faced adversity and criticism on their path to self-sufficiency. Before they could establish themselves as independent entrepreneurs, they had to overcome family opposition and social constraints (Vinze, 1987). Women have their own motivations for starting their own businesses. Women enter entrepreneurial careers to gain a sense of accomplishment and achievement, as opposed to their male counterparts, who start their businesses for the sake of growth opportunities and profit potential (Hillstrom).

Indian history bears witness to the fact that entrepreneurship has always been a male domain (Panchanatham, July 2011). However, increasing educational qualifications, social awareness, and the desire among women to be self-sufficient has prompted more women to pursue entrepreneurship as a career.

❖ ROLE OF WOMEN DURING THE PANDEMIC

Due to supply chain interruptions, the pandemic has impacted self-employed women (including mompreneurs and women of self-help groups), who account for over half of all working women in India. Women-owned businesses have been struck worse by the epidemic than men-owned firms, particularly in the hardest-stricken industries. In addition, nonpayment of past salaries and current arrears has exposed these women and their families to economic shocks.

In the immediate aftermath of the lockdowns, between March and April 2020, an estimated 17 million to 19.3 million women (Misra and Patel 2021) were unemployed (Abraham et al 2021). It's worth noting that women are overwhelmingly represented in high-impact sectors like commerce and services. Personal and non-professional services, which

ISBN: 978-91-987581-0-8

include small-business owners such as tailors, dressmakers, petty shopkeepers, barbers, and beauty salon owners, as well as domestic help and part-time workers, had higher volatility than other industries. Male employment plummeted by 30% and female employment fell by 43% as a result of the lockdown (Abraham et al 2021).

During the pandemic, more women-led businesses (72 percent) reported cash shortages than male-led businesses (53 percent) (Buteau and Chandrasekhar 2020). When compared to men, more women entrepreneurs (69 percent) reported deferring loan payments (50 percent). However, two studies (Buteau and Chandrasekhar 2020; Chawla et al 2020) discovered that women were more confident than men in the full recovery of their businesses. In fact, they showed signs of adapting to the pandemic's changes, with more than 54 percent already making a "business shift" such as adding new products and services. Another 24% intended to make a business change by the end of the year. (Sunil 2020). For example, Shiji, from Kerala turned into an entrepreneur during the Lockdown as she had to tend to her daughters and parents after losing her job with a motorcycle shop during the pandemic. She searched the internet and talked to a farmer in Gujarat and started making papads with vegetable extracts.

While COVID-19 has a disproportionate effect, recovery has been in favour of men. When compared to the pre-pandemic period, men's employment levels were 9.5 percentage points lower than women's, with men's employment levels rising by August 2020. (Deshpande 2020). After controlling criteria such as caste, religion, age, degree of education, employment arrangement, industry, and state of domicile, women were eight times more likely than males to have lost their jobs. Self-employment may have provided a "cushion" for those who have lost jobs in both the formal and informal sectors (World Bank 2020).

Women have been hit harder due to Covid-19 as compared to their male counterparts. They bore extra responsibilities of household chores and caregiving which made a huge impact on their mental, physical and psychological well-being. In most of the homes, support from the male members of the family was minimal which led to less time being spent on their entrepreneurial efforts by the women. Despite these hardships, most women felt that the time they spent in caregiving, running a household, or assisting their spouse's business had remained the same. Others believed that time spent on household work (43 percent) and unpaid work (38 percent) had increased during the pandemic. This is supported by questions about stress levels, in which women entrepreneurs consistently

reported moderate to extremely high levels of stress regarding household responsibilities, staying locked in, and increased expenses.

❖ LESSONS LEARNT - POST COVID-19 SCENARIO:

Generally, businesses owned by women-owned in India are service-oriented, smaller, and less capital-intensive, which led to faster adaptation to changing environments than larger or more capital-intensive businesses. Clothing manufacturers quickly adapted to manufacturing safety equipment (masks, gloves, PPE kits), coaching centres and gyms dramatically increased their clintele by holding "virtual classes," and food and beverage businesses shifted to a new slogan, "vocal for local", positioning to reach a wider audience digitally are examples of the adage, ‘Change is the only Constant’.

A majority of the entrepreneurs' businesses have not recovered to pre–Covid-19 levels. Following a sharp drop in March and April as a result of the lockdown, business growth is now about one-third of pre–Covid-19 levels. Only a few entrepreneurs have been able to return to pre–Covid-19 levels. Enterprises that had already experimented with or adopted digitalisation in various aspects of their business model recovered the fastest.

Despite short-term recession, entrepreneurs are optimistic about the recovery. According to a survey conducted, ninety percent of entrepreneurs believe they will be able to survive the crisis, with two-thirds believing major changes to their business model and cost structure will be required. Eighty percent of entrepreneurs expect demand to return to pre-lockdown levels by the year end.

Women have been quick to change their business models in order to be more relevant. In response to Covid-19, 54% of the women we interviewed have already changed their business model, and another 24% plan to do so by December. Only 6% believe they will be unable to change their business model. Approximately 60% of women have included new products or have started offering new services, 35% of them have shifted over to digital sales and delivery channels, 26% have reoriented supply chain or sales marketing function. While many of them have undergone fresh training a few of them have picked up new skills to be ahead of time. Covid-19 has proved to be a blessing in disguise for working women in India. There is a definite shift in increased recognition and support for women's contributions to family income. Because of the widespread negative impact on jobs and incomes, there is a greater familial and societal acceptance of women working formally, which can strengthen

ISBN: 978-91-987581-0-8

women's role in providing financial support to their families. Thirty percent of respondents believe there will be an increased need to work due to economic uncertainty, while 20% believe there will be a greater acceptance of work among family and community.

Quite surprisingly, up to 30% of women believe that working from home increased their productivity and allowed them to prioritise better. Simultaneously, Covid-19 has pushed the broader ecosystem to rapidly adopt digital business methods. Transactions have moved online as suppliers, customers, and employees adopted remote models; and as B2B commerce has scaled up, entrepreneurship has become more accessible to women. Beyond the difficult near-term circumstances, these shifts toward virtual or remote interactions have the potential to create a more enabling environment for women, who frequently face competing responsibilities that limit mobility. 45 percent of our respondents believe that increased adoption of remote work will make it easier for them to run their business successfully in the future.

Governments need to play a critical role in recognising and elevating female entrepreneurship as a key for reviving economic activity in the current environment. Priority initiatives include a state-led "call to action" for women to directly participate in the economic reconstruction effort, backed up by tailored government-led digital interventions to attract and empower women-run businesses. Multiple Digital India initiatives, for example, such as the engagement of small and medium-sized enterprises (SMEs) and the Aatmanirbhar Bharat Innovate Challenge, should be tailored to drive greater participation and enablement of women. Better still, Azadi ka Amrit Mahotsav and Ek Bharat Shrestha Bharat Campaigns can include schemes and competitions for women entrepreneurs.

The Government must move quickly to promote gender equality in the post-COVID era by financially boosting women-led enterprises. Schemes that bring together the public and private sectors to speed up technology adoption, innovation, and digital skills training for people with disabilities need to be implemented to revive the economy of the nation in general and motivate women in particular. Funds should be earmarked for MSME's and emergency loans must be created to streamline requirements for small businesses.

Women entrepreneurs should have access to adoption, innovation, and digital skills training, as well as improved financing and tax help. Programs, possibly in collaboration with state governments, aimed at assisting women entrepreneurs in starting and scaling businesses in high-

growth sectors such as EdTech, B2B commerce, health and nutrition should be initiated.

Women-focused Covid-19 recovery programmes, which include capacity building, data tracking, and infrastructure enablement, need to be implemented through collaborations between private and non-governmental organizations.

The most important change required is the change of perception in society, by celebrating the educational, health, and economic benefits of women's labor-force participation. Men (and families) who model positive behaviours should share domestic responsibilities. Formal and informal networks will help foster inclusivity in virtual and physical interactions. This will help reduce the gender gap in society and lead the nation towards development.

External shocks have a powerful impact on societies. This crisis presents a proverbial golden opportunity. Women from all sectors and segments of the economy are responding to this extraordinary shock with zeal, agility, and optimism. Vital ecosystem participants must step forward to support women in India and thus unlock this demographic asset.

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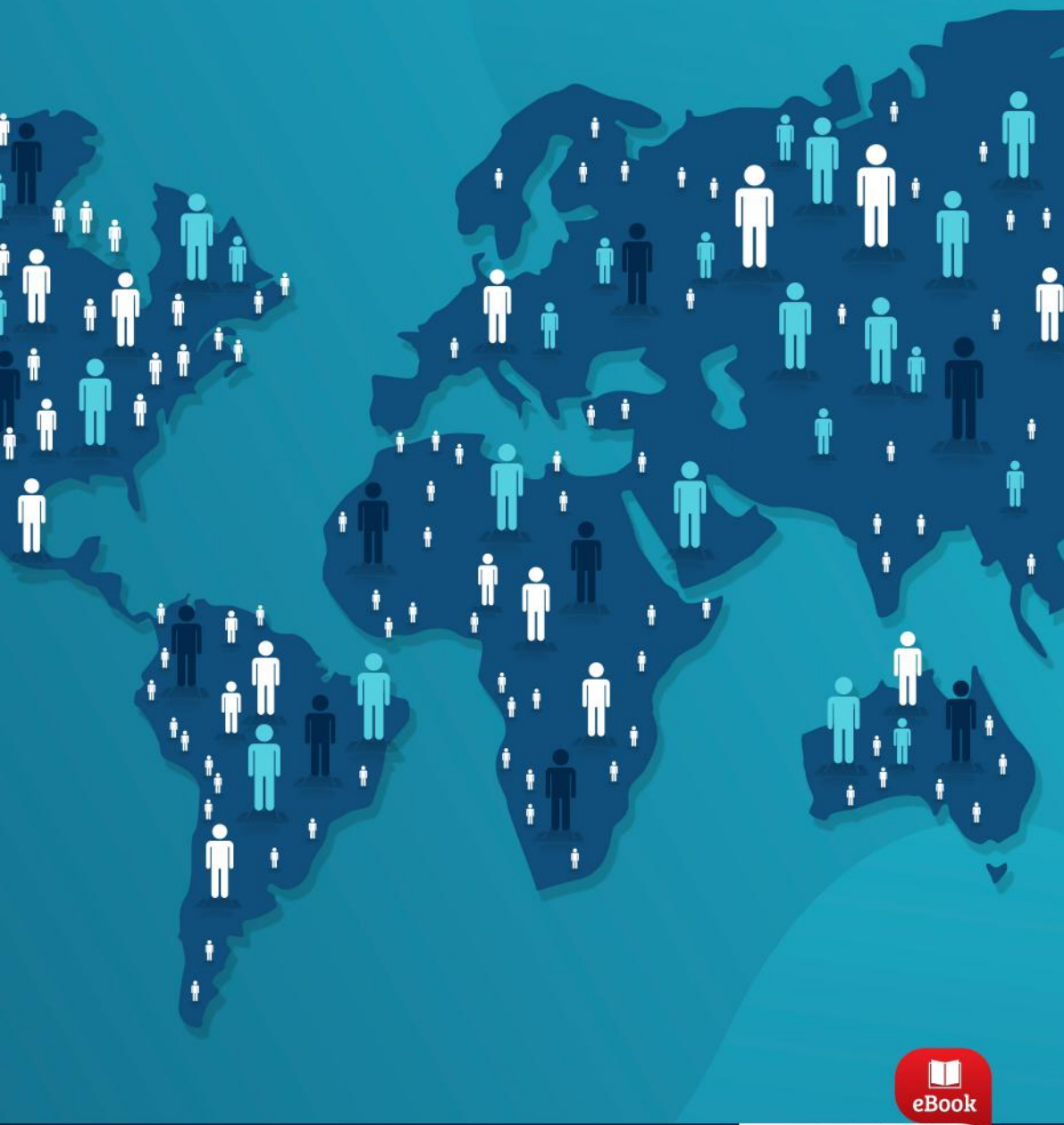

eBook

ISBN 978-91-987581-0-8

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Synthesis, Characterization, and Application of Modified Textile Nanomaterials

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Abstract
There is a growing concern related to the effects of textile nanomaterials. The development of textile nanomaterial has been one of the most active and important research areas in recent years. Design and synthesis of nanomaterials with a novel combination of textile material is expected to expand the demanding scope in the future. Present chapter will emphasis on the chemical nature and synthesis of textile nanomaterials by using different method such as hydrothermal, microwave, fabrication as well as the methods used to characterize them with regard to their different applications. Recent developments in textile nanomaterial have various applications in the field of sports, cosmetics, swimming, and lifestyle.

Keywords: Textile nanomaterials, nanofibers, synthesis, application

8.1 Introduction of Textile Nanomaterials

The word of nanotechnology (Nano-tech) can be applied in different fields [1–3]. This word was first time applied on textiles and also known as Nano-Tex. Later, other textile industries also started to invest in the textile nanomaterial development [4]. Nanoparticles on textile material have been the goal of different studies, to develop the fabrics with miscellaneous practical performance [5]. These nanomaterials (nano silver,

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Mohd Shabbir, Shakeel Ahmed, and Javed N. Sheikh (eds.) Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques, (167–188)

nano ZnO, and nano TiO_2) have been used as an antibacterial [6, 7], UV-blocking [8, 9], and self-cleaning [10, 11]. Textile nanomaterials can observe the high toughness for washing purpose, as owning great surface area and increase surface energy which declare more attraction for fabrics (textile nanomaterial) [12]. Improve the fastness of textile nanoparticles against washing by a specific solution [13] and other properties of fabric (tensile and bursting strength, friction and air penetrability) can also enhance by this solution [14].

Textile materials were prepared from natural occurring fibers, and have an important part in human being's life. Nowadays nanomaterials are broadly used in the advance textile industry for their appreciated properties as high quality textile materials. Natural fibers such as silk, hemp wool, and cotton are wasted throughout dispensation till further usages. Recycling of these fibers has large marketing area by a new route, because their extra-ordinary characteristics. Any other industries such as bio-medical industries required such bio-compatible materials based on these characteristics [15–17]. Some other valuable applications of textile nanocomposites are in the field of paper and paperboard applications as dry strength, surface strength agent. Textile nanomaterials were also used in cosmetics creams, nano-coatings, bio-nanocomposites, food industry, nano-barriers, pharmaceutical applications, absorbent products, oil recovery applications, and dispersion applications. Current literature works have described a new technique of synthesis of textile nanomaterials and their application in bio-medical and bio-technological fields [18–20].

The most popular textile nanomaterial is Chitosan (derivative of chitin), which is also known as the most popular bio-polymer with exceptional morphological and physiological characteristics [21–23]. These nanomaterial known as ideal polymer for textiles, food science, pharmaceuticals, agriculture and biomedical industrial application, because it has exclusive properties like as biodegradability, biocompatibility, and antibacterial activity [21, 24, 25]. New technique is quickly developing and broadly used in chemical, Pharmaceutical, food processing, cosmetics, and in the present time to textile finishing, which is known as nano encapsulation [26].

8.2 Synthesis of Textiles Nanomaterials

The selection of synthesis technique can be an important factor in identify the effectiveness of the textile nanomaterial studies. There are different methods of synthesizing textile nanomaterial such as hydrothermal [27],

combustion synthesis [28], gas-phase methods [29], microwave synthesis, and sol–gel processing with silver, ZnO and TiO_2 [30]. Synthesis of textile nanomaterial to have a better control over particle morphology, size distribution, quality, purity, and quantity, by engaging environment friendly and economical processes has always been a big task for the scientist and scholars [31].

8.2.1 Synthesis via Hydrothermal Method

Hydrothermal synthesis is commonly performed in a pressurized vessel, which is known as autoclave. Autoclave can be increased the temperature more than 100°C or until form the vapor. This type of synthesis is widely recommended for the synthesis of TiO_2 nanoparticles, which can easily be synthesized through hydrothermal treatment of peptized precipitates of a titanium precursor with water [32]. The hydrothermal method can be utilized to control morphological properties such as (size, morphology), crystalline phase, and surface chemistry through control of the solution composition, pressure, solvent properties, additives, and aging time and reaction temperature [33].

8.2.2 Synthesis via Solvo-Thermal Method

The Solvo-thermal and hydrothermal method both are the same, but the solvo-thermal process variety of solvents can be used in the place of water. This method normally has better control of the shape and size distributions and the crystallinity compared to hydrothermal method. It has been used to synthesize TiO_2 nanoparticles and also used to synthesize nano rods with or without the surfactants.

8.2.3 Synthesis via Chemical Vapor Deposition (CVD) Method

In the chemical vapor deposition process the substrate is covered with volatile precursors, which react on the substrate surface to produce the desired film. The quality of the placed materials completely depends on the reaction temperature, reaction rate, and concentration of the precursors [34]. Gracia *et al.* synthesized metal-doped TiO_2 by the same process [35]. The main feature or advantages of this synthesis method is the uniform coating of the nanoparticles or nano film. Cao *et al.* prepared Sn4+-doped TiO_2 nanoparticle films by this method and found that due to doping with Sn and observed more surface defects were present on the surface [36].

8.2.4 Synthesis via Physical Vapor Deposition (PVD) Method

PVD is also another method to preparation of thin film for the covered the substrate. In this technique films are formed precursor to product without a chemical transition. It has greater features or advantage in the place of CVD. PVD grown films have smoothness, conductivity, presence of contaminations, and crystallinity of titanium dioxide films with E-beam evaporation [37].

8.2.5 Synthesis via Template Method

The synthesis of textile nanostructure materials using template method has become very ideal through the last decade. In this method prepare numerous new materials with a regular and controlled morphology in the range of nano and micro by simply changing the morphology of the template material. The different type of templates has been studied, which utilized the synthesized the TiO_2 nanomaterials [38].

8.2.6 Synthesis via Conventional Sol–Gel Method

This method is used for synthesized various oxide materials such as nano silver, nano ZnO, and nano TiO_2 nanoparticle. The important of this technique contains high purity of the precursors, molecular scale mixing, and homogeneity of the products with a high purity of chemical, physical, and morphological properties. It is also known as multipurpose method.

8.2.7 Synthesis via Microwave Method

Various nanomaterials have been synthesized by microwave radiation. Microwave technique use of high temperature calcination for extended periods of time and allow for fast the synthesis of crystalline TiO_2 nanomaterials. Corradi *et al.* prepared colloidal TiO_2 nanoparticle suspensions within 5 min using microwave radiation [39].

8.2.8 Synthesis via Fabrication Process

Electro-spinning is the most important method among the synthesis of nanofibers.

In the electro-spinning process a high voltage is create an electricity for deposition or melt or streaming of polymer solution (Figure 8.1). Electric

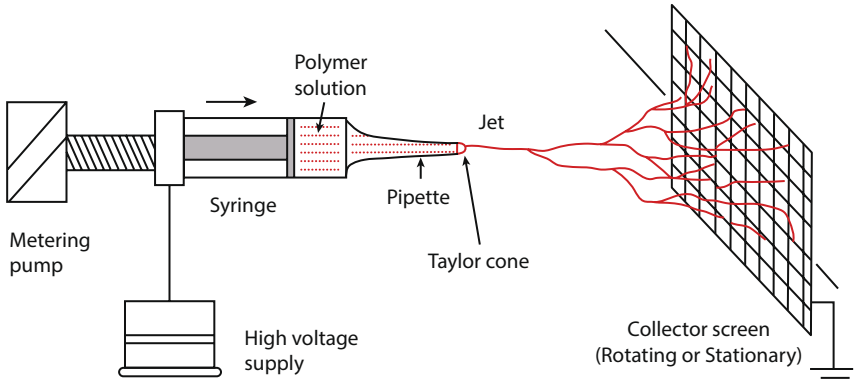

Figure 8.1 Schematic of electro-spinning.

field between the tip of capillary and a grounded collector is very high, and formed at the tip of capillary producing sub-micron diameter fibers. Different types of material were processed into nanofibers in the range of 50 to 1000 nm [40].

8.3 Characterization

Textile nanomaterial characterized by different technique such as spectroscopic, microscopic, X-ray, and other common techniques. The imaging techniques such as (SEM) scanning electron microscopy, (TEM/HRTEM) transmission electron microscopy, (AFM) atomic force microscopy, (STM) scanning tunneling microscopy have been utilized to observe the micro and nano size materials. The basic concepts of all the techniques are different but some common thing is that they observed extremely magnified image of the surface. The spectroscopic method such as (UV-Vis) Ultraviolet-Visible, Raman, infrared spectroscopy and many spectroscopic methods have been utilized to observe the optical properties of micro and nano size materials of textile. Textile nanomaterials can be analyze through X-rays technique like as (EDX) energy dispersive X-ray analysis, wide angle X-ray diffraction, (XPS) X-ray photoelectron spectroscopy, particle size analyzer. Some other common techniques also analyze the physical properties of textile nanomaterials. The basic principles of all these methods used in nanotechnology are described below (Figure 8.2).

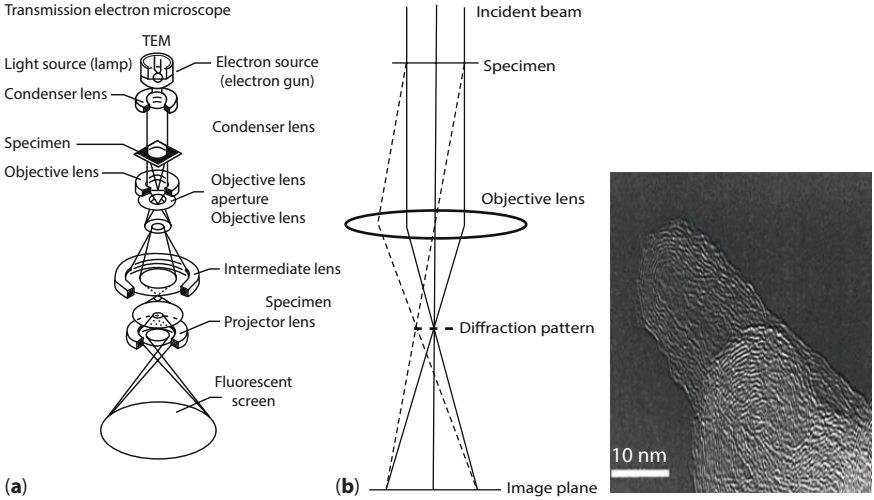

Figure 8.2 (a) Schematic diagram of transmission electron microscopy (b) TEM images of PP/MMT nanocomposites.

8.3.1 Microscopic Characterization of Textile Nanomaterials

8.3.1.1 Transmission Electron Microscopy (TEM)

The micro and nano image is formed by the electron transmeter by the sample and focused by a microscopic lens and looked on a display screen. This technique is widely used in material science, textile, metallurgy, and biological sciences. TEM images reveal the intercalation, exfoliation, and dispersion of nanoparticles in polymer matrices of textile nanomaterial, etc. [40].

High resolution transmission electron microscopy (HRTEM) is a similar imaging technique of electron microscope that allows to take image of the crystal sample at an atomic length with high resolution. This technique is a useful tool to find the nanoscale properties of crystalline material. It showed the maximum resolution is 0.8 Å.

8.3.1.2 Atomic Force Microscope (AFM)

This technique is ideal for quantitative measurement the nano scale textile material. AFM also used for surface imagining and roughness of the surface. Many types of material surface such as polymer nanocomposites, nanofinished, and nanocoated textiles were coated by nano-texture. It is a nondestructive technique and has very high three dimension (3D) [41] (Figure 8.3).

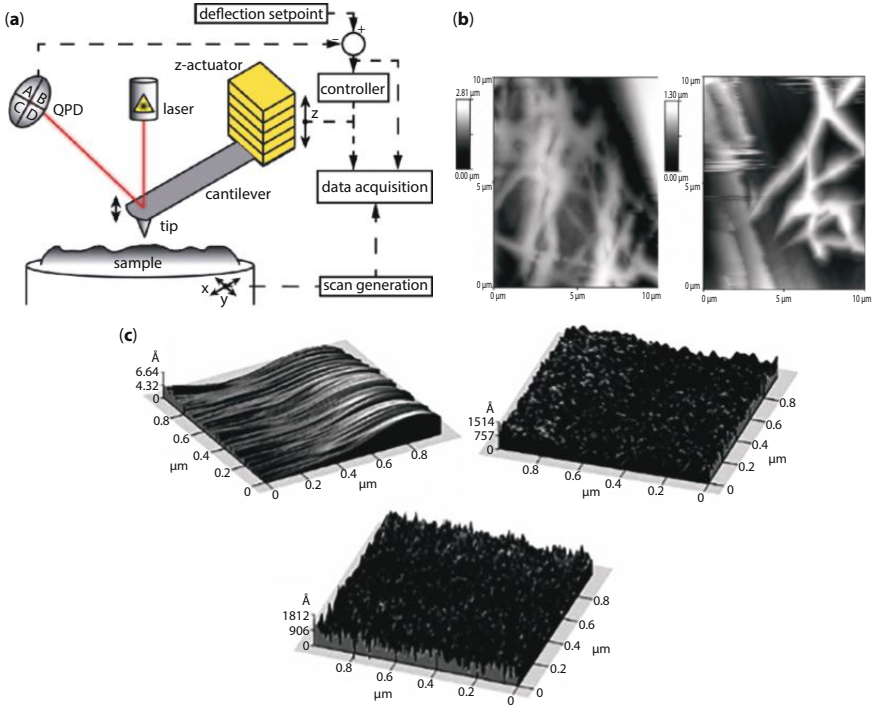

Figure 8.3 (a) Schematic diagram of atomic force microscopy. (b) nanofibers, nanofibers laid on nonwoven substrate (c) 3D views of non-contact mode AFM images of PET textile surface.

AFM can be used to identify the properties, nanostructures, surfaces, and interfaces of fibers and fabrics.

8.3.1.3 Scanning Electron Microscopy (SEM)

SEM is also an electron microscope that images is scanning of surface with a high energy beam of electrons. The SEM shows perfect 3D images with high magnifications (up to 300,000). But the images are only black and white which formed without light waves. The surface image and texture of polymer nanofibers, nanocomposites, nanoparticles, and nanocoating can be viewed through Scanning electron micrograph with high clarity by high magnification [42].

This technique can also be used to interpretation of the dispersion of nanoparticles such as carbon nanotubes, nanoclays, and hybrid POSS nanofillers and coatings on yarns and fabric samples (Figure 8.4c).

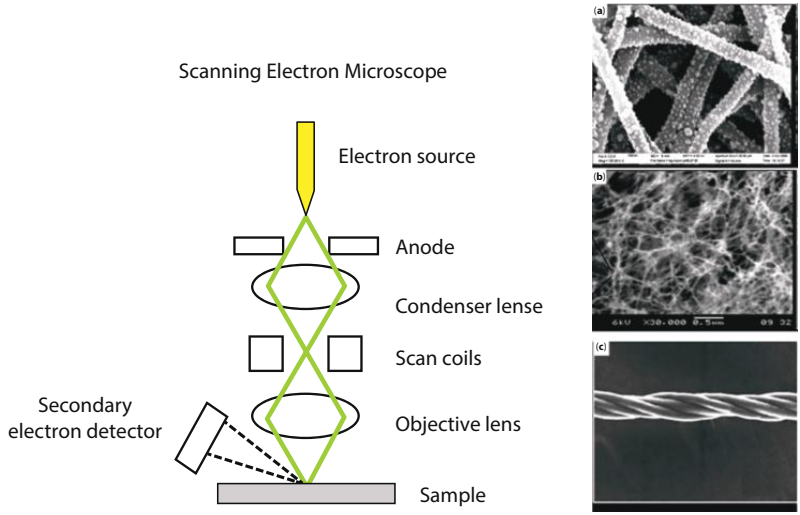

Figure 8.4 Schematic diagram of scanning electron microscopy. (a) Electrospun nylon 6 nanofibers with surface bound silver nanoparticles, (b) peptide nanofiber scaffold for tissue engineering, and (c) SEM image of plied CNT yarn.

8.3.1.4 Scanning Tunneling Microscopy (STM)

Scanning tunneling microscopy (Figure 8.5) is a minor different instrument for observing surface images with atomic scale resolution, in this technique a fine probe tip is scanned over the surface of a sample, with the help of a piezoelectric crystal, and the resulting tunneling [43].

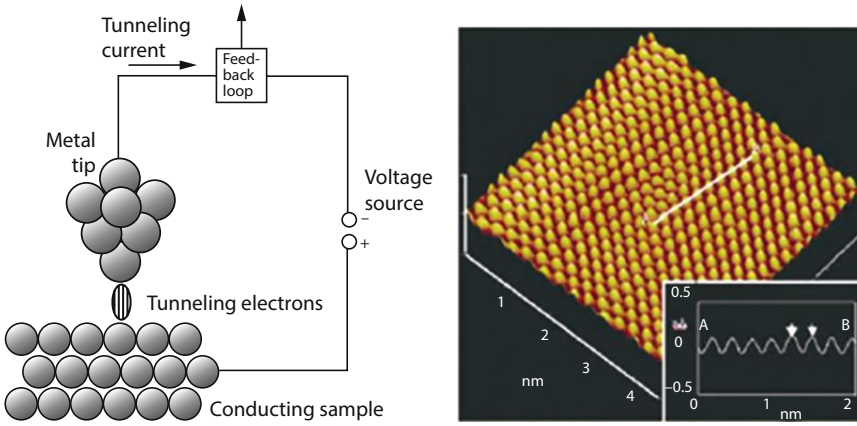

Figure 8.5 Schematic diagram of scanning tunneling microscopy and highly oriented pyrolytic graphite sheet under STM.

8.3.2 Spectroscopic Characterization of Textile Nanomaterials

8.3.2.1 Ultraviolet-Visible (UV-VIS) Spectroscopy

In the Ultraviolet spectrophotometers light source forced on reference and sample beams then output comes in monochromator, detector, and form the spectrum. The ultraviolet spectrum for a sample is obtained by exposing a sample of the compound by Xenon lamp. Spectrum was observed for absorbance versus wavelength [44] (Figure 8.6).

8.3.2.2 Raman Spectroscopy

This type of spectroscopic technique used for condensed matter physics and chemistry. It used to study vibrational, rotational, and other low-frequency modes in a system [45]. The laser light interacts with phonons or other excitations in the system, and the energy of photons being change high or low. The level of energy provides information about the energy of phonon in the system (Figure 8.7).

8.3.2.3 Infrared Spectroscopy (IR)

This technique specially used for characterization of nanomaterials. Fourier transform infrared (FTIR) spectrometer is preferred over dispersive spectrometer due to non-destructive technique. It can increase sensitivity of scan rate

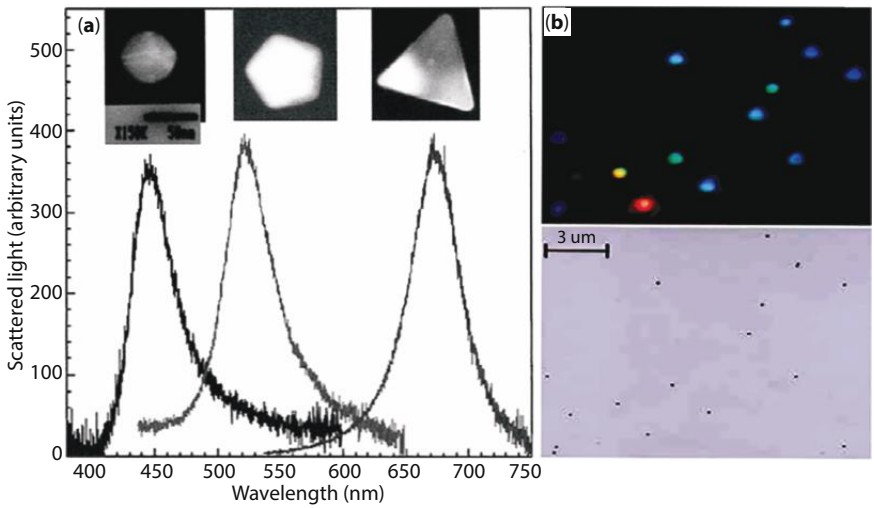

Figure 8.6 (a) UV-Vis spectroscopy of silver nanoparticles of different shapes and (b) color image of a typical sample of silver nanoparticles.

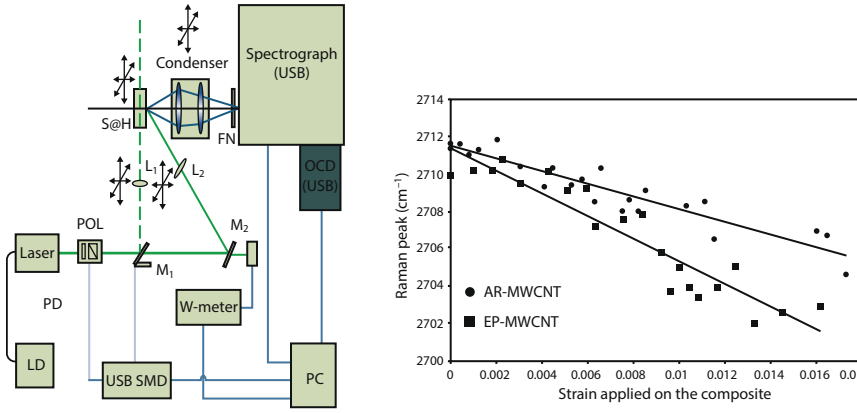

Figure 8.7 Schematic diagram of Raman spectroscopy and Shift in the Raman peak as a function of applied strain.

and co-added together to ratio of random noise. It has better optical through output and is also mechanically simple with only one moving part, etc.

8.3.3 Characterization of Textile Nanomaterials by X-Ray

8.3.3.1 Energy Dispersive X-Ray Analysis (EDX)

This technique analyzes the surface elements at different positions and provides an overall measurement of the sample. The concentration of nanomaterials at the surface can be observed using this technique. EDX contain some heavy metal ions (Au, Pd, and Ag) on the surface of nanoparticles (Figures 8.8b, c). EDX spectra have to be taken by focusing the beam at different regions of the same sample to verify spatially uniform composition of the bimetallic materials [46].

8.3.3.2 Wide Angle X-Ray Diffraction

This technique is similar to electromagnetic radiation of X-ray diffraction, but have shorter wavelength. This technique produced spectrum when electrically charged particles have sufficient energy. In an X-ray tube, the high voltage is maintained by electrodes toward a metal target. X-rays are produced and radiate in all directions.

8.3.3.3 X-Ray Photoelectron Spectroscopy (XPS)

This spectroscopy (Figure 8.9) is a quantitative spectroscopic. Surface chemical, elemental composition, chemical state, and electronic state of

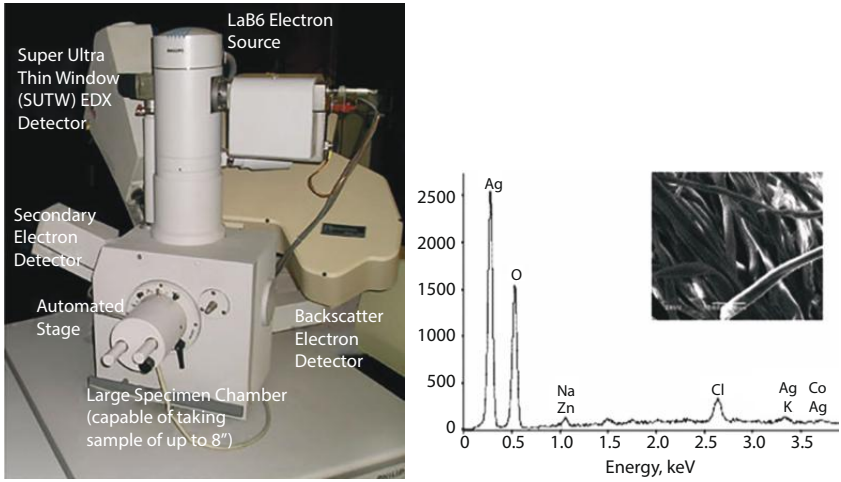

Figure 8.8 Schematic diagram of energy dispersive spectroscopy and SEM images and EDX spectra of nanoporous materials made of cotton cloth with silver nanoparticles 8.

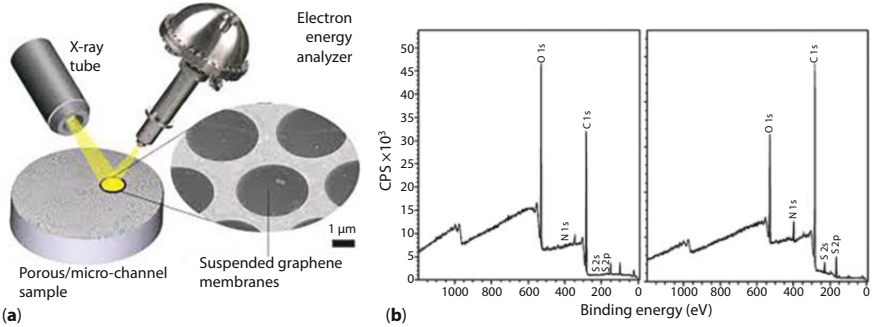

Figure 8.9 Schematic view of XPS. (a) Positively charged woven cotton fabric and (b) positively charged woven cotton fabric supporting 20 self-assembled layers of PSS/PAH.

the elements on the surface (up to 10 nm) of a material were analyzed by this technique [47]. XPS is also known as ESCA (electron spectroscopy of chemical analysis).

8.3.3.4 Particle Size Analyzer

Different techniques were available for the measurement of particle size distribution (PSD) such as optical counting methods, sieve analysis, electro resistance counting methods, laser diffraction methods, sedimentation

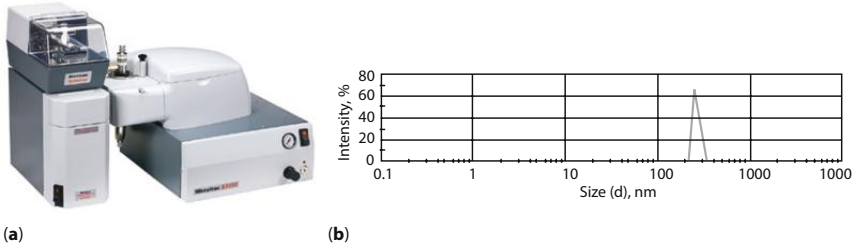

Figure 8.10 (a) Schematic diagram of particle size analyzer. (b) Size distribution of TiO_2 nanoparticles.

techniques, dynamic light scattering method, acoustic spectroscopy, etc. All of them dynamic light scattering (DLC) is regularly used for obtaining size of silver, titanium, silica, and zinc oxide nanoparticle are often used in textile substrates to get enhanced quality of the nanoparticle finished textile materials.

TiO_2 nanoparticle size and size distribution (Figure 8.10b) can be observed using DLS technique [48]. The enhanced property is dependent on the size of the sample nanoparticles. Therefore, size and size distribution performance of the nanoparticle in the dispersion as well as suspension is important before to characterize to the textile substrates.

8.3.4 Characterization of Textile Nanomaterial by Some Other Technique

The complete structural and chemical modifications of fabrics were further analyzed in terms of physical testing, determine the tensile properties, crease recovery angle, bending length, air, and water permeability.

8.3.4.1 Physical Testing

Before starting physical testing the samples were dried and conditioned at 65± 2% RH and 27 ± 2°C temperature.

8.3.4.2 Determination of Recovery Angle and Tensile Properties

Recovery angle was measured by folding and compressing the specimen under controlled condition. Tensile strength was observed as per B.S. 2576:1959.

8.3.4.3 Determination of Absorbency by Wicking Test and Bending Length

Wicking behavior of the treated and untreated samples were evaluated as per T-PACC standard method.

8.3.4.4 Evaluation of Water and Air Permeability

Water permeability test conducted using ASTM D 4491 constant head Methods. Metefem air permeability tester used ASTMD 737 test method for measurement of air permeability.

8.4 Application of Textiles Nanomaterials

Nanotechnology can offer high strength for textile material because nanoparticles have high surface energy and area and, based on this quality, improved the affinity for these materials and have to increase the strength. The overlap of nanoparticles on textile material will not affect their breathing and observation.

Now current researchers are developing nanotechnology to enhance the performances or to create extraordinary quality of textile material, which is prosperous.

8.4.1 Application Based on Properties of Textile Material

The properties of textile nanomaterials comprise oil resistance, water repellence, anti-static, wrinkle resistance, UV-protection, anti-bacterial, improvement of dye, flame retardation, ability, self-cleaning fabrics, and many more, which are described below.

8.4.1.1 Anti-Bacterial Properties of Textile Nanomaterial

Nano-sized silver, titanium dioxide, and zinc oxide are used for the anti-bacterial properties of textile nanomaterial. These metallic ions and compounds show the degree of sterilizing condition. The number of the oxygen in the air or water is changed into active oxygen by catalysis with the metallic ion and dissolves the organic substance for sterilizing effect. The use of nano-sized particles per unit area is increased, and thus anti-bacterial effects can be also increased [49].

8.4.1.2 UV Protective Properties of Textile Nanomaterial

The UV-protection property of a textile nanomaterial is improved when a dye, pigment, delustrant, or ultraviolet absorbance is complete, and the absorbed ultraviolet radiation blocks its transmission through a fabric to the skin. The excess of skin protection is required for different types of human skin, and it depends on distribution in reference to geographical location, time of day, UV radiation intensity, and season. This UV-protection is known as SPF (Sun Protection Factor). High SPF value is a better protection against UV radiation [50].

8.4.1.3 Water Repellence Properties of Textile Nanomaterial

Nano technology in the textile nanomaterial enhances the water-repelled property of fabric such as production of nano-whiskers, which are also hydrocarbons and known as cotton fiber. The addition of this fabric creates a peach fuzz effect without decrease in the strength of cotton. The particular space of the whiskers on the textile nanomaterial (fabric) is smaller than a drop of water and larger than water molecules [51]. However, liquid can still pass through the fabric, if pressure is applied.

8.4.1.4 Anti-Static Properties of Textile Nanomaterial

Static charge usually builds up in synthetic fibers such as nylon and polyester because they absorb little water. Cellulose textile nanomaterial have higher moisture ratio to carry away static charges. As we know synthetic fibers provide poor anti-static properties, so the scientist and researcher work to enhance the anti-static properties of textile materials by using nanotechnology. TiO_2, ZnO, and ATO show anti-static effects because they are electrically conductive nanomaterials. Such material helps to disperse the static charge, which is collected on the fabric. Silane nano sol improves anti-static properties, as the silane gel particles on fiber absorb water and moisture in the air by amino and hydroxyl groups in water [52].

8.4.1.5 Flame Retardant Properties of Textile Nanomaterial

Nanotechnologies has been applied in textile nanomaterials for flame retardant finish, which known by colloidal antimony pentoxide. Colloidal antimony pentoxide has a fine dispersive particle for use as a flame retardant synergist with halogenated flame retardants. Nano antimony pentoxide is used with halogenated flame retardants for a flame retardant finish to the textile nanomaterial [53].

8.4.1.6 Wrinkle-Free Properties of Textile Nanomaterial

Improved performance of nano-Tex has known as a new nanotechnology (wrinkle-free treatment). This technology preserves fabric strength and integrity, an alternative to harsh traditional processes. Conventional methods are commonly used to wrinkle resistance to fabric, resin. However, there are boundaries to applying its in fibers and resin, such as decrease in the tensile strength of fiber, abrasion resistance, water absorbency, dye ability, and breathability. To overcome the limitations of using resin, some scientist employed nano-titanium dioxide, and nano-silica [54] to improve the wrinkle resistance of cotton and silk, respectively.

8.4.1.7 Self-Cleaning Properties of Textile Nanomaterial

American company was developed nano-care, which is known as a self-cleaning cotton fabric. In the scientific terms, the fabric has been purified super-hydrophobic or super-non wet able. The nanowhiskers also make less interaction with dirt. When water is react to stained fabric, the dirt adheres to the water far better than it adheres to the textile surface and is carried off with the water as it beads up and rolls off the surface of the fabric. Self-cleaning fabrics could reform the sport apparel industry. The technology has already been used to create t-shirts and underwear that can be worn hygienically for weeks without washing [55].

8.4.1.8 Economical and Environmental Aspects of Textile Nanomaterial

The extraordinary properties of textile nanomaterials have attracted not only scientists and research scholar but also attract by businessman. The national science foundation (NSF) reported that textile nanomaterial related product and facilities will increase in 2015 with 1 trillion dollar. This amount is more than the all businesses such as telecommunications and information technology industries. In the future more than hundred billion Euros are forecast to be created by textile nanotechnology [56]. The textile nanomaterial markets could expand to US$ 1 billion. Due to huge development of textile nanomaterials, it was believed that 2 million new employment opportunities would be created in order to meet the worldwide annual production demand of US$ 1 trillion in future. Nanotechnology may impart favorably on the economical as well environment. Nanotechnology may save raw materials and also upgrade quality of life by using less resource without forgoing performance.

8.4.2 Application in Textile Industry

Nanotech enhanced the overall properties of textile material, which are seeing above based on properties. Some applications have for sport industry, space research, skin care, garments, and material technologies with better protection in environments. The modified textile material by nanotechnology is a unique method to improve the properties of the textile material, prolonging the process and also having multiple color options, etc. Nanotechnology can also be used to add new advantage such as energy storage and communications.

8.4.2.1 Textile Nanomaterial Used in Swimming Costume

The currently used swimming costumes have a plasma layer to repel the water molecules. The quality of the plasma layer is enhanced by nanotechnology that is prepared with the help of swimmer glide. The most widely recognized application is in the shark-skin costume in the Olympic swimming championship.

8.4.2.2 Textile Nanomaterial Used in Sports Goods

The quality of all sports wear has also been enhanced by textile nanomaterial. Scientists have developed naturally existing viral textile nanoparticles that have some of the toughest environments on earth and have new material for nanotechnology, a textile nanomaterial that minds their surface and interacts with the wearer. These textile-based nanosensors could provide a personalized healthcare system, which monitors your changes sign, such as responding to changes in the weather.

8.4.2.3 Textile Nanomaterial Used Inflexible Electronic Circuit

Textile nanomaterial (nano ribbon) used as chips, which are very flexible. These nano ribbons can cover the control of stretchable microscope cover slip. The researchers and scientists are describing applications in the healthcare industry and where these little, flexible electronic circuit could be used to monitor the activity of patients' brain. This circuit could also be used in surgical apparatus to monitor patients during surgery.

8.4.2.4 Textile Nanomaterial Used in Lifestyle

Nanotechnology is seen in many fields and also has application in lifestyle. Textile with the combination of cosmetics is among the first products to

use in nanomaterials. Nanotube fibers are used to make a material at least 17 times tougher than the present quality. In this view there are future developments with the use of this nanotechnology to create smart and interactive textiles (SMIT). That can be sensitive chemically, electrically, magnetically, thermally, or other stimuli.

8.5 Current Trends and Future Prospects

In the literature various studies have been describe the synthesis and characterization of nanomaterials for textile industry. Nanomaterials can be practically applied to textiles to impart antibacterial, self-cleaning, anti-wrinkle, UV protection, waterproof, and electrical conductivity functions. There have been many efforts to apply nanomaterials in the textile so far, but further research and developments would be necessary in the future. In this chapter, we have reviewed that the synthesis and characterization the textile material for different type of application. Although many researchers and scientist have been show interest for discovered more textile nanomaterials, and understand their functions. It is compulsory to increase its application for functional textiles such as sportswear, military wear, and fire safety wear, etc. Nanotechnology research in textiles has maximum possibility for the future approach but would be primarily an overview by current research progress in the simple, fast, new, and more resourceful characterization techniques for nanomaterials, nano-coatings, and nano-composites used in textile applications.

8.6 Conclusion

Textile nanomaterials have the possibility to improve the quality and stability of human life as well as industrial effectiveness in world. Still, the new textile nanomaterial may also pose harmful for the environment and decrease health safety issues. The Scientific Committee has decided that recently developed and identified nanomaterial is not risky for health and textile nanomaterials are not hazardous. There is still scientific doubt, which is not clear about the safety from textile nanomaterials by many characteristics, and therefore the safety concern of the substances must be done on a case-by-case basis. Although these are textiles, still very few studies are available in the literature, which describe the possible health risks involved with “nanotextile.”

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5

Synthesis of Nanomaterials and Their Applications in Textile Industry

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Abstract

Unexpected surface properties of nanomaterials *viz*. their relative low cost make them popular worldwide and due to this reason various type of nanoparticles have been synthesized by the researchers in last few years. After the revolutionary industrial development of twentieth century, manufacture of fabrics, natural fibers such as rayon, nylon and many others, which involve the incorporation of nanomaterials in synthetic materials and fibers, have been increased day by day with significant properties like low cost, chemical stability, and low cost production techniques. Development of nanomaterials is area of great interest for the improvement of existing functionality for the synthesis of new textile products with different properties and functions in single textile material. In last few years, significant improvement has been found in textile technologies like coloring, digital printing on textiles, and smart fabrics in which nanoparticles play key role in technological evolution because of their surface properties and for attaining new properties like flame retardant properties, antibacterial activity, and analyzed for special ultrathin fibers functionalization. In present chapter, we have reviewed the different methods for the synthesis of nanomaterials and their applications after the incorporation of nanomaterials into textiles.

Keywords: Nanomaterials, textile, fibers, antibacterial activity

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Mohd Shabbir, Shakeel Ahmed, and Javed N. Sheikh (eds.) Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques, (117–134)

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Modification of Textiles via Nanomaterials and Their Applications

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Abstract

Over the past few decades, Nanomaterials have boomed in an unprecedented way in field of textiles, due to demand for functional and durable apparel manufacturing. Nanomaterials can provide wrinkle-freeness, stain repellence, electrical conductivity, and static elimination to fibers without compromising their comfort and flexibility. Development of nanomaterials is a unique and multidisciplinary approach for textile functionalization, coloration along with UV blocking, antibacterial/microbial resistance, water repellent imparts flame retardancy, sensors, and self-cleaning property of textiles makes them a suitable candidate for smart textile material and for various end uses among all technologies. These nanoparticles can be deposited on various types of fabrics using various irradiation methods such as ultrasound, plasma, ultraviolet and gamma for maintainable coloration as well as functional finishing of various textile materials. The book chapter emphasizes on most appropriate approaches for incorporating nanoparticles in textile industry along with their advantages, recent advances, and studies concerning the use of nanomaterials in recent functional modifications such as textile coloration, UV protection, antimicrobial textile, and smart textiles of natural and synthetic textile materials.

Keywords: Nanomaterials, textile coloration, UV protection, antimicrobial textile, smart textile

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Mohd Shabbir, Shakeel Ahmed, and Javed N. Sheikh (eds.) Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques, (135–152)

Chapter 12
Outdoor Pollution Management by Nanotechnology

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ABSTRACT

Remediation of environmental pollution has become a hot issue in the world. Environmental pollution, mainly caused by toxic chemicals, includes air, water, and soil pollution. This pollution results not only in the destruction of biodiversity, but also the degradation of human health. Textile industrial effluent often contains the significant amount of synthetic and toxic dyes. Some dyes are water-soluble, dyes such as azo dyes, sulfonated azo dyes, etc. Hazardous effect of dyes results in the formation of tumor, cancer, liver or kidney damage, insomnia, diarrhea, nausea, vomiting, dermatitis, chronic asthma, coughing, headaches, and allergies in humans

DOI: 10.4018/978-1-7998-0311-9.ch012

and also inhibit growth of bacteria, protozoan, plants, and different animals. A range of wastewater treatment technologies have been proposed that can efficiently reduce toxic dyes to less toxic forms such as nanotechnology. In this chapter, the authors give an overview of the various aspects of nanotechnology to remediate industrial textile dye effluents.

INTRODUCTION

Dye is considered as colored material which can be natural, semi-synthetic or completely synthetic. Natural dyes are of natural origin and therefore it is non-hazardous in comparison to the synthetic dyes. Plastics, textile, printing, paper, leather, rubber, and paints industries are the major sources of synthetic dyes pollution (Singh & Arora, 2011). Several dyes containing effluents are released into the water streams by these sources. Textile effluent consists of large quantity of unfixed dyes as compared to other effluents which are discharged by other industries (Ali 2010). Textile dyeing industry intensively affects the earth and is considered as first water-Polluting activity (Kant 2012, Silva 2018). Human beings along with aquatic flora and fauna are affected by the discharge of contaminated dye effluents in the water streams (Korbahti & Rauf 2008, Fernandez *et al.,* 2014, Bouaziz *et al.,* 2015, Li *et al.,* 2018). For coloring of different materials, azo dyes are frequently used (Solis *et al.,* 2012).

Dyes can cause several health related problems to human body and can damage different organs such as liver, central nervous system, reproductive system, brain, and kidneys (Kadirvelu *et al.,* 2003). Water polluted by dyes at a concentration of 1.0 mg/L is not suitable for human's consumption (Malik *et al.,* 2007, Mittal & Gupta 1996). Benzidine and arylamine-based dye are harmful and found to have some carcinogenic properties (Ozcan *et al.,* 2004). Therefore, it is necessary to find economic and eco-friendly method for treatment of dye effluents (Song *et al.,* 2018).

BACKGROUND TO DYES

Colorants are basically chemicals which is responsible for imparting color to the materials on which they are applied. Pigments and dyes are the types in which dyes are classified. Both are different from each other on the basis of their solubility. The crystalline or the particulate nature of the pigments is retained during the application. But dyes on the other hand became the integral part of the material because these are soluble and can be easily diffused into the material. Polymers, paints, and inks are the materials in which pigments are used. Dyes are considered as main source

for contamination of water and it is considered as ionizing, aromatic, and colored materials. These compounds which originate from hydrocarbons such as anthracene, toluene, xylene, naphthalene, and benzene which are based on coal tar are used for coloring several materials such as greases, drugs, cosmetics, paper, food, waxes, fur, plastics, leather, textile materials, hair, and other products. Factors other than solubility are required for a coloured material to be considered as dyestuff.

The Physical Basis of Color

Dyes are colored due to adsorption of light in the visible region or in the 400-700 nm range. Color –possessing group i.e chromophore and conjugate systems i.e the system consisting of alternate single and multiple bonds must be possessed by dyes. Resonance of electrons is the force of stabilization in case of organic compounds which is exhibited by dye molecules. Presence of a chromophore which is the area of the molecule where the difference of the energy between the two separate molecular orbitals lies in the range of visible region is responsible for imparting colors to the dyes. π–π^* and n–π^* transitions occurs in chromophore and the solubility of dyes are effected by auxochromes which are present in most of the dyes. Transitions of n electrons occurred in auxochromes not the π–π^* transitions. Carboxylic acid, amino, hydroxyl, sulfonic acid groups the the various auxochromes which is present in dyes and are responsible for color of the colorant. But these functional groups are not accountable for color production (Gupta *et al.,* 2013, Janaki 2014, Mallakpour 2017, Mallakpour 2018, Saini *et al.,* 2018).

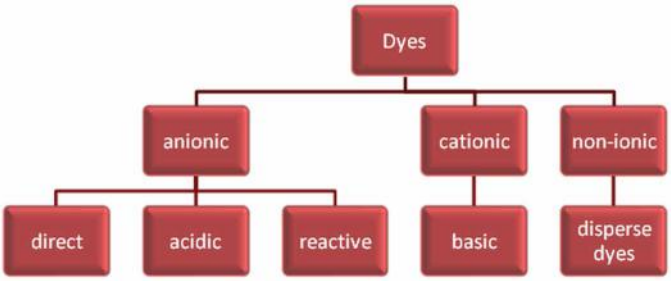
Classification of Dyes

Dyes are categorized on the basis of its chemical structure and color index (CI). Mono-azo, di-azo, tri-azo, anthroquinone, triarylmethane, and phthalocyanines are some of the general classes of the dyes. Anionic, cationic, and non-ionic are the different types of dyes which are classified on the basis of their utilization in textile industries. Yellow, orange, red, violet, blue, green, and black are the subclasses of the dyes on the basis of color.

There are generally two groups in which dyes are characterized:-

1. **Anionic Dyes:** Azine, nitroso, triphenylmethane, xanthene, and anthraquinone are the anionic dyes which are used for silk, wool, modified acrylics, nylon etc.
2. **Cationic Dyes:** Crystal violet, amaranth, and methylene blue are the cationic dyes which are used for polyacrylonitrile, modified nylons, in medicines, polyesters, and paper.

Figure 1. Classification of dyes
(Fu & Viraraghavan 2001)



Dyes are categorized according to the nature of their chromophore:-

1. **Nitro Dyes:** These dyes consist of NO_2 group (nitro group) which is attached to electron donating group such as amino and hydroxyl groups in an aromatic system.
2. **Nitroso Dyes:** These dyes are prepared on reaction of nitrous acid with naphthols or phenols. These dyes consists of nitroso group (chromophore) at orthoposition to the –OH group. These dyes are utilized in varnish industry, in paint, for rubber dyeing, and in the manufacture of pencils and wallpapers.
3. **Acridine Dyes:** These dyes are heterocyclic compounds which consist of acridine and its derivatives in their structure. These dyes are generally used for coloring mordant cotton and leather.
4. **Cyanine Dyes:** These dyes consist of delocalized charge on the two nitrogen atoms which are joined together by polymethine bridge. These dyes are used in industry, and in biotechnology for analysis and labeling because they are helpful label for nucleic acids and proteins.
5. **Oxazine Dyes:** These dyes consist of oxazine ring which act as a chromophore in which oxygen atom is attached at para-position to nitrogen atom.
6. **Thiazole dyes:** These dyes consist of thizole ring and it is mostly utilized for cotton.
7. **Anthraquinone Dyes:** These dyes are based on anthraquinone. The chromophore is provided by the resonance structure of the aromatic rings and the –CO groups. These dyes are utilized for dyeing silk, cotton, and rayon.
8. **Arylmethane Dyes:** These dyes are derived from CH_4 in which in which hydrogen atoms are replaced by aryl rings. Arylmethane dyes categorized into two subgroups:-

a. **Diarylmethane dyes:** these dyes are derived from methane in which two hydrogen atoms are replaced by two aryl groups.
b. **Triarylmethane dyes:** these dyes are derived from methane I which three hydrogen atoms are replaced by three aryl rings.

9. **Phthalocyanine Dyes:** These dyes consist of the derivatives of the phthalocyanine (tetrabenzotetraazoporphyrin) and its complex compounds with metals. The phthalocyanine dyes which are not soluble in water are generally used as pigments in the manufacture of printing colors, resins, plastics etc. the phthalocyanine dyes which are soluble in water are utilized for color fabrics.
10. **Indigoid Dyes:** These dyes consist of indigo as chromophore. These dyes are utilized for printing of cotton for dyeing proteins fibers and cellulose (Fabian & Hartmann 1980, Pisoni *et al.,* 2014, Raue & Corbett 2000).

Dye classification on the basis of the use or application is as follows:

There are some properties of dyes which are classified on the basis of their usage are:-

1. **Acid Dyes:**It is sodium salts of sulfonic acid and other acids like carboxylic or phenolic organic acids. Azo, nitro, nitroso anthroquinone, triphenylmethane, xanthenes, and azine are the different functional groups which are present in the acidic dyes. They are anionic dyes which are soluble in water and are used for dyeing silk, polypropylene fibers, nylon, polyamides, wools, and modified acrylics.
2. **Cationic (basic) Dyes:** They are called cationic dyes because colored cations are formed into the solution. Cationic dyes are also known as basic dyes and after the modication they can be water soluble. Hemicyanine, acridine, triarylmethane, thiazine, diazahemicyanine, oxazine, and cyanine are the different functional groups which are present in the cationic dyes. The positive charge carried by these dyes in their molecules is usually localized on the NH_4 group. These are used for cationic dyeable polyester, acrylic, cellulosic fibers, modacrylic, protein, and cationic dyeable nylon. Cationic dyes are utilized for dyeing dried flowers, jute, coir, cut flower etc.
3. **Disperse Dyes:** These dyes are free of the ionizing group and are insoluble in water which remained as suspended microscopic particles. Azo, nitro, benzodifuranone, anthroquinone, and styryl are the different functional groups which are present in the disperse dyes. Disperse dyes are mostly used for polyster dyeing and also used in form of aqueous dispersion for dyeing acrylic fibers, cellulose acetate, cellulose, and nylon.
4. **Direct Dyes:** These dyes are anionic dyes which are water soluble and coloured anions are produced due to ionization. For high affinity to cellulosic fibers,

this dye can be useful when applied with sodium sulfate and NaCl. Direct dyes are easily available in market, can be applied easily and utilized for dyeing leather, cotton, paper, nylon, and rayon. Direct dye without the help of other chemicals can easily hold on the cellulosic fibers.

5. **Reactive Dyes:** These dyes consist of atleast one reactive group which is able to form covalent bond with the fiber. The reactive group present in these dyes may be activated double bond or haloheterocycle. These dyes are generally used in the alkali situation and chemical bond is formed between reactive group of the dye and the –OH group on the cellulosic fiber. Bonding which occurs during dyeing leads to the fastness properties of these compounds. Due to the easy dyeing procedure, these dyes are used for dyeing cellulosics, some nylons, cottons, and rayons etc.
6. **Solvent Dyes:** These are characterized by its solubility in organic solvents. These dyes are nonpolar in nature and do not ionize in solution. Solvent dyes are used for coloring the waxes, organic solvents, plastics, hydrocarbon fuels, oil, lubricants, and gasoline etc. The compounds such as alcohols, chlorinated hydrocarbons, and liquid ammonia which are soluble in organic solvents are water insoluble is utilized for dyeing. Anthroquinone and azo group are the main groups present in these dyes.
7. **Sulfur Dyes:** These are called sulfur dyes because of the presence of sulfur-containing heterocyclic rings in their chemical structure. Sulfur dyes are synthetic organic molecules and it is utilized for the coloration of cotton, cellulosic fiber, and rayon due to the presence of sulfur group as chromophore. Sulfurization or thionization of organic intermediates leads to their ionization. These dyes are water insoluble and do not have affinity to cellulosic materials. Leuco compound is water soluble which is formed by treatment of sulphur dyes with weak alkaline solution of reducing agent or sodium sulfide and has affinity to cellulosic materials.
8. **Vat Dyes:** These are water insoluble dyes. These dyes polycylic compounds based on quinine structures which is utilized for the coloration of cellulosic fibers. These dyes are used generally used for color polyester and polyamide blends with cellulose fibers and also dyeing and printing cellulose fibers and cotton. These dyes are applied through the impregnation of fiber under the reducing conditions. It is further oxidized to insoluble form.
9. **Azo Dyes:** These dyes consist of aromatic compounds containing at least one azo group. These dyes are used for dyeing rayon, cotton, and polyester.
10. **Mordant Dyes:** Example of this dyes are dyes with metal chelating groups. These dyes are utilized for dyeing wool, cotton, and other protein fibers.
11. **Drug, Food, and Cosmetic Dyes:** These are natural and synthetic dyes. These are normally used in cosmetics, drugs, and foods, of which synthetic dyes

releated to anthraquinone, triarylmethane, carotenoid, and azo groups are the most commonly used (Hunger 2003, Gupta 2009, Janaki 2014, Parimalam 2012).

Nearly 1 lakh different types of dyes are synthesized with the rate of 9×10^6 tons/ year nowadays. These dyes are used in numerous industries including paper, colors, foodstuffs, textiles, and printing industries etc. The dye and textile manufacturing industries are responsible for the release of the color into the water. It is not easy to evaluate the quantity of dyes discharged into the water streams. It is estimated that >10,000 tons/year of dyes are consumed in the textile industries worldwide and nearly 100 tons/year of dyes are discharged into the water. The increased usage of dye causing water contamination leads to serious environmental trouble. The water quality is changed if dye is present in very small quantity (<1 ppm). Hence, for the supply of fresh water to the society there is need to remove these contaminants from the wastewater (Mu & Wang, 2016).

TECHNOLOGY FOR THE TREATMENT OF DYE EFFLUENTS

Various techniques are employed for the treatment of dye effluents such as adsorption (Baeza *et al.,* 2017), activated carbon (Yu *et al.,* 2016), osmosis (Luo *et al.,* 2017), clay-based adsorbent coating (Ab Kadir *et al.,* 2017, Azha *et al.,* 2017), membrane filtration (Dickhout *et al.,* 2017), electrochemical oxidation (Anglada *et al.,* 2007), organic resin (Nabi *et al.,* 2011a), coagulation/ flocculation (Shahadat *et al.,* 2017b), biodegradable nanocomposite (Shahadat et al., 2017b), hybrid ion-exchange adsorbents, incineration (Lin & Wu 2006), biomass (Rahman *et al.,* 2016), and nanocomposite material (Dong *et al.,* 2015). The techniques mentioned above characterized as conventional methods which involves elimination and recovery methods. Out of these techniques, adsorption is considered as most important technique for the treatment of dye effluents. Various adsorbents such as organic resin, graphene oxide, activated carbon, polyaniline, etc are used for the recovery and removal of dye effluents from the wastewater (Cazetta *et al.,* 2018, Banerjee & Chattopadhyaya 2017).

Nanomaterials

Nanotechnology refers to the study of extremely small structures in the range of 0.1 to 100 nm. The particle which lies in the range of 1-100 nm is termed as nanoparticles. Harmful pollutants including dyes, polychlorinated biphenyls, furans and dioxins, pharmaceutical and personal care products, phthalates, inorganic

pollutants, polycyclic aromatic hydrocarbons, viruses and bacteria, agrochemicals and pesticides, volatile organic compounds etc can be removed from the wastewater by using several cost effective, efficient and eco-friendly nanomaterials (Abdolmaleki *et al.,* 2017, Mallakpour *et al.,* 2017, Zare *et al.,* 2018, Prathna *et al.,* 2018, Tyagi *et al.,* 2018). Nanomaterials due to tunable pore size, high specific surface area (SSA) and related sorption sites, surface chemistry, short intraparticle diffusion distance have rapid adsorption rates and better efficiencies over wide range of pH as compared to conventional adsorbents. Low cost is needed for the fabrication of nanomaterials and only its small amount is utilized for efficient and effective dye removal. Hence for the adsorption use, these are effective in comparison to activated carbon due to less cost. Carbonaceous nanomaterials are one of the major class of nanomaterials, which comprise carbon nanofibers, fullerenes, graphene, and CNTs (carbon nanotubes). Carbonaceous nanomaterials due to higher affinity, high adsorptions kinetic and capacity are effective for dye removal from wastewater as compared to conventional activated carbon. Dyes are removed from the wastewater by π–π stacking, hydrogen bonding, covalent interaction, electrostatic interaction, and hydrophobic effect (Cai *et al.,* 2017, Shan *et al.,* 2017).

Coagulation–Flocculation

Sulfur and disperse dyes presented high coagulation and flocculation capacity while this method is not effectively applied for the color removal of acid, vat, direct and reactive dyes. Ethylediene dichloride, penta ethylene, and hexamine are the various co-polymers and ferric chloride, aluminum sulfate, copper sulfate, ferric, ferrous sulfate, and calcium chloride are the several coagulant agents which are generally used for color removal of colorants. The floc formed with the dyes is the mechanism behind the coagulation process and can be separated using filtration or sedimentation. The ability of settling of floc can be increased by dosing the polyelectrolyte during the phase of flocculation (Forgacs *et al.,* 2004). It is economic that only the separation of colorants is taking place. But the disadvantage of coagulation and flocculation process is the production of sludge (Valh *et al.,* 2011).

The characteristics of the suspended particles are changed in the coagulation method and floc are formed which sinks rapidly. The colloidal suspensions with negative charge are not effectively separated by conventional physical process. In coagulation process, electro kinetic repulsion between the particles is decreased by the addition of positive charge. Marmagne and Coste reported that in coagulation process, there is efficient removal of colour of sulfur dyes. The experiment was performed in bench flocculators, pH, temperature, and chemicals are the factors which affects the process of coagulation (Nguyen & Juang 2013).

Filtration Technology

For wastewater treatment, filtration technology is considered as a major part. Microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverses osmosis (RO) are the different filtration technology. Several promising results are shown by this technology for the color removal and for the process of water treatment, individual membrane is important. Various sorts of dyes are removed efficiently by the help of NF and UF but MF due to its large pore size is not sufficient for the treatment of wastewater. High membrane cost, high pressure, short life span, and momentous energy consumption are some of the limitations of this process and removal of organic contaminants or treatment of dyestuff are hindered by these properties. Salts rejections is better in case of RO. It is applied for recycling and gives improved results against several dye effluents in desalting and decolorizing.

Micro-Filtration

Dye baths consisting of pigment dyes as well as for rinsing baths are treated by this technique (Babu *et al.,* 2007). Chemical will remain in the dye bath which are not filtered by MF. Colloids, suspended solids or macromolecules having pore size of 0.1 to 1 micron are separated using MF and it is the pretreatment for NF or RO (Ghayeni *et al.,* 1998). For silt density index or turbidity, the performance of microfiltration is greater than 90. Poly (Vinylidene Difluoride), Poly (Ether Sulfone), Polycarbonate, Poly (Vinylidiene Fluoride), Poly Tetrafluoroethylene (PTFE), Poly (Sulfone), Polypropylene etc are the specific polymers from which MF membranes are formed. Operation at high temperature or where extraordinary resistance for chemicals are needed; carbon coated with zirconia, ceramic, carbon, alumina and sintered metal membranes, glass have been used. The operational velocities for micro and ultra filtration is 20 to100 cm/s and pressure is 20 to 100 (Ptm) (Naveed *et al.,* 2006).

Ultra-Filtration

This technique is used for the separation of macromolecules and particles, but only 31-76% dye is removed from this method. For reuse of treated wastewater for sensitive process such as textile dyeing is not permitted but for washing, rinsing etc where salinity is not a issue, the treated wastewater can be reused. UF can be used in combination with biological reactor, as pretreatment process for RO, and for metal hydroxide elimination (Naveed *et al.,* 2006). Polyvinyl chlorides (PVC), polytetrafluoroethylene (PTFE), polysulfone, acrylic copolymer, polypropylene, and nylon-6 are the various polymeric materials which are used for the formation of ultrafiltration membranes.

Nano-Filtration

This technique is used for the decoloration of effluents from the textile industries. Nanofilteration membranes are able to retain divalent ions, dyeing auxiliaries, organic compounds with low-molecular weight, hydrolized reactive dyes, large monovalent ions and they are normally made of aromatic polyamides and cellulose acetate. Nanofilteration and reverse osmosis membranes are manufactured by inorganic materials including carbon based membranes, ceramics, and zirconia. 5 to 30 Gross Flow per Day (GFD) is the flux rates for nanofilteration. By single nanofiltration, amount of removal of color greater than 90% were reported. Toxic effects of high concentration of dye > 1.5 g/L and mineral salts > 20g/L in the dye household effluents regularly reported (Tang & Chen 2002). The discharge of treated effluents in water streams is approximately unfeasible due to accumulation of dissolved solids. Textile decolorization of effluents by nanofilteration is fairly satisfactory.

Reverse Osmosis

Hydrolized reactive dyes, many types of ionic compounds, and chemical auxiliaries are removed by this technique in a single step and high quality of permeate is produced. Careful pretreatement of influent must be done because reverse osmosis is sensitive to fouling like nanofilration. Reverse membranes are generally made up of aromatic polyamides, inorganic materials, and cellulose acetate. In comparison to conventional treatments, membrane processes in combination with physio-chemical treatment has several advantages, such as decreasing the consumption of fresh water and the cost for wastewater treatment, decrease of regulatory pressure, capability to recover materials, costs of waste disposal can be decreased due to small disposal volumes. Several cost-effective applications in textile industries are associated with membrane processes (Naveed *et al.,* 2006).

Adsorption of Dyes

Adsorption is considered as an important method over other conservative approaches for dye removal from wastewater (Aljeboree *et al.,* 2014). Physical and chemical forces are responsible for the attachment of dissolved molecules to the surface of adsorbent in the process of adsorption. Wastewater treatment by activated carbon is widely employed. Combined adsorption and ion exchange or simply adsorption process is responsible for the removal of dye using activated carbon. Cost of operation, availability of adsorbents at low costs, and low initial capital are the factors which makes the wide applications of adsorption process for the elimination of textile contaminants. Various properties such as mechanically stable, ecofriendly, suitable

pore size, less processing procedures, easy accessibility, economic, compatibility, higher adsorption capacity due to large surface area, and regeneration capacity should be consisted by superlative adsorbent for adsorption of dyes (Vakili *et al.,* 2014).

Agricultural by-product, natural and modified clay (Ahmadishoar *et al.,* 2017), polymeric sorbent (Popescu & Suflet 2016), activated carbon (Tze *et al.,* 2016), industrial by-product, chitosan-based adsorbent (Çınar *et al.,* 2017), and resin (Naushad *et al.,* 2017) are the various adsorbents which are used for the removal of colouring agents.

Adsorbents

The contaminant which is absorbed is called adsorbate and the phase on which it is getting adsorbed is called adsorbent (Yagub *et al.,* 2014). Adsorbent plays a very important process in adsorption process. Great adsorption efficiency, low cost, long life, great selectivity, and broad availability are the necessary properties for the good adsorbents. Nanomaterials, activated carbon, and several low-cost adsorbents are utilized as adsorbents for removal of contaminants from wastewater (Toor 2010).

Activated Carbon

It is mostly used adsorbent for the elimination of wide variety of dyes from the contaminated water. It is non-graphitic form of carbon, internally porous microcrystalline. Micropore structures, great adsorption capacity, large extent of surface reactivity, large surface area are the factors which makes the adsorbents efficient for dye removal but the cost of fabrication and regeneration of adsorbent is too high. Extra effluent is generated during the regeneration by means of refractory method which causes loss of removal efficiency of adsorbent due to 10%–15% loss of adsorbent (Adeyemo *et al.,* 2017).

Low-Cost Adsorbents

Soluble organic dyes from wastewater are transferred to the adsorbent which is highly porous and solid surface. Adsorption is most effective and economic process for decolorization of textile effluents or dye elimination. Temperature, interaction of dye/adsorbent, pH, surface area of adsorbent, size of particle, and contact time are the main factors for the adsorption of dyes. There is need for the low-cost adsorbents due to low regeneration capacity and high cost of adsorbents. These adsorbents must present in considerable amount in nature, need minimum processing, and must be effective.

There are three categories in which low-cost adsorbents are divided:

1. By-products of industries and agriculture wastes like sugar industry mud, wood sawdust, fly ash, coal ashes, teak wood bark, wood chips, peels (banana, pomelo, garlic, jackfruit), papaya seeds, grounded sunflower seed shells, coconut tree flower, rice husk, grass waste, ground nut shell powder, rubber seed shell, neem leaf powder.
2. Various bioadsorbents like microbial, biomass, and fungi.
3. Various natural materials like glass wool, clay.

Mixed results are shown by these adsorbents and in very few cases these have adsorption capacity larger than activated carbons (Teng & Low 2012, Servos 2014, Suteu *et al.,* 2011a, Nazarzadeh *et al.,* 2018).

CONCLUSION

Dyes are natural and synthetic materials which impart color to the products and make the environment more beautiful but it is considered as harmful and can contaminant the water streams. From the literature review it is observed that there is increase in production and use of textile dyes in last few decades which cause threat to the environment. Textile sector due to large consumption of water sources is found to be considered as an important area. The presence of dyes even in small quantity is toxic to environment and should be eliminated before entering into the water stream. By mechano-physico-chemical and biological treatment procedures, dye removal from textile effluents can be achieved. Removal techniques for dye effluents from wastewater have drawn considerable interest.

Adsorption is considered as a cost effective and efficient technique for the removal of dye effluents from wastewater and hence can generate high-quality treated effluent. This chapter highlights on the removal of dye effluents from wastewater by using nanotechnology.

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KEY TERMS AND DEFINITIONS

Dye: Dye is a colored substance which provides color to another substrate through chemical bond with the substrate.

Effluent: Effluent is an outflowing of water or gas to a natural body of water, from a structure such as a wastewater treatment plant, sewer pipe, or industrial outfall, etc.

4

Conjugated Polymer Light-Emitting Diodes

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Abstract
The development of organic light-emitting diodes (OLEDs) has attracted considerable interest in innovations for our daily life and future. They have promising applications in flat panel displays, energy-saving, eco-friendly, thinner and smaller in size, lightweight, and cost-effective fabrication process. For the development of OLEDs, numerous conjugated polymers have been studied due to their semiconductor nature, which is being associated with pi bond delocalization along the backbone of the polymer chain. Conjugated polymers are highly recommended for electroluminescent devices such as OLEDs. The chapter comprises basic knowledge of polymer light-emitting diodes, their construction, device function, and use of conjugated polymers in blue, red, green, and multicolored light-emitting diodes along with challenges and their future perspectives.

Keywords: Conjugated polymers, organic electronics, OLEDs, PLEDs, band gap, blue, green, and red emission region

4.1 Introduction

Light-emitting diode (LED) is a semiconductor light source that emits light in response to an electric current [1]. In semiconductors, electron recombine with holes, releasing energy in the form of photons [2]. The color of the light (corresponding to the energy of the photons) is determined by the

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Inamuddin, Rajender Boddula, Mohd Imran Ahamed and Abdullah M. Asiri (eds.) Polymers for Light-Emitting Devices and Displays, (77–98)

energy required for electrons to cross the band gap of the semiconductor [3]. Nowadays, organic light-emitting diodes (OLEDs) have attracted considerable attention of researchers, scientists, and industrial aspirants and bring innovation to our lives due to its unique properties such as low-cost, wide viewing angle, flexibility, lightweight, low power consumption, and thin panel thickness [4–8]. OLED device architecture includes the use of an organic carbon-based film which is made up of some conjugated polymers, sandwiched between two charged electrodes. These electrodes are the transparent anode (generally glass) and the other is a metallic cathode [9]. OLEDs have smart features of ultra-thin and fine image-quality along with lightweight as self-emitting devices [10]. Nowadays, they are very familiar to general consumers and civilians due to their uses in smartphones like Samsung's Galaxy series as well as in the manufacturing of large TV displays [11]. OLED can be fabricated by small molecules or polymers. The former can be fabricated by vacuum deposition method and polymer organic light-emitting diodes (PLEDs) are generally developed by solution deposition method [12, 13]. The latter method has attracted wide attention due to its ease of preparation and low cost [14]. The process of fabrication of PLEDs can be carried out at room temperature so that organic flexible substrate can be a platform for device fabrication [15]. This technology allows polymers to fabricate full color PLED pixels by various printing methods or techniques like dye diffusion [16], laser-induced thermal transfer [17], screen printing [18], inkjet printing [19, 20], and patterning with the photolithographic process [21, 22]. In the comparison of small molecules OLEDs, these patterning methods make PLEDs more useful in the larger size and high-resolution display [23]. For PLEDs, three colors, i.e., red [24], green [25], and blue [26] used for full-color display for which various types of conjugated polymers have been proposed and synthesized.

Conjugated polymers are commonly referred as "Organic Macromolecules" having conjugation of the single and double bond in their polymer backbone chain that makes them intrinsically conducting in nature [27]. In these organic macromolecules, the overlapping of p-orbitals takes place resulting delocalized π-electrons system which is responsible for unique optical and electronic properties [28]. In conjugated polymeric chain, injection of hole and electron *via* π (bonding) and π^* (antibonding) can create a self-localized excited state by delocalization of charge in valence and conduction bands which on emission can decay radiatively and revealed outstanding potential in electroluminescent devices [29]. The generation of charge carriers such as polarons, bipolarons, and solitons are responsible for the conduction mechanism [30].

These conjugated macromolecules show changes in electrical and optical properties when doped or functionalized by chemical species [31]. A numerous variety of conjugated polymers have been developed and evaluated since 1977, since the discovery of electrical conductivity in polyacetylene discovered [32]. These materials include polyanilines [31, 33] and their derivatives such as poly(o-phenylenediamine) [34, 35], polyluminol [36, 37], and some other polymers like polypyrroles [38], polynaphthylamines [39–41], polythiophenes [42], polyanisidine [43], polycarbazoles [44–46], polyphenylenevinylene (PPV) [47], and their derivatives [48], polyphenylenes [49], polyfluorenes [50], and polyaryleneethynylenes [51]. These have attracted numerous industries and academics for a different type of optoelectronic applications. Conjugated polymers have drawn considerable attention due to their strong fluorescence emission [52], excellent hole transport ability [53], flexibility [54], and solution processability [55–57]. Numerous reports have been published regarding enhancement of processability of conjugated polymers by blending or composite formation [58–61].

Conjugated polymers which are processable by solubility are the most promising candidate for optoelectronic devices such as LEDs [62]. Enhanced solubility and processability of conjugated polymers help in preparing an emissive electroluminescent thin film of organic compound which emits light in response to an electric current in optoelectronic devices [63, 64]. Chemical structure and extended conjugation in such type of polymers provides controlled morphology, enhanced solubility and processability for using them in OLEDs *via* preparing an emissive electroluminescent thin film of organic compound which emits light in response to an electric current [65]. In addition, extended conjugation also provides a low band gap as a functional property for these applications [66].

4.2 History, Classification, and Characteristics of Polymer OLED Material

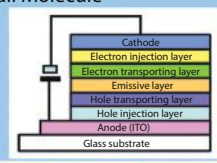
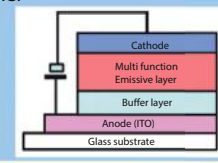
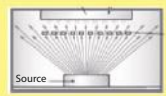
In Cambridge University, a group worked on conjugated polymers and found electroluminescence in these materials in 1989 [67]. In this finding, the device had a very short lifetime of some minute and very weak external quantum efficiency (EQE) of 0.1%. Some of the companies worked on the progress of polymer OLEDs material and optimization of these devices fastly such as Sumitomo Chemical Co. Ltd, Cambridge Display Technology (CDT), Dow Chemical and Covion, etc., and the result of the research was

achieved as several tens of thousands of hours long lifetime and high EQE of about 5%~10%.

OLEDs material can be broadly classified into two groups on the basis of emissive materials which includes small molecules based OLEDs and polymer-based OLEDs [68, 69]. Small molecules-based OLED can be fabricated by the vacuum deposition method [70] and polymer-based OLED can be developed by the solution deposition method, Table 4.1 [71]. The polymer material can be conjugated or non-conjugated further for the fabrication of OLED while dendrimers play the role of intermediate of polymers and small molecules, Figure 4.1. The multilayer device structure is used in small molecule OLEDs, and so there is a requirement of more amendments in chemical structures in addition to solubility while polymeric material to form OLEDs is willingly soluble by ink solvents and makes it a useful material for wet process or printing process discussed earlier in Section 4.1.

Copolymerized or modified conjugated polymeric materials work without a multilayer structure in OLEDs [72]. In these devices, one of the most important parameters in emission color and this is controlled by incorporation of emissive moieties into the polymeric backbone, which is generally a wide band gap structure [73].

Table 4.1 Comparison of small molecule LED and polymer LED *(Reprinted from Chizu Sekine et al., 2014 Sci. Technol. Adv. Mater. 15, 034203).*

	Small Molecule	Polymer
		
Process	Dry process (Vacuum evaporation) 	Wet process 
Patterning	Shadow mask	Printing (IJ etc.)
Structure	Complex layer structure (5-6) →Complex process	Simple layer structure (2-3) →Simple process, scalable
Material	Separated function	Integrated function
Issue	Layer structure complexity Difficulty in mask patterning	Performance (esp. LT) Patterning technology

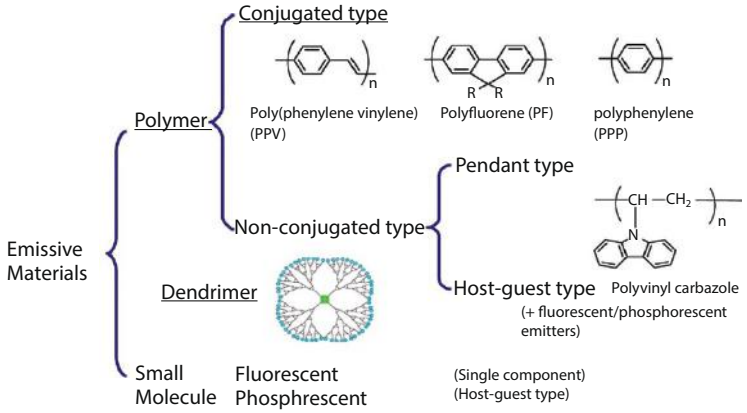


Figure 4.1 Classification of polymers according to emissive materials. (Reprinted from Chizu Sekine *et al.*, 2014 *Sci. Technol. Adv. Mater.* 15, 034203).

4.3 Polymer OLED Device Construction and Working

An OLED is a 100- to 500-nm-thick solid-state semiconductor device and about 200 times smaller to human hair [74]. The structure of OLED comprises a cathode, an emissive layer, a hole injection layer and an anode. In OLED there is an interlayer sandwiched in between cathode and anode electrodes [75]. The interlayer is composed of an organic layer in which the delocalization of pi electrons takes place and make this layer conductive in nature [76]. These materials are known as organic semiconductors due to the conductivity between conductors and insulators [77]. In organic semiconductors, their HOMO (highest occupied molecular orbitals) and LUMO (lowest unoccupied molecular orbitals) are considered as valence and conduction band present in the inorganic semiconductor [78]. An interlayer between hole injection and emissive layer makes an improvement in the device structure as well as in its performance due to cross-liking properties of the interlayer [79]. In polymer OLEDs, an interlayer is responsible for the enhancement in the emission efficiency. This layer is placed in between the hole injection layer and the emission layer. The function of this layer is hole-transporting as well as electron and exciton blocking. In summary, this layer is responsible for the separation of the hole injection layer and emission zone, as well as due to its electron blocking property, it accumulates electrons at the interface of the interlayer [80]. However, modern

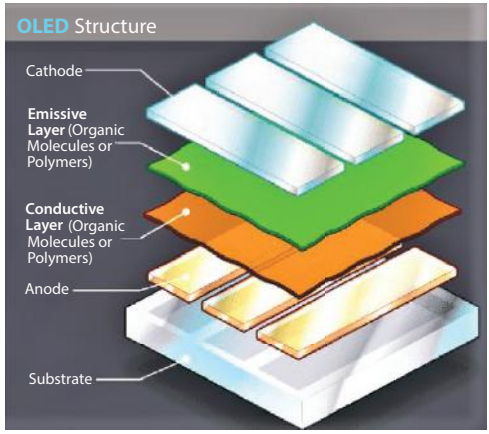


Figure 4.2 The basic OLED device architecture. Source: https://electronics.howstuffworks.com/oled1.htm.

OLEDs are fabricated by a very simple bilayer structure having a layer of emissive material and other is conductive material [9]. The basic OLED structure is shown in Figure 4.2.

Polymer OLEDs device performance is based on its emission efficiency and its lifetime. Its emission efficiency was discussed by Tokito and his labmates [81] and expressed as:

$$\Psi = \Upsilon.n_{e-h.}\Psi_{ph}.(1 - Q) \tag{4.1}$$

In the above equation, Ψ stands for electroluminescence efficiency, Υ stands for carrier balance for electron and hole, Ψ_{ph} stands for photoluminescence efficiency, and Q stands for quenching factor. It can be stated by the equation that by improving carrier balance for electron and hole, by enhancing photoluminescence efficiency and recombination rate or by suppressing cathode quenching, device performance can be improved in terms of electroluminescence efficiency.

4.4 Blue Light-Emitting Diodes

Various types of conjugated polymers have been proposed for blue light-emitting diodes which were highly soluble and reveled strong blue fluorescence or emit blue light in 350–440 nm range without any excimer

formation on longer wavelength [82–85]. For blue OLED, some phenylene chains have been polymerized by meta linkage and displayed 4.69 cd A^{-1} efficiency [86].

In this regard, carbazole is a rigid plane biphenyl monomer having a wide band gap along with its high flexibility and high luminescent efficiency which helps in modification of the molecule skeleton for its use as a key chromophore in OLEDs [87, 88]. These are extensively used in the development of highly competent blue light-emitting diodes as a key role of host and charge-transporting materials [89]. By derivatives of carbazole, Morin [90] and his coworkers developed light-emitting diodes by electron and hole transport molecules, i.e., 2-(4-biphenylyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole and N,Ń-diphenyl-N,Ń-bis(3-methylphenyl)-1,1′-biphenyl-4,4′-diamine, respectively, which showed electroluminescence in 424–432 nm wavelength (blue region) with Al and indium tin oxide as the electrodes. They also developed 2,7 carbazole based blue light-emitting copolymers with some other highly aromatic comonomers by Yamamoto or Suzuki cross-coupling reactions. These high molar mass modified with substituent species were highly water-soluble and amorphous in nature as well as these showed good redox properties and thermal stability for their application in layer blue light-emitting diodes [91].

Numerous works have also been reported on polyfluorenes that is also a blue light-emitting material [92]. Although, polyfluorenes exhibited promising features, literature suggested the tendency of forming excimers and aggregation which caused shifting of emission spectra towards longer wavelengths or showed bathochromic shift and decreases fluorescence quantum yields [93]. To remove such type of problems, scientists and research have done a number of studies and done functionalization by bulky side substituents or copolymerization with other monomers or by introduction of lithe spacers amid the chromophores [94–98]. Oligo(9, 9-dihexyl-2,7-fluorene ethynylene)s were synthesized by Tsutsui *et al.* [99] for extraordinary photoluminescence having high quantum yields as well as high oxidative and thermal stability for their use in OLED application. Chan *et al.* [100] developed poly(9,9-dihexyl-2,7-dibenzosilole) by copolymerization of monomers dibromo and bis(boronate) which showed better efficiency in a single layer light-emitting device in comparison of polyfluorene.

4.5 Green Light-Emitting Diodes

Seino and his labmates developed a green organic light-emitting device (OLED) whose power efficiency was too high (100 lm W^{-1}). This was

achieved *via* energy transfer from an exciplex and it was 1.6-times higher than green thermally activated delayed fluorescence (TADF) OLEDs [101]. Tanaka *et al.* [102] developed highly efficient green organic light-emitting diodes (OLEDs) using a conjugated polymer dipyridylphenyl moieties and fac tris(2-phenylpyridine)iridium, $Ir(ppy)_3$ as a phosphorent emitter and yield 29% at 100 cd/m^2 and 26% at 1000 cd/m^2 external quantum efficiencies which were too high and lead to 133 lm/W and 107 lm/W ultra high power efficiencies at 100 cd/m^2 and 1000 cd/m^2 respectively. A highly efficient green OLED was fabricated by using 9,9-diarylfluorene-terminated 2,1,3-benzothiadiazole derivative in Ku's lab [103] which revealed EQE (ηext) of 3.7% and maximum brightness at 168,000 cd m^{-2}. Zhu and his coworkers [104] proposed green and blue-green phosphorescent OLEDs based on tetraphenylimidodiphosphinate and iridium complex. These were highly efficient, due to shorter excited stated lifetime and better carrier transport ability along with good electroluminescence performance. 3′,5′-di(carbazol-9-yl)-[1,1′-biphenyl]-3,5-dicarbonitrile was used as a host material for green thermally activated delayed phosphorescent and fluorescent OLEDs by Cho *et al.* [105]. This materials showed high quantum efficiency close to 25%. Chen [106] and his coworkers achieved highly efficient green phosphorescent OLEDs by 1,3,5-Triazine derivatives as new electron transport-type host materials. A dicarbazole-triazine hybrid bipolar host material was developed in which dicarbazole moiety is electron donor and triazene is electron acceptor. This device was highly efficient green phosphorescent OLEDs having maximum efficiency of up to 20.0% [107].

4.6 Red Light-Emitting Diodes

Red OLEDs have an emitting layer comprising of one material during their initial development. Okada *et al.* [108] developed a highly efficient complex for red OLED by using 1-phenylisoquinoline. The complex revealed emission peak in the red region, i.e., 598–635 nm, the quantum yield of 0.17–0.32 and lifetime of those complexes ranged 1.07–2.34 μs, respectively. Jung and his labmates [109] reported red organic light-emitting devices (OLEDs) by incorporating various donor-acceptor moieties in polymeric backbone which showed emission at 637–677 nm and highest brightness of 8,300 cd m^{-2} with 4.46% maximum EQE at 7 V, the current efficiency and the power efficiency was found 3.43 cd A^{-1} and 1.64 lm W^{-1}, respectively. 3-2-(3,3-dicyanomethylene-5,5-dimethyl-1-cyclohexylidene)

vinyl-N-naphthyl-carbazole(NCz-2CN)and3,6-bis(2-(3,3-dicyanomethylene-5,5-dimethyl-1-cyclohexylidene)vinyl-N-phenyl-carbazole (PCz-4CN) which are derivatives of carbazole were used as donor-Л-acceptor for obtaining red OLEDs by Fu *et al.* [110]. They emit in red region 630–666 nm and maximum luminance of 4,110 cd/m^2 attained at 15 V. The current efficiency was found 2.09 cd/A while maximum luminous efficiency was found at 0.49 lm/W.

4.7 Multicolor Light-Emitting Diodes

Bouillud *et al.* [111] presented conjugated polymers based on fluorene with the incorporation of thiophene and phenylene moieties in their copolymer having outstanding properties of tunability of the electroluminescent properties. By changing the composition of comonomers, it has the ability to change their emission from blue to green or yellow. They also suggested hole injection and hole transport phenomena by the addition of an insulating buffer layer as well as the hole transporting material into the material. This electroluminescence efficiency was increased from 4.5 to 125 cd/m^2 by incorporation of N,N'-diphenyl-N,N'-bis(3-methylphenyl)-1,1-biphenyl-4,4'-diamine as the hole transporting layer and LiF as an insulating buffer layer.

Wong and his coworkers [112] studied the use of conjugated and non-conjugated polymeric backbone in terms of synthesis, physical properties, sample quality, and device performances for blue, green, and red OLED materials (Figure 4.3), while Chou *et al.* [113] prepared universal bipolar host by phosphine oxide and two carbazole groups for blue, green, and red phosphorescent OLEDs which was highly efficient.

4.8 Advantages of OLEDs over Other Liquid Crystal Display

OLEDs revealed many advantages with other conventional liquid crystal displays (LCDs) such as polymer OLEDs that show different colors such as red, green, blue (RGB) as well as white too which is important to many applications [114, 115]. OLEDs are biodegradable. An OLED display can be many times lighter, more flexible, and thinner compared to LCD, as well as it can display deep black levels because it works without a backlight [116]. These are much brighter as compared to LCD.

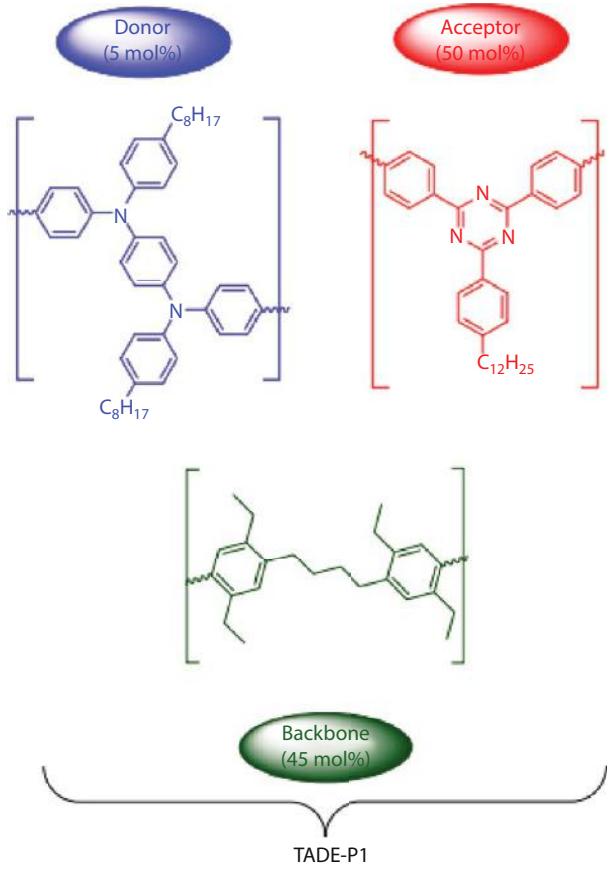


Figure 4.3 Functionalized conjugated polymer having donor (5 mol.% triphenylamine), acceptor (50 mol.% 1,3,5-triazine) and backbone (45 mol.%) with an insulating n-butyl link (*Reprinted from Michael Y. Wong, 2017, Journal of Electronic Materials. 46, 6246–6281).*

These have the active light-emitting capability as well as the OLEDs are driven by the direct current with 10-V approximate voltage [117]. They are also highly efficient in a light color so that full-color display can be realized easily and in place of early vacuum display devices, these are all-solid-state devices [118]. In addition, they have a lithe information display technology with low energy consumption and high light-emitting efficiency [119]. These devices have outstanding light-emitting properties and temperature features which least affected by temperature fluctuations and faster response time. They are easy to prepare at a very low cost [120].

4.9 Applications of OLEDs

In 2003, Kodak has used OLED in the fabrication of its first digital camera [121]. OLEDs are widely being used in the latest smartphones, DVD players, digital cameras, digital watches, etc., due to its high flexibility and foldability which helps in saving space and weight [122]. After this, numerous companies have used this technology in their products including Nokia [123], Samsung [124], etc. Since the year 2019, OLED screen is readily used in many mobile phones including Honor view 10, Nokia 6.1 plus, Samsung Galaxy A8+, Vivo V15 Pro, Gionee S11S, OnePlus 7 Pro, etc., and in TV such as Sony Bravia Android Smart OLED TV KD-55A8G, LG Smart TV OLED55C8PTA, METZ Android OLED TV M55S9A, etc. OLEDs have also applicable in high-end television systems, flat-panel displays, computer monitors, some pocket-size systems like digital cameras, portable gaming consoles, media players, android phones, and mini-screens [125–127].

These are also widely used in various multiple-input output wireless optical channels [128]. Some other applications of OLED are shown in Figure 4.4.

4.10 Challenges and Future Possibilities

OLED has a wide area of applications in different areas, but still, there are many challenges involved in this technology such as its is costly in

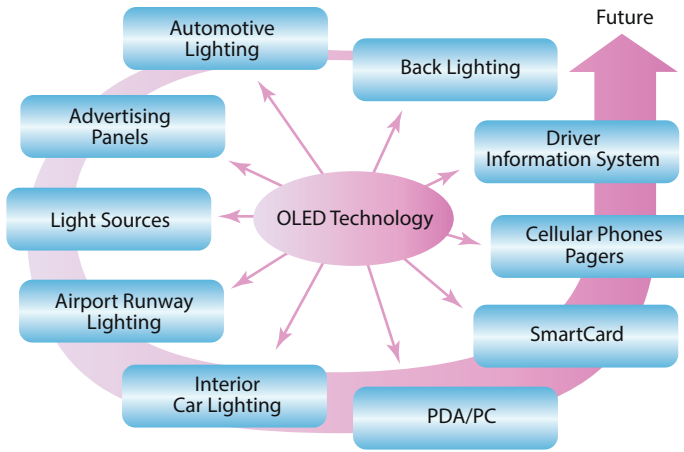


Figure 4.4 Applications of OLED. Source: https://www.elprocus.com/oled-display-technology-architecture-applications/.

comparison to LCD or LEDs. There is still a lack of a broad range of products incorporating OLEDs. Light efficiency is still low and compared to other display devices, their lifetime is shorter. Red, green, and white LEDs give longer lifetime but the blue OLED revealed a limited lifetime of 1.6 years. Technology is highly sensitive to water so can be damaged by moisture. When OLEDs compared with LCD in direct sunlight, these show worse scenario. In the future, these problems can be resolved by using various types of technologies and conjugated polymers. OLEDs can be used for curved display in the future as well as transparent displays entrenched in windows. The property of flexibility of OLEDs maybe uses in roll to roll manufacturing process which allows flexible display architecture. Flexible, stretching, and self-healing materials need to incorporate for OLED device fabrication that can also improve barrier layers to protect OLEDs from moisture and oxygen. By removal of triplet exciton from conjugated polymer backbone could expressively enhance the device stability, specifically at the initial stage of pouring, i.e., *via* the introduction of additive which quenches lead the high efficiency and device lifetime. For this, various features of polymers could be introduced in single polymer *via* its copolymerization, doping, medication, or *via* functionalization of monomers then copolymerization.

4.11 Conclusion

Great progress has been done in the synthesis of conjugated polymers for OLED device fabrication. By modification, copolymerization, doping, and other techniques, those materials are being prepared which helps in applications of electron transport materials to improve the device fabrication and performance of OLEDs. The efficiency of the OLED device is dependent on charge injection, charge transport, and emission. The combination of phosphorescent emitters and conjugated polymers is very important to achieve high efficiency. For this point of view, many functionalized or copolymerized conjugated polymers have been investigated having various features in a single polymeric material as conjugated polymers having delocalized pi electrons in their backbone possess brilliant charge carrier transport properties so by incorporation of various moieties conjugation length could be controlled or tuned for further improved modifications in OLEDs.

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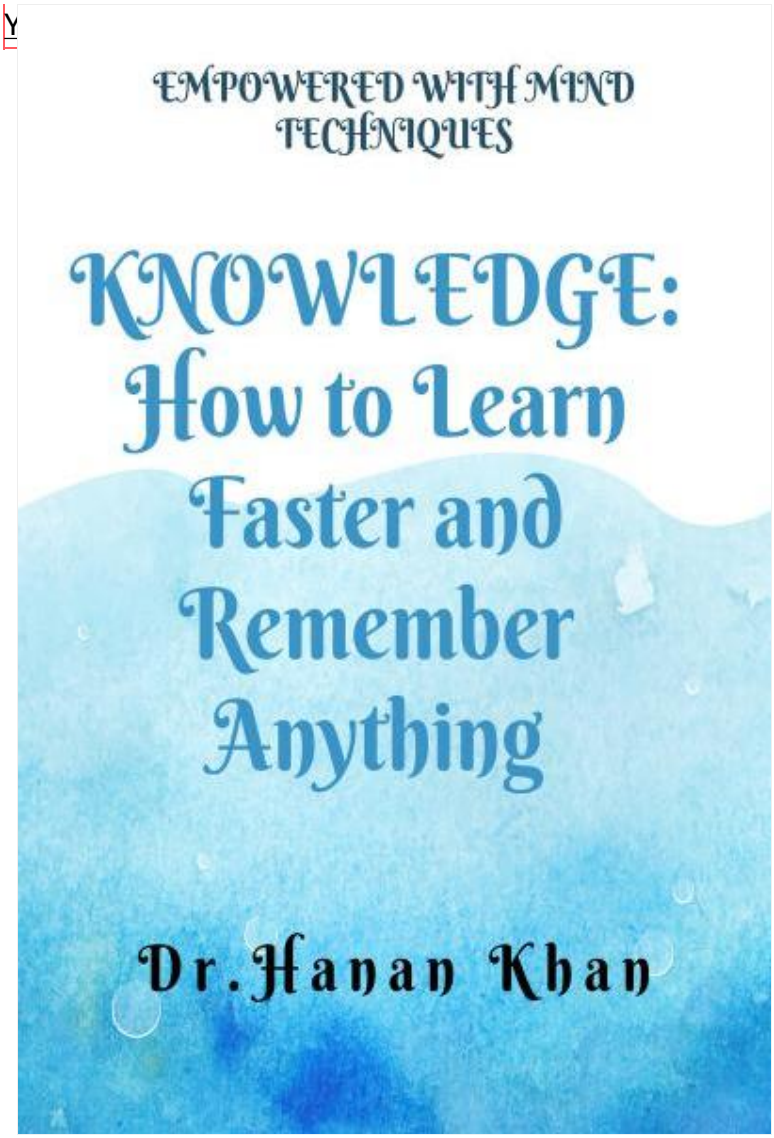

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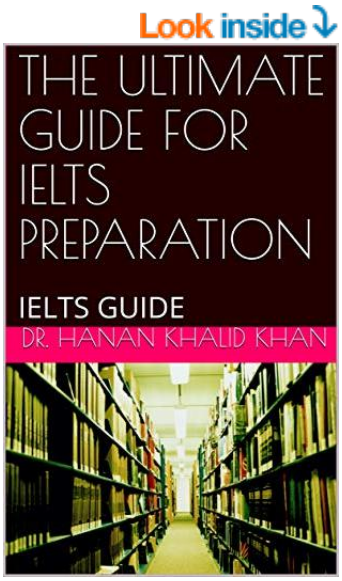

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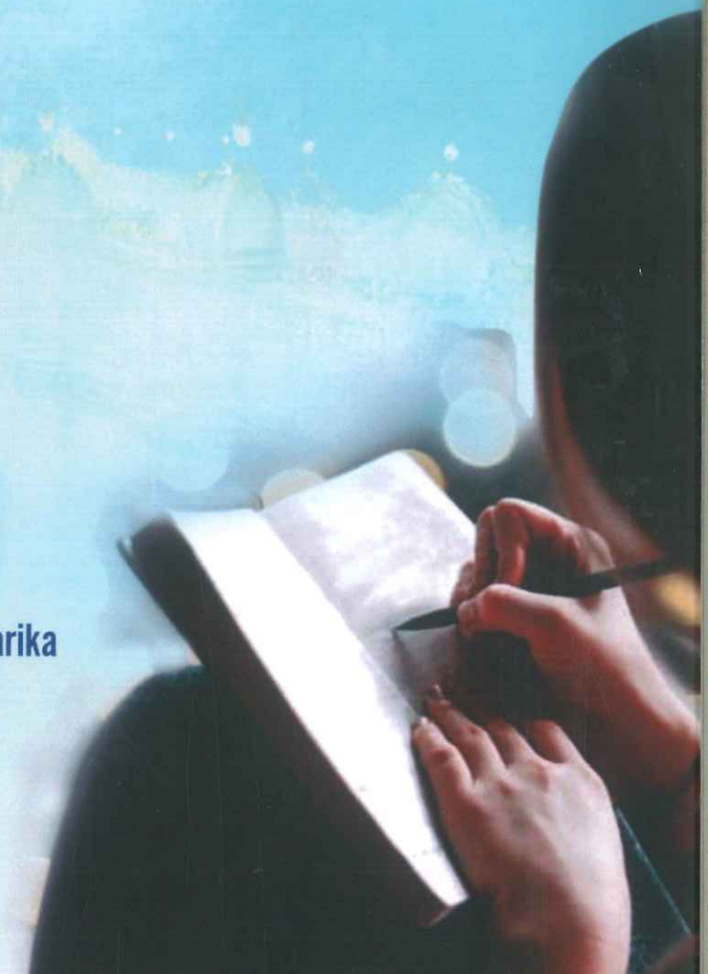

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The Issue of Identity, Hybridity and Assimilation in the Diasporic Poems of Sujata Bhatt

Rashmi Maniar, Hanan Khalid Khan and **Lavanya Paluri**

More women poets are leading to present the world in its multi-dimensions, in various ways, in Indian writings in English. In other words, they give us a complete understanding of human nature without leaving out any aspect of life. Sujata Bhatt is a well-known name among Indian women poets who write in English. She is an Indian diaspora poet who expresses herself through poetry. She uses her experiences on three continents creatively in her writing, which is rooted in multiculturalism. Sujata Bhatt's diasporic experience does not stifle her creativity; rather, it provides her with a range of viewpoints that broadens her comprehension of life's complexities. Trans-cultural migrants have become a kind of psychological refugees in this age of accelerated globalisation, as a result of crossing complex geographical and cultural boundaries. They strive to forge a sense of stability – a sense of identity – while stuck in the confluence of pluri-cultures. Her poetry engraves a homing impulse while simultaneously denying fixed-source discourses.

The picture of a home that is located at a distance – with reference to both space and time, is at the heart of the diaspora concept. For Diasporans, home is the point of origin where they come together to form their identity. While there are those who believe the two are separate, there are others who believe they are not. In academic assessments of diaspora communities, the impression of 'home' and 'homeland' is significant. The importance of home (land) in the emergence and evolution of the diaspora idea is enormous, even today. This picture of the original house is created in the mind of the first owner. generation, as well as in the diasporic consciousness of the first, second, or third generations of migrant workers Contemplation and recollection are embedded in a homeland, from which the concept of home emerges. As a result, home is a place where one lives; it is a concept that is infused with thoughts, emotions, and fantasies. Diasporans live in the mythical homelands of their forefathers

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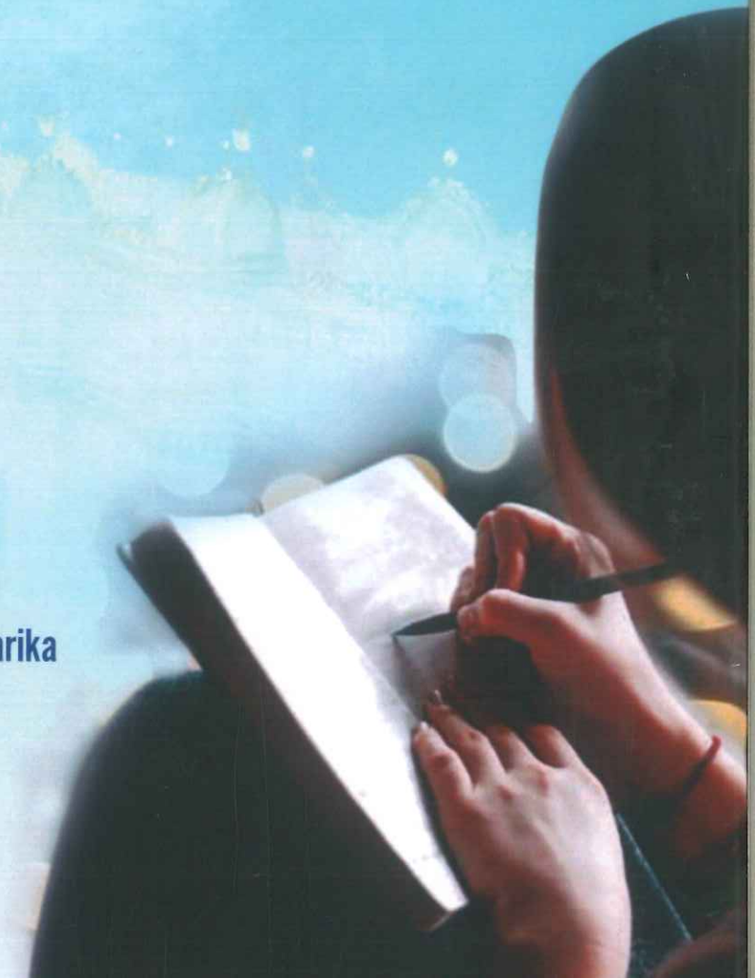

8

Identity Conflicts in Diaspora Communities

Priya Raghav and **Vandana Kaushik**

The concept of 'Diaspora' refers to the physical dispersal of the Jews all over the world from Palestine. The Webster's dictionary defines Diaspora as people settled far from their ancestral homelands. The double consciousness that people from most diaspora communities face has led to the emergence of hybrid identities. However their fate like *trishanku* is conflicted. This is something that has been well documented in literature and films. When confronted with an alien environment there are those for whom home becomes an imaginary utopian dream. The anguish to find one's roots and origin comes from being rejected as an outsider or the other. The desire of belonging somewhere, the desire of an individual to claim a country as his/her homeland is inherent in everyone. Diasporic communities are in that in between space where they are caught up between two cultures, two languages, two nations and a fractured identity. They can neither belong to the country they originated from nor can they completely assimilate with the new one. Like Salman Rushdie writes, 'Imaginary Homelands' is all about the feeling of belonging nowhere. Thus in this paper I will try to map out how complex and significant the idea of identity is for diasporic communities specifically in context of globalisation.

Introduction

The story of the Indian diaspora can be traced back to the colonial period, when the British sent Indians across their empire for various purposes. Indians worked as indentured laborers, civil service workers, or small merchants for the British. The aftermath of World War II, saw Indians migrating to various parts of the world for work, education and a host of other reasons. The Indian Diaspora is a generic term used for referring to people who have migrated from the territories that are currently within Republic of India. It encompasses NRIs (Non-resident Indians) and PIOs (Persons of Indian origins). The Indian Diaspora is estimated to be over thirty million. The importance of Indian Diaspora is significant, as it has brought economic, financial, and global benefits to India. The Indian Diaspora currently constitutes a powerful, and in some respects unique, force globally.

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ISBN-10: 9-19-875810-1
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DIP: 18.10.9198758101.001

PROBLEMS OF DEVELOPMENT OF LOWER-CLASS WOMEN

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❖ ABSTRACT:

Women have made significant contributions in many ways to the agricultural system of agricultural India. Men as well as their rural economic activities have a huge role to play. But women do not get as much wages and respect as male farmers or workers. In particular, lower-class women in many cases play a major role in the family production system and economic activities. In many cases they participate in economic activities as a complement to the family. But in terms of Indian census or other criteria, women have been repeatedly neglected. That is why we see that even if women participate in a large number of economic activities, or do a lot of work as a complement to men, in many cases they are not considered as workers. As a result, women are being identified as unemployed in economic terms. This research article highlights the barriers to women's develpoment and why they are neglected.

Keyword: *Agricultural system, Obstruction of women, Peasant-workers, Humiliation of women*

Indian lower-class women have been engaged in various manufacturing and financial occupations since ancient times. In ancient India, ‘Shudra’ women engaged in various financial activities, including animal husbandry and agriculture, and shared the financial responsibilities of the family with their husbands. There are many instances where the responsibility of repaying the debt of the husband fell on the wife. It is mentioned in Kautilya's Arthashastra.[1] Lower class women have saved upper and middle class families from being employed in various financial

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occupations and have also helped in maintaining economic balance in the society.

The vast majority of women workers employed in various sectors of the Indian economy still come from the lower castes. Although upper-middle class women are now employed in various productive and financial jobs, they are only a fraction of the female workforce.[2]According to the 1991 census, 51.56 % of males and 22.73 % of females in India are workers who are engaged in various productive activities in the economy of the country. And according to the 2001 census, 52% of male workers and 26% of female workers, the percentage of female workers here is much less than that of male workers. Because many women engaged in productive work have been shown as unemployed in the census report. These workers are further divided into 'non-workers' and 'marginal workers'.Those who have been employed for 183 days or 6 months in the previous year are 'mainly employees' as defined in the census report. And those who were employed less than 183 days in the previous year are 'marginal workers'.

Table-1
Percentage of all India Women & Men, 1991 & 2001

Men 1991	**Women**	**Men 2001**	**Women**
Workers 51.56	Workers 22.73	Workers 52.0	Workers 26.0
Mainly workers 50.62	Mainly workers 16.48	Mainly workers 87.3	Mainly workers 57.3
Marginal workers 0.94	Marginal workers 6.25	Marginal workers 12.7	Marginal workers 42.7

[Source: Census of India, 1991, Series:8 Paper 1 of 1991, Supplement; Census of India 2001, Series 1, Primary Census Abstract, Total Population.]

Table-1 shows that between 1991-2001, the percentage of female 'mainly workers' increased slightly more than 3 times, but the percentage of female 'marginal workers' increased almost 7 times.And in 2001, the rate of female 'marginal workers' (42.7 %) was three and a half times that of male 'marginal workers' (less than 183 days a year as temporary and contract workers) (12.7 %). This means that most of the female workers

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are contract and temporary workers, whose work has no security. There is also no doubt that a large proportion of women workers belong to Scheduled Castes/Scheduled Tribes and Other Backward Classes, although the latest accurate average figures for the whole of India are not available.A quote from the National Sample Survey (1977-78) is pertinently quoted here, *"The workforce participation rate among the SC/ST women is much higher compared to women from other castes and there is evidence of higher incidence of casual labor amongst these women."*[3]

Table-2
Percentage of Women & Men Workers of North-eastern India

Region	Men **1981**	Women	Men **1991**	Women	Men **2001**	Women
All India	52.67	19.67	51.56	22.73	51.9	25.6
Arunachal	58.63	45.67	54.21	39.61	50.6	36.5
Meghalaya	53.96	37.49	49.09	36.69	48.3	35.1
Mizoram	52.54	37.72	54.37	43.94	57.3	49.5
Nagaland	52.58	43.20	48.61	39.25	46.7	38.1
Manipur	46.40	39.48	45.36	37.50	48.1	39.0
Sikkim	57.22	37.61	53.60	52.74	59.4	38.4

[Source: Census of India, 1991, Series8: Paper 1 of 1991, Supplement; Census of India 2001, Primary Census Abstract, Total Population.]

Everyone knows more or less about the hard work of Scheduled Caste (Indigenous) women.Table-2 shows that the average rate of women workers is much higher than the average of women workers in the hill states of north-eastern India inhabited by tribals. In 1991, Meghalaya had the lowest rate of female workers among the 5 indigenous hill states, at 36.69 per cent. But even this lowest rate is much higher than the average rate of female workers in India (22.73%). The highest female worker rate in Sikkim is 52.74 %. This rate is almost equal to the percentage of male workers there (53.60%) and more than double the average rate of female workers across India. However, it is noteworthy that the average rate of female workers in Sikkim has increased significantly between 1981 and 1991. Between 1991 and 2001, the number of male workers in India increased slightly, but the rate of female workers increased significantly. In 2001, the female labor rate (49.5%) was highest in Mizoram. Thus, a large proportion of working women in this country are employed in 96%

ISBN: 978-91-987581-0-8

of the unorganized sector, of which agriculture and agric-related manufacturing are the major sectors.

Table-3
State-wise percentage of Women & Men Workers rural areas, 1981, 1991 & 2001

State		Farmer			Agricultural workers		
		1981	1991	2001	1981	1991	2001
Andhrapradesh	Men	45.08	39.07	34.30	31.46	37.29	34.20
	Women	25.71	24.55	27.40	62.02	63.23	53.60
Bihar	Men	51.92	50.82	37.20	33.69	36.13	42.70
	Women	26.73	33.05	24.20	65.61	60.12	62.70
Gujrata	Men	54.15	49.49	44.50	23.72	24.57	3.30
	Women	34.61	35.48	33.30	53.74	49.84	34.70
Hariyana	Men	55.48	49.78	46.90	19.15	23.52	12.80
	Women	59.39	57.17	51.90	25.72	29.04	12.70
Punjab	Men	48.81	46.11	39.08	28.12	30.32	19.90
	Women	09.72	28.03	16.10	42.59	34.09	14.30
Orissa	Men	56.91	54.52	44.40	24.70	25.37	30.00
	Women	26.26	27.77	30.60	57.21	57.50	37.20
Tamilnadu	Men	43.82	37.82	31.70	30.95	35.89	30.06
	Women	28.50	24.63	29.20	60.07	59.80	46.30
West Bengal	Men	42.87	40.84	30.05	31.79	30.00	27.10
	Women	18.09	20.22	14.30	48.44	45.47	30.00
India	Men	55.03	51.61	45.20	24.19	24.19	23.10
	Women	36.94	38.58	41.50	50.36	48.43	35.60

[Source: Census of India, 1991, Series:8. Paper 1 of 1991, Supplement; Census of India 2001, Series 1, Primary Census Abstract, Total Population.]

According to the 1991 census, 80% of rural workers are engaged in agriculture, which accounts for about half of the national income. There was no significant change in 2001 either. And most of the women workers are associated with this agriculture. But the surprising thing is that the actual evaluation of the contribution of women in the agricultural economy has not been done even today.[4] Table-3 shows that in 1991, 87.01% of female workers in rural areas were involved in agricultural

ISBN: 978-91-987581-0-8

production, while 78.09% of male workers were involved in agriculture.In other words, the employment rate of female workers is much higher than the employment rate of male workers in agriculture in rural areas. But 38.58 % of the women workers engaged in agriculture are farmers and 48.43 % are agricultural workers. Among the male workers, 51.61 % are farmers and only 26.48 % are workers. In other words, the percentage of female workers in agriculture is almost double that of 48.43 % of male workers (26.48). In 2001, the percentage of males (45.) was less than that of females (41.5). The percentage of female agricultural workers (35.6) is much higher than the percentage of male workers (23.1).

It is to be noted here that even if a person is a landless shareholder or supervises the cultivation without any cultivation, he is considered as a farmer in the census report. He has been caught as an agricultural laborer if many people work on the land only for exchange of wages.[5] Many times when men in rural areas are engaged in various alternative jobs in urban areas, women are the ones who supervise the cultivation with the help of laborers and grow crops on the family land. According to the definition, these women also fall into the category of wage farmers. However, according to Table-3, in the three decades of 1981, 1991 and 2001, the main position of women in agriculture was as laborers, not as farmers.

There are, of course, many differences in the rates of agricultural labor in different states, such as in the employment of different castes and classes. In rural areas of Andhra Pradesh, Bihar, Orissa and Tamil Nadu, in 1981 and 1991, more than 55% of women workers were laborers. In 2001, more than 50 per cent women workers were employed in Andhra Pradesh.The percentage of women workers in Bihar was the highest (62.7 %). In fact, the percentage of women workers largely depends on the economic status of different states, class differences and the rate of female education.

The percentage of women workers in West Bengal in 1981 and 1991 was 48.44% and 45.47% respectively. In 2001, West Bengal had 14.3 % female farmers and 30 % laborers. Compared to other states, the percentage of women farmers and laborers is moderate.However, many of these women workers are marginal workers who have the opportunity to work 183 days a year or less for six months. Most of the female workers work only during the growing season, usually from April to July. Other

ISBN: 978-91-987581-0-8

times they have to look for alternative jobs. And for this purpose, women often have to move to urban areas.

Usually men plow the land, level the land, irrigate, apply chemical fertilizers, and sometimes sow the seeds. The cleaning of weeds, re-planting of seedlings, re-planting of green manure, dung manure, harvesting of crops, taking of crops home by head, sifting of crops, sorting are usually done by women.[6] The work of clearing weeds and planting seedlings elsewhere is generally considered to be the work of women.These two things are not usually done by men. However, sometimes men also do other work specific to women.

However, one thing to note is that according to the definition of the census report, women engaged in domestic work fall into the category of 'non-workers'. As a result, many women involved in agricultural production have been left out of the 'workers'. But a lot of women's agricultural work falls into housework and general household chores.[7]The percentage of women workers is bound to be much higher than the rate shown in the census report if women are involved in these activities related to home based agriculture. Thus it can be said that the census has devalued the work of women as agricultural laborers.

Many of the women's work in agriculture are housework. For example, women usually do housework, drying, warehousing, drying hay, as well as cooking for wage laborers in a farming family.In other words, in a farming family, a lot of work related to farming belongs to women's household. But these household chores directly involved in agriculture are not considered productive work in the census and these workers are called 'non-workers'. But there is no denying that these 'unemployed' or unpaid women have a special role to play in increasing agricultural production.

It has been seen that the exchange value of different work based on home is a lot.If the work related to farming is done standing in the field, it will be 'employed', and if the work related to production is done within the family, it will be housework and 'unemployed'. Needless to say, it is not reasonable to accept such an argument. But through this the contribution of women in agricultural production is being underestimated. There is no denying that the less time men have to work in the field and the less fruit they produce as a result of not doing these things in the

ISBN: 978-91-987581-0-8

family, the greater the contribution of these women to agricultural production.

Besides, women have to cook for the whole family at home, gather wood, leaves or fuel for cooking, deliver food to the field for men, etc. There are also many other household chores such as caring for cows and calves, feeding, etc.[8] The labor and time spent by women in these activities to keep the agricultural economy alive is no less valuable. If men did these things instead of women, both agricultural production and family income would be less.However, the position of these women in the agricultural economy is 'non-workers' and their identity as unpaid workers.

Table-4
State-wise percentage of Women & Men Workers, 2001

State	Farmer		Agricultural workers	
	Men	Women	Men	Women
Andhrapradesh	11.4	7.1	59.1	79.2
Assam	32.7	36.8	11.0	18.0
Bihar	08.7	06.6	74.0	84.0
Gujrata	10.9	09.9	31.0	53.9
Hariyana	07.4	09.2	36.7	53.2
Kerala	01.8	01.4	30.9	39.0
Madhyapradesh	28.7	24.0	35.3	53.6
Maharastra	12.6	13.4	35.2	61.7
Punjab	04.0	3.4	39.1	36.4
Orrisa	21.9	10.7	39.7	57.9
Tamilnadu	11.1	09.1	50.6	69.4
West Bengal	20.9	12.9	35.0	45.7
India	21.0	18.1	39.2	57.4

[Source: Census of India, 2001, Primary Census Abstract, Total Population SC/ST.]

It is also worth mentioning that the role of Scheduled Caste women in agricultural production is evident in Table-4. According to Table-4, the percentage of scheduled men and women involved in 2001 work in India is 60.2 % and 75.7 % respectively. But it should be noted that only 18.1 % and more than 57 % of the scheduled women are agricultural laborers. Among the states, except Assam and Rajasthan, the rate of female farmers is much lower than the rate of scheduled male farmers and the rate of

ISBN: 978-91-987581-0-8

female workers is much higher than that of male workers. In other words, even among the Scheduled Castes, the predominance of women workers is more than that of men.

Most of the Scheduled Caste/Scheduled Tribe women are not allowed to work on their own family lands and are forced to work in other lands for wages. Lack of own family land, extreme poverty and lack of alternative employment are responsible for this. And this is why Scheduled Caste/Scheduled Tribe people, especially women, are arbitrarily exploited and oppressed by landowners. In the plain states, there is a shortage of female farmers compared to males and a large number of female laborers, but in the hilly areas inhabited by the tribals, another picture is observed. Here men and women are almost equally involved in farming. Among the inhabitants of the hill country there is still a custom of clearing the forest and making land in some places. Although these tasks are usually performed by men, in some cases women and children are also involved. In addition, women do the work of clearing weeds and sowing seeds, harvesting crops, sweeping crops, uprooting tree trunks and carrying loads of burnt wood elsewhere. There is also work to be done until the crop is stored in a specific room made of leaves.[9] When women are engaged in these activities, men are again engaged in burning trees in new lands or clearing the land for cultivation. So it can be said that women are involved in work on par with men. Even women are seen plowing the land.

❖ CONCLUSION:

Therefore, in the context of this discussion, it can be said that slave laborers belonging to Scheduled Castes/Scheduled Tribes are the most miserable among the workers in the agrarian economy. Moreover, despite the abolition of the slave labor law in 1976, in practice, the status of slaves and workers is less in states other than Kerala and West Bengal.The money and resources provided for the rehabilitation and technology of slave labor are so scarce that the workers who have been legally released from slavery have to return to the old landlords and lenders because of their poverty. And not only the returning male workers, but also the female workers have to work with the male workers as slave workers.[10]

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.002

EDUCATIONALLY BACKWARD: SIGN OF POVERTY

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❖ ABSTRACT

Education is a tool for empowerment. Access to quality primary education is a major concern in India. Education is an imperative area that is essential for the progress and development of individuals, society, and nations. Individuals, who are residing in the conditions of poverty often encounter various impediments within the course of the acquisition of education and development of literacy skills. The impact of poverty on education is mainly considered unfavorable, but measures are required to get implemented to alleviate the barriers that arise due to poverty within the course of the acquisition of education.

'Poverty is man-made, not God-given' is a famous saying in the world. . Even after 73 years of independence the people of India particularly weaker sections, vulnerable and poor experience every day the basic amenities of life. Tendulkar Committee and Ranga Rajan Committee reports reveal that more than 70% of the people in India are still impoverished. Noble economist Amartya Sen transformed the development agenda by re-conceptualizing poverty as a matter of capabilities such as literacy and access to health care rather than a lack of income.

Education provides a foundation for eradicating poverty and fostering economic development. It is the groundwork on which much of the economic and social well-being of the citizens is built. Education is the key to increasing economic efficiency and social consistency, by increasing the value and efficiency of the labor force and consequently raising the poor from poverty. This paper is aimed at contextualizing the role of education in advancing economic development and thereby alleviating poverty.

Keywords: *Backward classes, Impoverished, Illiteracy. Poverty, Unemployment.*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

Children belonging to poverty-stricken families, who lack the basic resources and necessities live in an unsafe and polluted neighborhood, they are deprived of environments that are supportive of learning. Poverty has adverse effects on the cognitive development of individuals. The increasing standardization, de-skilling, and control of the teacher's work are viewed to have unfavorable effects upon the education of the students, who have undergone multiple deprivations because of poverty and social disadvantage. The children, who reside in the conditions of poverty have slower cognitive and social development and are deprived of physical or mental health. For the poverty-stricken and most socially excluded children, like those from the traveling community, the lack of culturally appropriate education can make these difficulties even larger. So, it is inevitable that children belonging to the families that are living in poverty will experience different challenges at school to those faced by those children coming from families that are not living in poverty or are well off." "The families, who belong to deprived, marginalized and socio-economically backward sections of the society, usually experience problems in getting their children enrolled in schools, instead, they compel them to work and contribute in the sustenance of living conditions. These individuals have recognized the significance of education, but their major problem that proves to impede within the course of the acquisition of education is lack of resources. Poverty is regarded as an impediment within the course of social, cultural, economic, political, and educational development. In the present world, education is regarded as important in the elimination of the conditions of poverty.

Other Backward Class (OBC) "is a collective term used by the Government of India to classify castes that are educationally or socially disadvantaged. It is one of several official classifications of the population of India, along with General Class, Scheduled Castes, and Scheduled Tribes (SCs and STs). "The indirect effect of education on poverty is important concerning human poverty, the reason being, as education improves the income, the fulfillment of necessities becomes manageable and increases the living standards which means, decline in human poverty. The education indirectly helps in the accomplishment of basic needs like water and sanitation, utilization of health facilities, shelter, and it also affects the women's behavior in reproductive decision making and family planning."

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❖ FACTORS OF POVERTY:

The causes of poverty are many and complex. Various factors contribute the poverty i.e. economic factors, social factors, and geographic factors. The financial backwardness, low productivity, low income, poor infrastructure facilities, lack of institutional credit, inequalities in income, and indebtedness et., constitute economic problems causing poverty. Apart from economic factors, illiteracy, high population growth, immobility of people, unemployment, discrimination, social exclusion, traditions, and custom are considered as social factors. Geographical factors like natural calamities, droughts, unfavorable climatic conditions, the absence of natural resources, etc. play a crucial part in making communities relatively poor.

❖ SIGNIFICANCE OF EDUCATION:

Education assists in the development of knowledge and skills amongst individuals. With the acquisition of knowledge and development of skills, they can acquire various types of employment opportunities. The individuals, who are educated and possess adequate knowledge will be able to enhance their wages and hence lead to the elimination of poverty, therefore, the higher the level of education, the lesser will be the number of poverty-stricken persons. The direct impact of education on reducing poverty is through the increase in wages.

Fulfillment of Basic Necessities – The fulfillment of necessities is essential for individuals, belonging to all categories and backgrounds. An educated person can fulfill the basic requirements of housing, food and nutrition, civic amenities, health, cleanliness, education, and other requirements. They generate awareness amongst themselves to create means to meet their basic needs and requirements."

❖ CONSTITUTIONAL OBLIGATIONS OF THE STATE:

Poverty should be addressed by the state because it is painful not only for the poor but for the larger society of which they are part. When Sen viewed the concept of impoverishment in capabilities approach, in comparison to Sen, the other major exponent of the capabilities approach Martha Nussbaum has devised a list of capabilities, which she believes in integral to a free and just society. She seeks to make education compulsory on the basis that is a function rather than a capacity

In the preamble, Justice is not seen as un-dimensional, viewed as having implications across political, economic, and social spheres. Economic justice implies the ultimate eradication of poverty, equal

opportunities, and fair wages. Improvement in impoverished status in society can be done only by educating them, providing work, and inculcating awareness about themselves.

Article 38 of the Indian Constitution enjoins upon the State to strive to promote the welfare of the people by securing a social order in which justice, social, economic, and political shall inform all the institutions of national life and to minimize inequalities in income, status, facilities, and opportunities not only amongst individuals but also amongst groups of people.

Article 39 directs the State inter-alia to secure to the citizens the right to adequate means of livelihood; that the ownership and control of material resources of the community are so distributed as best to subserve the common good; that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment; that the children are given the opportunities and facilities to develop in a healthy manner and conditions of freedom and dignity and that childhood and youth are protected against exploitation and moral and material abandonment.

Article 43 of our Constitution has also adopted as one of the Directive Principles of State Policy that: "The State shall endeavor to secure, by suitable legislation or economic organization or in any other way, to all workers, agricultural, industrial or otherwise, work, a living wage, conditions of work ensuring a decent standard of life and full enjoyment of leisure and social and cultural opportunities. ". This is the ideal to which our social welfare State has to approximate in an attempt to ameliorate the living conditions of the workers

Under Article 340 of the Indian Constitution, the government must promote the welfare of the OBCs. “The president may by order appoint a commission consisting of such persons as he thinks fit to investigate the conditions of socially and educationally backward classes within the territory of India and the difficulties under which they labor and to make recommendations as to the steps that should be taken by the union or any state to remove such difficulties and as to improve their condition and as to the grants that should be made, and the order appointing such commission shall define the procedure to be followed by the commission. A commission so appointed shall investigate the matters referred to them and present to the president a report setting out the facts as found by them and making such recommendation as they think proper.”

ISBN: 978-91-987581-0-8

❖ NATIONAL COMMISSION FOR BACKWARD CLASSES:

"India's National Commission for Backward Classes is a constitutional body (123rd constitutional amendment bill 2017 and 102nd amendment 2018 in the constitution to make it constitutional body) (Article 338B of the Indian Constitution) under India's Ministry of Social Justice and Empowerment established on 14 August 1993. It was constituted according to the provisions of the" National Commission for Backward Classes Act, 1993

❖ RESERVATION POLICY:

"The Mandal Commission adopted various methods and techniques to collect the necessary data and evidence. To identify who qualified as an "other backward class," the commission adopted eleven criteria which could be grouped under three major headings: social, educational, and economic.

Social:

- Castes/classes considered as socially backward by others
- Castes/classes which mainly depend on manual labor for their livelihood
- Castes/classes where at least 25 percent females and 10 percent males above the state average get married at an age below 17 years in rural areas and at least 10 percent females and 5 percent males do so in urban areas.
- Castes/classes where participation of females in work is at least 25 percent below the state average.

Educational:

- Castes/classes where the number of children in the age group of 5–15 years who never attended school is at least 25 percent above the state average.
- Castes/classes when the rate of student drop-out in the age group of 5–15 years is at least 25 percent above the state average
- Castes/classes amongst whom the proportion of matriculates is at least 25 percent below the state average

ISBN: 978-91-987581-0-8

Economic:

- Castes/classes where the average value of family assets is at least 25 percent below the state average
- Castes/classes where the number of families living in kutcha houses is at least 25 percent above the state average
- Castes/classes where the source of drinking water is beyond half a kilometer for more than 50 percent of the households
- Castes/classes where the number of households having taken consumption loans is at least 25 percent above the state average.

The Right of Children to Free and Compulsory Education Act,2009(RTE) was enacted in 2009 to provide free and compulsory education to all children between 6 and 14 years of age. It was subsequently amended in 2014, 2015, and 2017. The legislation follows from the 88th Constitutional Amendment of 2002 that recognized the right to education as a fundamental right. It directs the central and state governments as well as the local authorities to work together to ensure that all children (aged 6-14) have access to quality elementary education free. It holds the relevant governments responsible for the availability of funds, infrastructure, teachers, syllabi, and so on. Interestingly, the Act requires all private schools to reserve 25 percent of their seats for students who live in the vicinity and are from the weaker sections of society. It prohibits unrecognized schools from practice, bars charging capitation fees or donations for admission, and forbids children from being expelled, held back, or required to pass a board exam till the completion of elementary education.

❖ CONCLUSION:

India has long struggled with its past. The same goes for a large part of the population of India, those that have historically been less well-off and have yet to be able to take full advantage of the modern systems in place across the country. Deep-rooted prejudices and practices have been difficult to weed out, even with the intensive studies and judgments in place. With progress being made in one direction, a small portion of those that are being catered to can be observed hoarding the resources and creating a further layered entrenchment of the haves and have-nots. Systemic implementation of the vast number of recommendations made by the intensive studies done across the last half-century is yet to reach its peak, signaling administrative lethargy even today. India should enact

ISBN: 978-91-987581-0-8

single-window comprehensive legislation dealing with all issues related to economic policies to overcome the pathetic situations by the impoverished. Progress of the Nation will not alone accomplish much unless it is combined with measures designed to promote the participation of the poor community initiative in the implementation of education policies backed with a strong coalition of the poor could make a significant difference. Therefore, to successfully attain the goal of reduction of impoverishment set by the 2030 agenda for millennium sustainable development, it is required to make innovative ideas, systems, and action plans from the perspective of integrating poverty reduction, human rights, and development.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.003

ACHIEVING SUSTAINABLE DEVELOPMENT THROUGH ENVIRONMENTAL MANAGEMENT IN NORTHEAST INDIA WITH SPECIAL REFERENCE TO ASSAM

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❖ ABSTRACT:

From the 2nd half of the 20th century, the issue of sustainable development became a matter of international concern. The environmentalists, statesmen, policy makers, and organizations for environmental protection, have much concern to the matter of achieving sustainable development as it is related to the survival of humans as well as all other living beings. In the modern age of science and technology, industrialization has assumed a key position in the development of a country. Just for the sake of environmental protection, no nation can stop industrialization at the cost of progress and development. For speedy development, industrialization has to be expanded. In this juncture, it is believed that sustainable development can be achieved through environmental management, i.e., mobilization and holistic and efficient use of natural resources. Proper planning, management and use of resources can be helpful in removing a country's poverty to a greater extent and will be helpful in maintaining ecological balance.

India's northeastern region is endowed with vast natural resources supplemented by topical, subtropical and temperate climate. It is expected that by holistic utilization of these resources sustainable development can be accelerated in this region.

This paper attempts at studying the issue of sustainable development and environmental management in the context of North East India with special reference to Assam.

Keywords: *Environmental management, sustainable development, resources, Northeast.*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

One of the biggest challenges facing the world is environmental degradation supplemented by numerous factors. India is also no exception. From the 2nd half of the 20th century at various levels such as policy making, environmental agencies and voluntary societies, the issue of sustainable development has gained much importance. In simple term, sustainable development stands for the providing materials, goods and services and use of natural resources to the present generation without compromising the needs of the future generations.

In the modern age of science & technology industrialization has assumed key position in the development of a country. To provide food, clothes and shelter to the masses every country is heavily dependent on industrialization. The state of industrialization has categorized the world countries as developed, developing and underdeveloped. In agriculture, contribution of industrialization in bringing out "Green Revolution" in real sense is immense by providing utensils, fertilizers, pesticides, cold storages, transportation and irrigation facilities to increase food production, sugar, milk, medicines, a variety of luxury items, jute, leather, chemicals, cement etc. have lifted living standards of human being to a significant level. However, industrialization has played havoc into our environment and existing natural resources. On the other hand, air, water and soil pollution are gifts of industrialization. Natural forests are dwindling causing drought, flood, siltation of rivers, dams, reservoirs. In this juncture a quarry arises- should the industries be banned? But it is true that no nation can stop industrialization at the cost of its progress and development. What we need to do is the planning for the management of environment and conservation of natural resources for a secured future and sustainable development.

❖ OBJECTIVES OF THE STUDY:

The present study endeavors at addressing the following objectives-

(i) to study the idea of management of the environment,
(ii) prospects of environmental management for sustainable development in Assam as well as Northeast India,
(iii) to make some recommendations for environmental management to ensure sustainable development.

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❖ METHODOLOGY:

The present study is analytical in nature based on secondary sources. Various reference books, journals, articles and websites have been consulted pertaining to the study. All possible efforts have been made to make the study objective and meaningful. Personal observation of the author is also taken into account.

Keeping in mind the objectives, the present study is divided into three parts- Theoretical framework, environmental management in northeast India, and conclusion and suggestion.

❖ THEORETICAL FRAMEWORK:

Environmental planning and management can be defined as the initiation and operation of activities to direct and control the acquisition, transformation, distribution and disposal of resources in a manner capable of sustaining human activities, with a minimum disruption of physical, ecological and social processes. It also implies successful utilizations of the environmental resources and solution of the environmental problems. Followings are the goals and objectives of environmental planning and management-

i. Decrease the entropic effects of economic activities throughout our economic system.
ii. Protect public health and safety and the natural ecosystem from improper handling of resources and residuals.
iii. Stabilize and perpetuate the socio- economic system.
iv. Provide this protection at minimum economic cost (so that management resources are not wasted).
v. Provide these services in as just and equitable a manner as possible.

The nations across the globe are in competition for achieving of their own economic growth and for establishing its hegemony in the international arena. For the fulfillment of the aspirations, all the nations have been paying attention towards the process of industralisation by using available resources without any judicious consideration. During the past few decades, the rapid growth of population and industralisation all over the world have created excessive pressure on the natural resources and thereby total environment of the globe. Human –centric self-centered and aggressive approach of development has damaged the balance of nature at a large extent. This tendency of modern men has caught the attention of the environmentalists, scientists, academicians, social

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workers, policy makers and planners to make the issue of environmental degradation and sustainable development.

The vital importance of the proper management of India's land resources was realised when an exhaustive paper entitled "A charter for the land" was published in "The Economic and Political Weekly" of March 31, 1973. But even after the initiative taken by the then Prime Minister Mrs. Indira Gandhi, little emerged except a directive to State Governments that they should set up State land use Boards under the chairmanship of Chief Ministers. Even recommendations of N.D. Tiwari Committee on the Environment (1980) to set up a Central Land Commission to serve as a policy planning coordinating and monitoring agency "for all issues concerning the health and scientific management of our land resources" failed to find acceptance. The 6th Plan document and the 7th Plan had nothing more to do with the problem.

However, the serious ecological and socio-economic crisis was soon realised and the Central Government constituted three new bodies – (1) the National Wastelands' Development Board(1985) charged with the responsibility of the mounting a massive afforestation programme with the help of the people, (2) the National Land Use and Conservation Board(1986), which was expected to formulate a national policy and a perspective planed for the conservation, development and management of the land resources of the country, and (3) as apex body called the National Wasteland and Land Use Council(1983) which has all Chief Ministers as its members and over which Prime Minister presides.

The National Youth Policy of 2014 has very sincerely considered the participation of the youth in all vital areas for the transformation of social life and protecting the environment. It has emphasized on the promotion of social values for the protection of future of Indian society in specific and global society in general. It has emphasized on sensitizing the youth about the protection and improvement of the environment and developing compassion for the living creatures.

❖ ENVIRONMENTAL MANAGEMENT IN NORTHEAST INDIA:

Northeast India has an image of dense, evergreen, and inexhaustible forests of precious timber, exotic wildlife, home to numerous tribal communities and hides-out of armed insurgents. It is also

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known for its mountains and hills, turbulent rivers, flooded plains, proud and brave hill communities and colourful craftsmen of the river valleys. The region holds the world's record of highest rainfall at a place and also has the wettest zone (Cherrapunji & Mawsynram is in Meghalaya) in the world. It exports its famous Assam tea all over the world. Among its exotic wild species of mammals, one –horn rhino is also a unique creature of its own type. The region is known for quick growth of vegetation because of heavy and recurrent precipitation. Though covered with forests all over the hills and plains, the 'states' as such have limited forests under their direct control and bulk of the forests is under the customary authority of the communities, especially in the hill areas, a right guaranteed by the Indian constitution.

When one glances at the topography of NER, it is indeed a panoramic view and an awe- inspiring landscape, each unit having distinct features of its own. With the fascinating and fabulous environment of this region, it is said that rich potential wealth of mineral resources is lying untapped, ready to be exploited for the people's benefit. Accordingly, the Geological Survey of India (GSI), a Government of India establishment, has taken up the challenge of conducting survey in the scattered area of the region. The findings are quite encouraging. Parts of *Mokokchung, Longleng and Tuensanj* districts of Nagaland have rich deposits of petroleum oil. In the Barail range of Assam, there is thick and well-bedded sandstone (80%) and a thin band of shale (20%) with coal seam (1-2 meter thick) (www.meghelayatimes.into/index.php.cfm). All along the foothills of Assam- Arunachal, scientists have found evidences of rich mineral deposits. These are concentrated in the Sonitpur district of Assam and West kameng districts of Arunachal Pradesh. Sedimentary rocks found in *Ngopa, Khazawl, Champhai and Serchhip* districts Mizoram. The areas which have substantive resources are. Rich deposit of coal and limestone are found in the Upper Assam and the states of Meghalaya. Coal reserves in Meghalaya are estimated to be 63,880 million tones.

Industralisation in the region has not developed successfully and even small-scale industries have not been feasible due to lack of adequate economic infrastructure like transportation, communication and market accessibility. The region's economy remains primarily agricultural. Primitive farm practices of slash and burn cultivation is still practiced in many hill areas, while traditional single farming in the plains continues.

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The Northeastern region has the vast potentiality to produce conventional energy. A major problem with thermal power generation is that of air pollution by stack exhausts. Electrical energy generation by hydro-electric power is non-polluting and uses a renewable source of energy. However, there are several problems associated with the construction of dams on natural waterways. The construction of such dams alters the downstreams ecology as well as that in the lake area behind the dam. Huge areas get submerged. Flora, fauna or any agricultural produce of this land get affected. People and towns in this area have to be removed and reallocated, causing disturbances and sometimes hardships. For example, in their study on Lower Subansiri Hydel dam, Vagholikar and Ahmed found the 'dam submergence zone' falls in the eastern Himalayas. This is an important part of Indo-Myanmar biodiversity hotspot, one of the 25 hotspots in the world, and houses Endemic Bird Areas (EBA) identified by Birdlife International. The 3436 ha of forests to be submerged comprise crucial wildlife habitats and project also envisages building of over 70 km of roads in the region. The submergence area includes four reserve forests in Arunachal Pradesh and one in Assam (Tale Valley Sanctuary, Tale Valley RF, Panir RF, Kamala RF, and Jiadhol in Arunachal Pradesh and Subansiri Reserved Forests in Assam). These are all primary forests with rich wildlife. The submergence area is in the midst of a rich biodiversity zone and part of contiguous forests. The area is also part of an important elephant corridor (Vagholikar and Ahmed, 2003: 26)

Forests play a vital role in influencing our environment and the atmosphere. In the states of N.E. India, the area under forests is much higher than the national average. It is 82.21 percent in Arunachal Pradesh, 30.20 percent in Assam, 77.87 in Manipur, in Meghalaya it is 69.70 percent, Mizoram 86.99 percent, Nagaland 85.83 percent and in Tripura it is 54.79 (Basic Statistics of NER, 2012). Initially forests take carbon dioxide from the atmosphere in the process of photosynthesis and provide us oxygen. A number of forest products become precious assets to our day-to-day life. To fulfill the requirements of industrialization and increasing population forests have paid heavily. Due to indiscriminate deforestation, soil erosion, landslides, siltation of rivers, dams and reservoirs, flood and drought have become common problems of the region.

In the year 2011, the Government of India through the Ministry for the Development of North-Eastern Region (DoNER), Environmental

Management Framework was made for the states of Mizoram, Nagaland, Sikkim and Tripura by initiating "North East Rural Livelihood Project". It focuses on supporting various livelihood activities to increase and sustain income of the poor, especially women in these states. The aim of this programme is to provide alternative livelihood to shifting cultivation as shifting cultivation mainstay of the people in Mizoram and Nagaland and tribal dominated hilly areas of Tripura. On the other hand, subtropical climate of Sikkim not favourable for sustain means of livelihood.

❖ CONCLUSION AND SUGGESTIONS:

For achieving sustainable development, it is felt that environmental management could play a big role. As the region is endowed with vast resources proper utilisation of such resources can bring desired development without compromising the needs of the future generations. In this direction, following suggestions can be made for sustainable development.

1) Environmental planning, management and awareness needs to be created through formal and informal education among all sections of the society. In this venture along with the government, NGOs could play a big role in educating the people in creating awareness and holistic use of natural resources.
2) Massive programmes aimed at the natural regeneration of non-agricultural lands by protecting them against unrestricted grazing should be adopted so as to save the country from recurring and increasing severe floods, drought, growing depletion of the productive capacity of its land resources and stupendous soil run off losses it suffers. Soil conservation works must also be undertaken on all eroding lands irrespective of whether these are under agricultural or other uses. The amelioration of waterlogged and saline lands, the protection of good agricultural lands against diversion to urban uses, the maintenance of the fertility of overworked agricultural soils and the vigorous conservation of whatever, natural forests are still left to us must also figure prominently in a comprehensive programme of land management.
3) Proper emphasis should be given on conservation and plantation of medicinal plants. The subtropical state of Northeast India is the home of a variety of medicinal plants. The states are losing its economic benefit due to lack of awareness and research in this

direction. So, there is an urgent need for conservation and development of agro-technology for the medicinal plants.

4) Agro based industry can be set up in the region for sustainable industry which has economic viability as well as environment friendly. For example, it may be mentioned that Meghalaya is the second ginger producing state next to Kerala in India. Hence ginger processing units can be set up which is an aspect of agro based industry. Soft beverage producing factory could be set up as the state produces an adequate number of bananas throughout the year.
5) Horticultural corps may be a boost for economic potential as being environmentally friendly.

For that micro irrigation programme should be undertaken by the government.

6) Instead of big Hydel project, more small size hydro projects are called mini hydel or micro-hydel, which can be built on small streams and even on canals in the region especially Assam which has a good number of rivers and receives adequate rainfall. It is feared that construction of a big dam will compromise the future of the region as the region is situated in the high Semitic zone.
7) All kinds of waste whether generated during extraction of raw materials, the processing of raw materials, residential, institutional or commercial should transform to productive one. For that desired plan, policy and scientific approach is necessary. The International Conference on Waste Management (1-2 April,2016), namely RECYCLE,2016, conducted by the Indian Institute of Techonology Guwahati addressed the issue of major environmental problems caused by Solid and Liquid waste management. It aimed at making proper strategies and necessary infrastructure for organized waste management.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.004

POPULATION OF INDIA AND PROBLEMS OF OVER POPULATION

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❖ ABSTRACT:

In the world India is one of the densely populated countries. It has about 15% of support to the world population and India's land area is 2.4% of the world land area. In 1950-51 India's population was 361 million. According to 2001 census it was 1,027 million. In the world, India is the second most populated country. It was nearly a fifth of the world's population. The Indian census carried out in 2011 the population of India was exactly 1,210,193,422, which means India has crossed the 1-billion mark. According to the revision of the World Population Prospects In 2019 the population stood at 1,352,642,280. According to UN data In 2020 India population is estimated at 1,380,004,385 people at midyear.

On Monday, December 6,2021The current population of India is 1,399,346,585. In the total world population, India population is equivalent to 17.7%. India ranks number 2 in the list of countries by population. In India the population density is 464 per Km^2. The urban population is 335% it is equal to 483,098,640 people in 2020. Assamese, Bengali, Gujarati, Hindi, Kannada, Maithili, Marathi, Malayalam, Odia, Punjabi, Telugu, Tamil and Urdu are official spoken language in India.

The world's population is increasing mainly due to increases in agricultural productivity and medical advancements. Brazil, China and India add more to their woes by neglecting substantial increases in their populations. Many people are already aware of overpopulation due to social and environmental problems, but only a few are aware of its adverse effects on health. It's not just India's struggle, China and Brazil are also coping with the ramifications of overpopulation.

***Keywords**: India Population distributed by States and Union territories, highest population Countries, highest and lowest growth rate in 2021, Problem and steps to control the overpopulation in India.*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

India is a large country and most people are ignorant and illiterate who live in backward areas. India has more than 50% of its population below the age of 25 in 2020 and more than 65% below the age of 35. The average age of an Indian is 29 years compared to 37 for China and 48 for Japan.

India has more than two thousand ethnic groups, and every major religion is represented, as are four major families of languages are Indo-European, Dravidian, Austro-Asiatic and Sino-Tibetan languages as well as two language isolates the Nihali language spoken in parts of Maharashtra, and in parts of Jammu and Kashmir people spoken the Burushaski language. 1,000,000 people in India are Anglo-Indians and 700,000 United States citizens are living in India.

The population growth rate depends on the difference between the birth rate and the death rate. In India can largely be explained by variations in birth and death rates. The death rate continued to fall over the entire plan period. But the birth rate continues to remain high by current standards. As a result there has been a net addition to the size of the population. India's demographic trends during the last five decades reveals that the death rate has fallen much faster than the birth rate.

In India, the sex ratio has been estimated a number of methods and data set including the National Family Health Surveys (NFHS), the Decennial Censuses (DC), the Sample Registration System (SRS), the Civil Registration System (CRS), and the Health Management Information System (HMIS).

The sex ratio was 940 females for 1000 males in 2011 and 944 females for 1000 males in 2016. In the last century this ratio has been showing an upwards trend for the last two decades after a continuous decline. In 2011–2013 the Sample Registration System was revealed through a population census with that the sex ratio of India was 909 females per 1000 of males. It has skewed downwards from then, in 2013–2015 recording 900 females and 896 females in 2015-17 per1000 of males. Furthermore, that survey conducted with the SRS also showed Chhattisgarh as the highest sex ratio at 961, Haryana was recorded the lowest at 831. However, sex ratio has moved into a positive direction. According to the latest round of National Family Health Survey 2019-21 India has 1,020 females per 1,000 males.

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INDIA POPULATION PYRAMID IN 2020

Population	1,392,700,250 (April, 2021)
Growth rate	1.1% (2020)
Birth rate	18.2 births/1,000 population (2020)
Death rate	7.3 deaths/1,000 population (2020)
Life expectancy	70.03 years (2020)
• male	68.71 years (2020)
• female	71.49 years (2020)

POPULATION DISTRIBUTED BY STATES

Rank	State	Population	Percent (%)
1	Uttar Pradesh	199,812,341	16.50
2	Maharashtra	112,374,333	9.28
3	Bihar	104,099,452	8.60
4	West Bengal	91,276,115	7.54
5	Madhya Pradesh	72,626,809	6.00
6	Tamil Nadu	72,147,030	5.96
7	Rajasthan	68,548,437	5.66
8	Karnataka	61,095,297	5.05
9	Gujarat	60,439,692	4.99
10	Andhra Pradesh	49,386,799	4.08
11	Odisha	41,974,218	3.47
12	Telangana	35,193,978	2.91
13	Kerala	33,406,061	2.76
14	Jharkhand	32,988,134	2.72
15	Assam	31,205,576	2.58
16	Punjab	27,743,338	2.29
17	Chhattisgarh	25,545,198	2.11
18	Haryana	25,351,462	2.09
19	Jammu and Kashmir	12,541,302	1.04
20	Uttarakhand	10,086,292	0.83
21	Himachal Pradesh	6,864,602	0.57
22	Tripura	3,673,917	0.30
23	Meghalaya	2,966,889	0.25
24	Manipur	2,855,794	0.24
25	Nagaland	1,978,502	0.16
26	Goa	1,458,545	0.12
27	Arunachal Pradesh	1,383,727	0.11
28	Mizoram	1,097,206	0.09
29	Sikkim	610,577	0.05
	Total (India)	1,210,854,977	100

Source: Census 2011 & UIAI for 2021 Estimates

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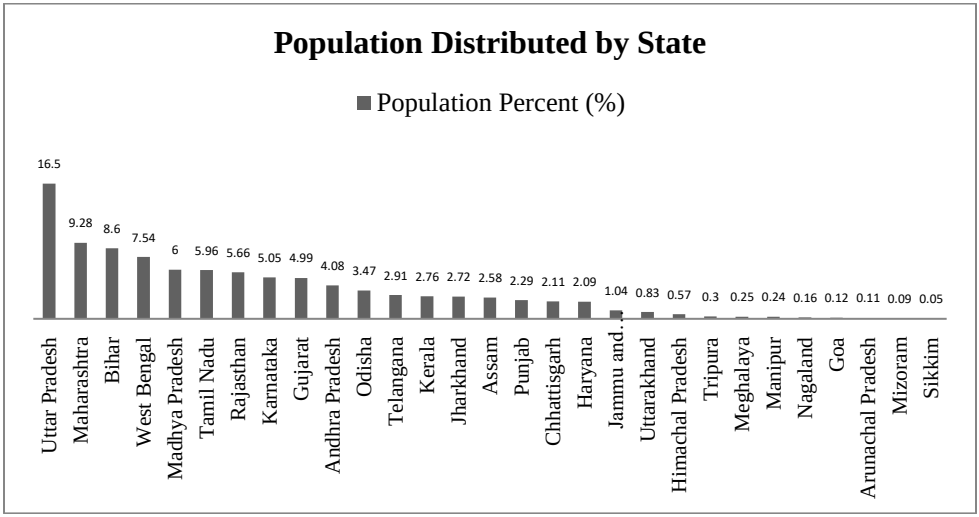

India is a federal union comprising 29 states and 7 union territories. Uttar Pradesh is the largest state by population & Goa is least populated state in India. Let's have a look at the population of States & Union Territories. As per the Unique Identification Authority of India, India's population is 1,371,360,350 approx in 2020. India's 2020 population is estimated at 1,380,004,385 people at mid-year according to UN data.

In India the most populated state is Uttar Pradesh. Uttar Pradesh, Maharashtra, Bihar, West Bengal, and Madhya Pradesh are top 5 populated states in India. In 2011 Maharashtra is at 2nd Spot, but Bihar with a higher growth rate approx 20% is very close to Maharashtra by 2023-24 it will be at the second spot. **India's Population is estimated in 13, 75,586,000 or 1.38 Billion** according to the Census Population Projection Report in 2022.

Almost half of the country's population lives in these five (Uttar Pradesh, Maharashtra, Bihar, West Bengal, and Madhya Pradesh) highest populous states and the 10 most populated states of India contribute 74% of India's population. During this decade Bihar has the highest population growth rate.

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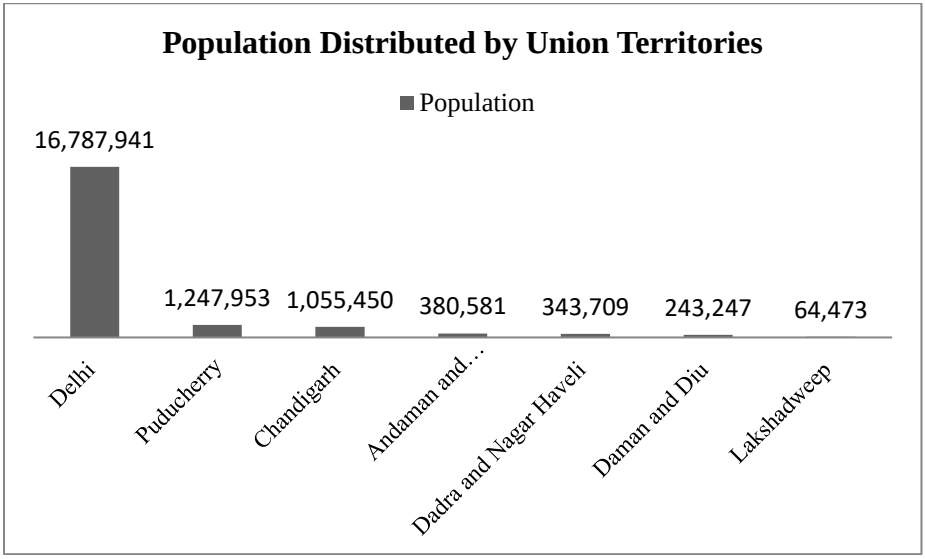
POPULATION DISTRIBUTED BY UNION TERRITORIES

Rank	Union territories	Population	Percent (%)
1	Delhi	16,787,941	1.39
2	Puducherry	1,247,953	0.10
3	Chandigarh	1,055,450	0.09
4	Andaman and Nicobar Islands	380,581	0.03
5	Dadra and Nagar Haveli	343,709	0.03
6	Daman and Diu	243,247	0.02
7	Lakshadweep	64,473	0.01

Source*: Census 2011, UIAI & Census Population Projection report*

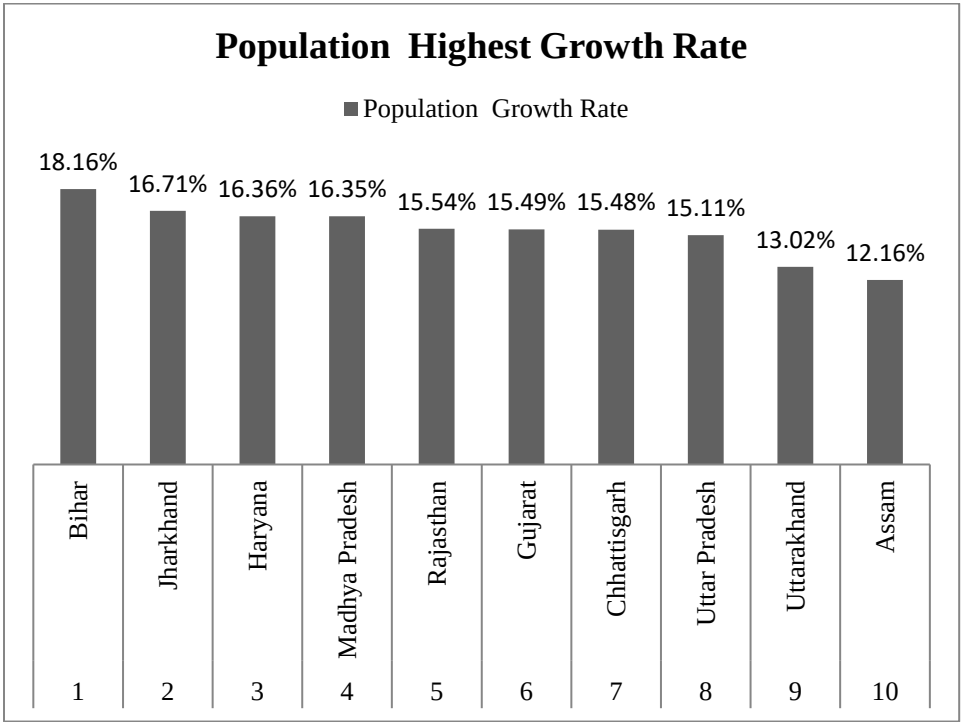


STATES WITH HIGHEST GROWTH RATE 2021

Rank	States	Growth Rate
1	Bihar	18.16%
2	Jharkhand	16.71%
3	Haryana	16.36%
4	Madhya Pradesh	16.35%
5	Rajasthan	15.54%
6	Gujarat	15.49%
7	Chhattisgarh	15.48%
8	Uttar Pradesh	15.11%
9	Uttarakhand	13.02%
10	Assam	12.16%

Source: Census 2011 & UIAI for 2021 Estimates

ISBN: 978-91-987581-0-8



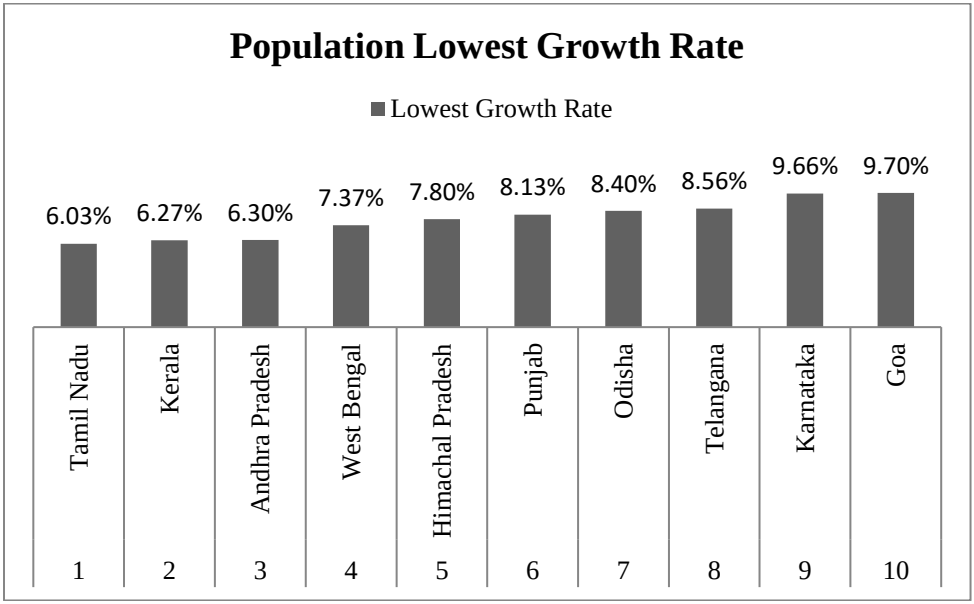
As per estimates in 2011-2021India's growth rate is approx 12.56%. Bihar has the highest population growth rate 18.16% during 2011-2021 followed by 16.71% Jharkhand and 16.36% Haryana.

INDIAN STATES WITH LOWEST GROWTH RATE 2021

Rank	States	Growth Rate
1	Tamil Nadu	6.03%
2	Kerala	6.27%
3	Andhra Pradesh	6.30%
4	West Bengal	7.37%
5	Himachal Pradesh	7.80%
6	Punjab	8.13%
7	Odisha	8.40%
8	Telangana	8.56%
9	Karnataka	9.66%
10	Goa	9.70%

Source: Census 2011 & UIAI for 2021 Estimates

ISBN: 978-91-987581-0-8



As per estimates, in 2011-2021 India's growth rate is approx 12.56%. Ten States have grown at a rate below 10%. In the 2011 census, most of the South & Western Indian States have a growth rate below the national average and in 2021 also they have a low growth rate. Tamilnadu (6.03%) is a state with the least growth rate followed by Kerala (6.27) and Andhra Pradesh (6.30).

❖ COMMON CAUSES LEADING TO OVER POPULATION IN INDIA ARE:

- Still the birth rate is higher than the death rate. We have been successful in declining the death rates but the same cannot be said for birth rates.
- Due to the population policies the fertility rate and other measures has been falling but even then compared to other countries it is much higher.

Our countries which are leading to over population in the above causes are interrelated to the various social issues.

❖ IMPACTS OF HIGH POPULATION:

Due to overpopulation our country scenario is not good, even after 67 years of independence.

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- **Unemployment**

It is very difficult to generating employment for a huge population in India. Every year the number of illiterate persons increases. The unemployment rate is thus showing an increasing trend.

- **Utilization of Manpower**

The number of jobless people is on the rise in India due to economic depression and slow business development and expansion activities.

- **Infrastructure Facilities**

Unfortunately development of infrastructural facilities is not keeping pace with the growth of population. The result is lack of communication, education, housing, healthcare, transportation etc. There has been an increase in the number of overcrowded houses, traffic congestion, slums etc.

- **Utilization of Resource**

Forests, land areas, water resources are over exploited. There is also a scarcity of resources.

Then it causes production decreased and costs increased. Food production and distribution have not been able to catch up with the increasing population and hence the costs of production have increased. The major consequence of over population is Inflation.

- **Distribution of Income**

In the face of an increasing population, there is an unequal distribution of income and inequalities within the country widen.

❖ PROBLEMS ON OVER POPULATION:

- **Universal Marriage System and Early Marriage**

Even though the marriageable age of a girl is legally 18 years, the concept of early marriage still prevails and getting married at a young age prolongs the childbearing age. In India also marriage is a universal practice and a sacred obligation , where almost every woman is married at the reproductive age.

- **Illiteracy and Poverty**

Poverty is the factor for the rapid growth of population. Impoverished families have this notion that more the number of members in the family, more will be the numbers to earn income. Some feel that more children are needed to look after them in their old age. Also, hunger can be a cause of death of their children and hence the need for more children. Strange but true, Indian still lags behind the use of contraceptives and birth control

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methods. Many of them are not willing to discuss or are totally unaware of them. Illiteracy is the another cause of over population

- **Age-old cultural norm**

Sons are the bread earners of the families in India. This age-old thought puts considerable pressure on the parents to produce children until a male child is born.

- **Illegal migration**

Last but not the least we cannot ignore the fact that illegal migration is continuously taking place from Bangladesh, Nepal leading to increased population density.

❖ STEPS TO CONTROL POPULATION IN INDIA:

- Increasing the welfare and status of women and girls.
- Spread of education and sex education
- Increasing awareness for the use of contraceptives and family planning methods.
- Encouraging male sterilization and spacing birth.
- Free distribution of contraceptives and condoms among the poor
- Encouraging female empowerment.
- More health care centre for the poor
- Major steps which have been already implemented but still need to be emphasized more control population.
- A bold population policy should initiate Government of India, politicians and policy-makers so that the economic growth of the country can keep pace with the demands of a growing population.
- Experts are hopeful that by increasing public awareness and enlisting strict population control norms by the Government will definitely lead the way for the country's economic prosperity and control of the population.
- In the global world India's strengths in various fields cannot be ignored, whether it is in science & technology, medicine and health care, business and industry, military, communication, entertainment, literature and many more.

The above steps can play a major role in controlling the population.

❖ CONCLUSION:

Really India is not over-populated because it is a vast country with plenty of natural resources. These resources have not been fully used as yet. The most serious obstacle to the economic development is India's

rapidly growing population. It is not possible to reduce the existing size of population. But it is possible to slowdown the rate at which population is increasing. In spite of the fact that the population policies, family planning and welfare programmes undertaken by the Government of India have led to a continuous decrease in the fertility rate. The overall development of the country and rise in per capita income can go a long way in reducing the rate of increase in population. Already the death rate has fallen to a very low level. There is no scope for reducing it further. But the birth rate continues to be high by current standards. Therefore, in future India's population will be a function of birth rate alone. Excess population is itself a symptom of over-population. This problem is becoming more and more acute day by day due to rapidly increasing population by about 22 million persons a year. So, India is over-populated. It's time for all global forums to provide effective solutions in order to resolve this problem.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.005

IMPACT OF GLOBALIZATION ON POVERTY AND INEQUALITY IN INDIA

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❖ ABSTRACT

There are conflicting views about whether globalization has increased or reduced poverty. Proponents of globalization state that economic progress has been rapid in those countries where globalization has been given priority. Due to the increasing economic cooperation among the countries, progress has been made everywhere, which has benefited all the citizens. This has reduced poverty all around. The opposition side says that there can be no bigger lie than this. They say that the World Bank is the only institution providing statistics on poverty. Its president, says that in the last 20 years (from 1980 to 2000), the number of poor has decreased by 200 million. But on the other hand, the first sentence of the World Development Indicator 2001 is that "1.2 billion out of the world's 6 billion people live on less than a dollar a day". This number was the same in 1987 and it was the same in 1998 as well. The paper tries to produce an analysis on impact of globalization on poverty and inequality in India.

Keywords*: Globalization; Poverty; Inequality; Malnutrition.*

❖ INTRODUCTION

In fact the figures given by the World Bank are misleading. In the nineties, the World Bank has made changes in the basis of the assessment of poverty itself. The poverty criterion has been changed from $1.08 per day to $1.08 per day. Earlier, the assessment was done on the basis of PPP computed in 1985 whereas now the computation has been done on the basis of PPP of 1993. For this reason the two rates cannot be compared and the propaganda of poverty reduction is misleading. The new $1.08

ISBN: 978-91-987581-0-8

condition has reduced poverty in 71 of the 94 countries. In China it is 14 percent and in India it is 9 percent.[1] They say that if we compare poverty in both the old and new rates, then the situation becomes as follows –

BASIS	POVERTY RATE ON OLD BASIS	POVERTY RATE ON NEW BASIS
Sahara South African Region	39.1	49.3
South America Continent	23.5	15.3
West Asia/North Africa	4.1	1.9

The World Bank has also changed the base in such a way that the reporting period of some items has been increased from seven days to 30 days. Along with this, the estimate is high in the computation of PPP and there is a difference between the actual survey. In China, it has been estimated on the basis of estimates only in some cities because there the government refused to conduct a comprehensive survey. India had also refused to participate in the 1993 survey, due to which the calculation has been done on the basis of the 1985 survey itself. The number of people below the poverty line in these two countries is so much that they can have an opposite effect on the world indicator.[2]

Different criteria have also been suggested by the World Bank and by other agencies, depending on which lack of things they would consider as poverty. One premise is that those under $1.25 should be considered poor. Some consider the other two dollars to be necessary to meet the minimum requirement. If 2 dollars is considered, then in 1991 the number of poor will be 2.2 billion. It is necessary that the criterion of poverty should be such which is acceptable to all and it should not be changed for a long time in this or on the basis of survey, so that comparative study can be done.[3]

In this sequence, another parameter is also considered. This is a state of malnutrition. Many studies have been done in this. Malnutrition can be considered as another form of poverty because today there is no ignorance about what are the nutritional elements, which are necessary to be consumed, but to get them economic condition comes in the way. The study is conducted by the Food and Agriculture Organization in relation to

ISBN: 978-91-987581-0-8

malnutrition. The updated report pertains to the period 2012-14. According to this, 800 million people in the world are suffering from malnutrition. The number of these in India is 164 million. In the report of the period 1990-92, the number of malnourished was stated to be 84 crore. This shows that the number has not decreased significantly.[4]

Contrasting opinions are also seen on the condition in which the distribution of income is going on within the countries. There are many types of basis for its assessment such as a). Gross National Product - converted into dollars on a PPP basis; b). Computation by assigning weights to each country on the basis of population; c). the top ten percent of the population compared to the lower ten percent of the population; or d). On the basis of National Income Account. The results will be different in all of these. Then it should also be noted that the value of the dollar has increased in the last decades, as in India in the 1970s, the dollar was equal to eight or nine rupees, whereas today it is around 60. It has to export more goods to pay back the debt. These loans are not repaid on PPP basis but at market rate only.[5]

There is also no consensus among economists about the computation of inequality. There are three methods of computing this –

1) Comparison of the highest and lowest tithe with the middle, also known as the Gini ratio, on the basis of which the disparity among countries has increased (i.e. rich countries have become richer, poor countries more poor).
2) If the entire national income is taken together and each country is treated as equal (India=Uganda), the disparity has increased.
3) Poverty has not increased or decreased if the comparison is made on the basis of population weight.

Some people point out that even though the percentage increase is the same, the actual distance increases, e.g. a one percent increase on $30,000 becomes $300, but a five percent increase on $4000 will also mean $120, which means that the actual difference from the previous $ 26000 increases to $ 26180.

While the average output in the bottom twenty countries during 1960-62 was $212, in the richest countries it was $11,417. (Both figures are based on 1995 dollar price); at the same time, in the period 2000-02,

these figures have increased to 267 and 32,339 dollars respectively. The percentage increase is 26 and 83 percent respectively.[6]

On the other hand it is also argued that there is no importance of comparison of countries among themselves. There is no point in computing the inequality. It should be seen that income is increasing in all countries. The basic question in his view is what the state of inequality within the country is. In this regard, in the 2012-13 study of ESCAPE (Economic and Social Commission for Asia Pacific) of 40 countries of Asia, it has been said that the birth ratio of income inequality in India has increased from 30.8 to 33.9 between 1990 and 2019. . In China these figures are 32.4 and 42.1 and in Indonesia 29.2 and 38.1. Inequality in India has increased but not reduced, it is clear. It is to be seen that India has come a little later in the race of globalization. It can be said that income inequality has increased or at least not decreased due to globalization.[7]

It is generally seen that the rich people of developing countries want to imitate the developed countries in everything. Even their laundry soap should be the same as that used in developed countries. Corruption is used to reach this position. Due to this the whole system of the developing country gets affected. Another effect of this is the migration of people with higher education from developing countries to developed countries. This drain of talent has the opposite effect on the progress of developing countries. It is a profitable deal for developed countries because they get talented people cheaply. We have seen in the past about the claim that globalization is the best way to reduce poverty and inequality, but it can be said that at least this makes the difference clear.

One of the arguments in favour of globalization is that the mutual trade of countries is increasing. The World Bank has conducted a study in which all the countries have been ranked in terms of globalization. The top one-third of countries with more globalization were found to be making more rapid economic progress than the rest. This study is about the difference between 1977 and 1997. One drawback of this study is that countries that showed rapid progress had very low GDP in the base year. Therefore the percentage increase appears to be very high. In macro economies such as China and India, the percentage growth will be less. Globalization in both these countries has also happened at its own slow pace and still there are protective restrictions in them. There are also such

ISBN: 978-91-987581-0-8

countries as Japan, South Korea and Taiwan, which have increased trade only by keeping their economy limited. When he became rich, he took steps to be liberal as is happening in China now.

It is necessary to reflect on what are the reasons behind not being able to remove poverty and inequality. The construction industry is growing in developing countries, but it is seen that as the production in the construction industry increases, its contribution to the gross output decreases. The reason for this is the rapid growth in the service sector. For this reason, the World Bank has also given up talking about the contribution of the construction industry and the emphasis is being laid on the matter of human needs. If the role of the construction industry is limited, what could be another reason? The value of exported goods is decreasing in comparison to the value of imported goods. Due to this, the amount being received by the import-export difference to the developing countries is getting reduced, due to which inequality or poverty is being affected. Many African countries which have an open economy but are largely dependent on exports have to face the adverse situation due to this policy.

It has been observed that most of the sales of the world's largest 500 multinational companies, which are called global, are being done in their home region - North America, Europe or East Asia. These companies are becoming area wide, not worldwide. High-income industries are flourishing only in developed countries. The cost of a skilled worker is 15 percent higher in Germany but it is still a leader in the construction industry. One reason for this is that the contribution of labour is now comparatively less. The relation of second production has become more than the technical knowledge available in the firm, so it is unprofitable to keep more salary people also. Contact with other advanced industries of its level in the developed area also becomes easy. In this way production with less technical knowledge is done in low cost countries and high cost, in which dividend is high, is done in developed areas. Due to this, there is no equality in the mutual inequality among countries due to globalization.[8]

Due to the above reasons and due to migration, developing countries are able to come forward only in less technical areas and globalization cannot be helpful in eliminating inequality. On the other hand, the prices of goods with advanced technology can be kept high, which has to be paid by the developing countries only. Because of this,

only developed countries are getting the benefit of globalization. One aspect of this can also be traced to research going on in technology. Except Japan, this is happening only in western developed countries. Countries like China and India still have to depend on foreign investment. In China, only Taiwan and other foreign technology is being used in production.

There are some other things also worth considering. Information technology is expanding as an alternative to the construction industry. In this, education and technical knowledge are more important. With this, financial services are also expanding. This situation increases the risk of financial flight overnight. A few years back in East Asia, due to this a serious situation had arisen. For this reason, continuous monitoring becomes necessary. It is true that development is necessary to improve the economic condition of the people. In this, the developing countries where cheap land and cheap labour are available, will have their contribution. The time of self-contained economy has passed. But at the same time it is necessary to try to reduce the inequality within the country and among the countries, which is not happening right now. For this, first of all, the methods of computation have to be changed so that only the work of entertainment is not done, but the real progress can be known. Lest the economy be going in the opposite direction like climate change. For this, instead of importing, it will be necessary to give importance to the expansion of indigenous industry. In this the state will have to make a policy of proper national interest. The World Trade Organization will also have to work in such a way that instead of mutual exchange, more facilities are provided to the developing countries.

Globalization is characterized as the seamless cross-border exchange of goods, services, capital, technology, ideas, information, legal systems and individuals. With the increase in globalization it was expected that the benefits of development would reach every section of the society, but at least from the examples of developing countries there is enough evidence that globalization has not resulted inequitable growth.

- **Globalization and increasing inequality**

Globalization has promoted inequality based on gender, class, caste, region, religion and ethnicity in India.[9]

ISBN: 978-91-987581-0-8

For example:

- **Metropolis-Satellite Linkage:** Resources from extremely backward and tribal areas are being increasingly exploited for the development of more developed areas. For example the case of mining in Niyamgiri hills by Vedanta group.
- **Income inequality:** According to Thomas Piketty, income inequality in India has reached its highest level since the year 1922.
- **Inequality in national wealth:** Over the past two decades, foreign development aid from rich countries to poor countries is $50-80 billion a year. Over the same period, about $500-800 billion of illicit funds are transferred from poor countries to rich countries each year.
- **Labour Inequality:** Globalization has created a high demand for cheap labour to increase profits. More than 90 percent of Indian workers are employed in the unregulated unorganized sector.
- **Caste and religion based inequalities:** Globalization and consequently better access to resources of creamy layer or rich people in particular caste category have increased inequalities within caste sub-groups.
- **Impact on Agriculture:** With measures like Green Revolution in agriculture, the rich farmers became richer while the poor farmers failed to get its benefits. Small and marginal farmers account for 85% of India's population and more than 2,00,000 farmers have committed suicide since 1997.
- **Environmental inequalities:** Large scale transportation, use of technology, water bodies polluted by industrialization, expansion in non-sustainable practices etc. are some of the common consequences of globalization, which is worsening the ecological situation by making poor areas more vulnerable.

❖ CONCLUSION:

Globalization has also intensified human trafficking. Thus, it has transformed human beings into commodities which are being bought and sold in international markets. It should be noted that globalization increased various benefits such as better standards of living and better medical facilities, but globalization induced poverty and inequalities have also created unsafe conditions for millions of people.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.006

CAUSES OF POVERTY AND GOVERNMENT SUPPORT TO THE POVERTY IN INDIA

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❖ ABSTRACT:

India is said to be the second largest populate country in the world (1,407,547007- current population- taken at 3:11pm, 21st December 2021), next to China (1,446,238,767- current population- taken at 3:13pm, 21st December 2021). The population is increasing in India, every second and also the birth rate is higher than the death rate. The death rate is considerably reduced in India, but the same cannot be taken for the birth rate. The population is increasing in India because of the early marriage and the girls are married at the reproductive age, as compared to other countries. It is said that poverty also leads to the growth of population as the people think that they need more people to fetch income for the family, and also of the fear that children would die because of hunger. Illiteracy is another factor for the raise in the population as people are not aware of the use of condoms and other preventive measures which are introduced by the government. Objectives of the chapter are (i) to present the Indian population and reasons for poverty, (ii) to present the causes of poverty and (iii) to present steps taken by the government to eradicate poverty in India. This chapter concluded that the poor people are unaware of government schemes and

ISBN: 978-91-987581-0-8

benefits, because the aim of the plan may reach if the beneficiary are aware and utilize in an effective manner.

❖ INTRODUCTION:

India is said to be the second largest populate country in the world (1,407,547007- current population- taken at 3:11pm, 21st December 2021), next to China (1,446,238,767- current population- taken at 3:13pm, 21st December 2021) . The population is increasing in India, every second and also the birth rate is higher than the death rate. The death rate is considerably reduced in India, but the same cannot be taken for the birth rate. The population is increasing in India because of the early marriage and the girls are married at the reproductive age, as compared to other countries. It is said that poverty also leads to the growth of population as the people think that they need more people to fetch income for the family, and also of the fear that children would die because of hunger. Illiteracy is another factor for the raise in the population as people are not aware of the use of condoms and other preventive measures which are introduced by the government. It is said that the women are forced to give birth to children until a male baby is born in their family. The illegal migration is entering into India from Bangladesh, Nepal and from Sri Lanka. The increase in population leads to unemployment, increase in the cost of products, decreased production, unequal income distribution. All these factors lead to the increase in poverty among the people of India. Though the government of India has taken many steps to reduce the population of India by increasing the marriage age of woman to 21, the status of women and girls, empowerment, sex education, family planning, free distribution of condoms among the poor, male sterilization, births spacing, health centers etc for the reduction of population. The main reason of poverty in India may be concluded with the reason of great increase in population. Let us discuss the causes of poverty in India, which is considered to be the main reason for India to be a backward economy. The government has made lots of steps to reduce the poverty of India right from the independence, but hasn't shown a success for the eradication of the same.

❖ OBJECTIVES:

1) To present the Indian population and reasons for poverty.
2) To present the causes of poverty.
3) To present steps taken by the government to eradicate poverty in India.

ISBN: 978-91-987581-0-8

❖ CAUSES OF POVERTY:

It is said that India is rich country inhabited with poor people. The saying emerged as the Indian **resources are under-utilized** such as the water resources are not properly channelized for irrigation, in turn affects the agriculture and the production of the country. As **agriculture** depends hugely on the rainfall which always fails in the seasons, if the water resources are properly taken for agricultural purposes would help India to grown in agriculture. The next is the export of iron ore to other countries like Japan which is not up to the economies, instead that should be done as finished iron products would help the economic development of our nation. As India has got more than 20% of forest resources, the minerals if taken out of it would make the nation grow for the eradication of poverty. We are quite rich in our resources but the problem here is, that it is not utilized properly in the right channel.

The next reason for the poverty of India is that the one fifty of total income of the nation is held by 1% of the Indian population in the year 2021, while its just 13% of the income is held by the last 50% of the Nation's income. Since the **national money is in the hands of a very few people**, the rest of the population is going without any money. Here is a saying that rich becomes richer and the poor becomes poorer. In daily life, messages in newspapers, televisions, journals, articles stating the poverty in India and steps to eradicate the same, but we always lack in taking the first step of wiping of the hunger of the people who are living below the poverty line. The 70% of the population is living in the village, where people depend much on agriculture. Moreover, the flood, famine, cyclone and earthquake also affect the agriculture in our country. Most of the people are illiterate and more than 45% of the Indian population is labour force. The scholars who graduate every year expecting a job is also left without a decent job and also the unemployment is rising in a huge rate. An UN report says that the India of huge population, more than 300 million people living in poverty with no healthy food, hygiene drinking water, sewage, electricity and education. The country is having huge industrial groups and the consumer markets are regulated by few monopolies in the country.

The money that is locked in the Swiss Bank, by the depositors of Indian also made the country poor. Since it is not evenly distributed among the people of India, some are left empty handed in our nation. Though government is taking lots of steps to bring out the money from the bank goes in vain. **The black money**, for which the tax is not paid affects the financial system in the country. Black money is the money which is

earned by means of illegal activities or the money for which the tax is not paid. This money which is got in the form of cash, not taxed, cannot be spent for the development of the economy, instead could be used for underground businesses, that naturally affects the money rotation in the nation, inturn leads the poverty of the people. The Indian government is spending on rural welfare scheme, helps in reducing the national poverty. It is targeted that by the government in eradicating the poverty for all people who live in extreme poverty by the year 2030.

The use of new technology in agriculture is very less in many states of the country unlike in the states of Punjab and Haryana. This will provide more employment opportunities for the poor and the increase in the production of food grains. But since the people depending on agriculture are not rich enough to take loans and to repay the same. Since the usage of technology is not been adopted in the states of Assam, Orissa, Bihar, Madya Pradesh and East Uttar Pradesh, the poverty is also in the increasing phase in India. As a result, the poverty triumphs to a larger extent. Moreover, the Indian government has neglected the public sector investment in agricultural sector, the irrigation system fails to fulfil the need of the agricultural lands, if were adopted would have raised productivity, employment and income for the people who depend on agriculture. So, agriculture has to depend heavily on rainfall which is insufficient for the productivity and the reduction of poverty.

Another important and the leading cause of poverty is the rapid increase in population in our country. Population in India is increasing since 1951 with 36 crores to 140 crores by the end of November 2021, that is more than 80 crore people have been added to the Indian population in the past 70 years since independence. Due to this reason, the available land for per person is decreasing, and the people don't have sufficient land to produce output and fetch income out of it. In this case, the person who is earning in the family is much burdened because he has to carry the whole responsibility of the family members. This leads to lower per capita consumption expenditure which is not enough for meeting the basic needs of a human being, resulting in lower standard of living of the people, lowers savings and investment, lesser employment opportunities, resulting in unemployment. All the above affected the national income and resulted in poverty. In a country, which increases the savings and investment for the capital formation for the development of the nation is reducing, the steps taken for the reduction of poverty is also in a declining phase.

The problem of under and unemployment in the Indian economy is another important reason for the prevalence of poverty in our nation.

ISBN: 978-91-987581-0-8

When the educated graduates are paid less for the qualification, underutilisation of their skills, job and part time. The increase in the unemployment and the poverty are growing together. The unemployment, growing population, excess labour force, low income, low capital formation, low productivity and poverty. In India, a poor cannot sustain with hunger for a longer period, so he takes up a job whichever is available, even getting a low remuneration. The poor, though work very hard for longer period of time, still unable to earn enough money to meet the basic needs.

❖ STEPS TAKEN BY THE GOVERNMENT TO ERADICATE POVERTY IN INDIA:

Government has introduced minimum payment every month for the people living under the poverty line. The minimum requirement is provided by the government by way of ration shops, ensuring the minimum needs of the poor there by solving the poverty problem atleat in a minimum rate.

1) Integrated Rural Development Programme

The integrated rural development programme was introduced in the year 1978–79 and universalized from 2nd October, 1980. Aim of this programme is to provide support to the rural poor in the form of subsidy and bank credit for productive work opportunities through successive plan periods.

2) Jawahar Rozgar Yojana /Jawahar Gram Samriddhi Yojana (JGSY)

The above two schemes National Rural Employment Programme (NREP) and Rural Landless Employment Guarantee Programme (RLEGP) were merged in the year1989, under Jawahar Rozgar Yojana (JRY). The purpose was to generate good work prospects for the unemployed in rural areas by creating economic infrastructure, community and social assets. The old scheme started again with a new name as Jawahar Gram Samriddhi Yojana (JGSY), mainly for rural economic infrastructure programme with the purpose of employment generation.

3) Employment Assurance Scheme

This scheme was launched in the year 1993. It mainly covers drought-prone, desert, tribal and hill area blocks. In the year1997-98, it extended to several other blocks. Employment assurance scheme was planned for creating employment opportunity in the form of manual work when there is no agricultural season. It was expected to lead to the creation of robust economic and social infrastructure and address the needs of people.

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4) Food for Work Programme

In the year 2000, the Food for Work Programme was started as a component of EAS. It was started with some major drought-affected states, namely Maharashtra, Rajasthan, Orrisa, Gujarat, Himachal Pradesh, Madhya Pradesh, Uttaranchal and Chhattisgarh. The main aim is to enhance food security through wage employment.

5) Sampoorna Gramin Rozgar Yojana:

The new Sampoorna Gramin Rozgar Yojana (SGRY) Scheme was started in 2001 was the mix of old JGSY, EAS and Food for Work Programme. The primary aim of the scheme was the generation of wage employment, creation of good economic infrastructure in rural areas as well as food provision and nutrition security for the underdeveloped.

6) Rural Housing – Pradhan Mantri Gramin Awaas Yojana (PMGAY)

PMGAY is a government flagship programme, created for providing housing for the Indian rural poor. A similar scheme for urban poor was launched in 2015 as Housing for All. For BPL population, similar program was launched by late PM Rajiv Gandhi, known as Indira Awaas Yojana which was one of the major flagship programs.

7) National Old Age Pension Scheme (NOAPS)

NOAPS came into effect from the year 1995, providing pension to old people above 60, who does not have any means of subsistence is the main aim of this project. It is provided by the central government. The implementation of this scheme in places is given to panchayats and municipalities.

8) National Family Benefit Scheme (NFBS)

NFBS was started in the year 1995 and is sponsored state governments, under community and rural department. They provide certain amount to a member of family who becomes the head of the family after the death of its primary breadwinner.

9) National Maternity Benefit Scheme

NMBS provides certain amount grant mother in three instalments. The women must be older than 19 years. It is normally provided eighth to twelfth weeks before the birth of child. And in case of the death of the child, the women can still avail it.

10) To accelerate economic growth

The government tried to impart various methods for accelerating economic growth. They really expected that the poor will be raised above the poverty line with the various growth measures. While efforts were made to accelerate economic growth but they fail as they applied capital-

ISBN: 978-91-987581-0-8

intensive technologies of the Western Countries. Our nation is more on the road to the labour-intensive path of economic growth. Hence, fiscal and monetary were adopted that provide incentives for using labour-intensive techniques.

11) By agricultural growth and poverty alleviation

One of the most important factors is agricultural growth that can help reduce poverty. As per reports of Montek Ahluwalia commission (former member of Planning Commission), it brought clearly that agricultural growth and poverty are inversely related. As higher the agricultural growth is, it leads to lower poverty ratio.

12) By speedy development of infrastructure

The speedy development of infrastructure, an important measure is to generate employment opportunity and raising their productivity. Infrastructure development involves construction of buildings, roads, highways, ports, telecommunication, power and irrigation. It encompasses mainly construction work which is again labour-intensive thing.

13) By accelerating human resource development

In addition to infrastructure development, poverty can also be reduced through human resources development. HRD requires better investment in areas of educational facilities such as schools to promote literacy, vocational colleges and technical training institutes to impart skills to the people.

14) By accelerating the growth of non-farm employment

Rural areas are of special importance for the reduction of poverty and growth of non-farm employment opportunities. This type of employment can be created in sales, marketing, transportation, handicrafts, dairy farming, forestry, food processing and other agricultural products, repair workshops, etc.

15) By giving access to assets

After independence, faster rate of population increase has led to greater sub- division and fragmentation of agricultural holdings. Lack of employment opportunities in factories, industries and non-farm sectors has deteriorated the conditions of agricultural labour and self-employed small farmers.

16) By giving access to credit

Credit availability for the poor and underprivileged on easy terms can create better living conditions. Small farmers can gain access to dynamic resources such as better seeds, good fertilizers, etc. Construction of minor irrigation channels such as wells and tube wells can be accelerated.

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17) By proper public distribution system (PDS):

From the studies, it came out that households spend nearly 80 per cent of their income on food. Hence, an effective way of raising rural incomes and to ensure food security to the poor households, the government should work on an assured supply of adequate quantity of food-grains.

18) By direct attack on poverty

The government realised in the early 70's that it is going to take a long time for economic growth to generate enough employment opportunities for the needy people in our country.

❖ CONCLUSION:

Government should provide all the facilities to all, people need comfortable, safe and secure life. But based on the people income and financial background rich people are getting better commodities and good life. Poor people working to earn money to push a day, very next day again they have to earn to live. Government is working on to provide basic facilities, shelter and medical facilities to all people, especially for poor people. In this chapter, the authors have given some steps taken by the government to eradicate poverty in India. Poor people are unaware of government schemes and benefits, so the aim of the plan may reach if the beneficiaries are aware and utilize the schemes in an effective manner.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.007

ISSUES AND CHALLENGES OF POVERTY, MICROFINANCE AND WOMEN EMPOWERMENT: REALITY CHECK FROM IMPHAL EAST DISTRICT, MANIPUR

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❖ ABSTRACT:

The problem of poverty and inequality seem to have taken precedence over the problem of growth, and over the years the community involvement and the concept of self-help were felt most required for the success of these efforts. Poverty is comparable to the disease of cancer that one who has infected with has to sustain discomfort until his death. Solutions to the alleviation of poverty lie in generation of self-employment opportunities. Such opportunities can be created by bringing at least one member of every BPL family into the fold of SHG. In such context of growing importance of SHGs. Hence, search for newer approaches and instrument of poverty alleviation continues. In this context, self help Groups (SHGs) and microfinance have emerged as an innovative and potential instruments for poverty alleviation. Hence, Self-Help Groups are realized to be a proven model/methodology to address the issues of poverty alleviation

Keywords: *Poverty Alleviation, Microfinance, NGOs, SHG-Bank Linkage*

❖ ISSUE OF POVERTY:

Poverty is a serious social phenomenon due to unproportionate ratio between total population and resources currently available in the economy.The proposition is so serious that it deprives their fundamental freedoms of choice and action, face extreme vulnerability to ill health and exposed to ill treatment by the institution of the state and society and are powerless to influence key decision affecting their live. Poverty is

comparable to the disease of cancer that one who has infected with has to sustain discomfort until his death. To quote the reference of Amartya Sen, "People must not be allowed to become so poor that they offend or are hurtful to the society. It is not so much the misery and plight of the poor but the discomfort and cost of the commodity which is crucial to this view of poverty. We have a problem of poverty to the extent that low income creates problems for those who are not poor. The solution to the problem of poverty in general of any economy is considered achievable by consistently rising levels of economic growth and development. In the words of W.C. Peterson, 'Economic growth involves an increase over time in the actual output of goods and services as well as an increase in the economy's capability to produce goods and services'. It has been recognized that successful development requires comprehensive, multifaceted, and properly integrated mandate. In addition, another problem of an economy is poverty amid plenty and it becomes the world's greatest challenge. Efforts are on persistently mainly in underdeveloped and developing countries to contain the prevailing phenomenon in the world. Hence, all over the world, in many different ways, countries have tried to rolled back poverty and improved in the recent past, may be in terms of global wealth, global connection and technological capabilities. However, due to uneven distribution of these gains makes the gap between countries, regions and peoples widen causes difficult to build the conditions for sustained, equitable growth in the world.

Of the World's 6 billion people, 2.8billions- almost half- live on less than$2 a day, and 1.2 billion-a fifth-live on less than $1 a day, with 44 percent living in south Asia .In rich countries fewer than 1 child in 100 does not reach its fifth birthday, while in the poorest countries as many as a fifth of children do not .And while in rich countries fewer than 5 percent of all children under five are malnourished, in poor countries as many as 50 percent are.

The average income of in the riches 20 countries is 37 times the average in the poorest 20 countries ─ a gap that has doubled in the past 40 years. And experience in the different parts of the world has been very diverse.[3]. How can we find out about the implementation factors that triggered success and foster those approaches on a global scale to shrink poverty in many parts of the world where it remains widespread?

It is indeed necessary to build a strategy to meet the challenge of reducing poverty through the force of global integration and technological advancement to serve the interest of poor people.

ISBN: 978-91-987581-0-8

Poverty is commonly understood as the condition of having little money and few material possessions. Not all agree on the undesirability of poverty, with a number of spiritual traditions emphasizing the virtue of voluntary renunciation of material goods, and disavowing the logic of accumulation. In international and community development literature however, poverty has the additional meaning of deprivation of basic needs. While some seek to define poverty in economic terms, others consider social and political arrangements to be intrinsic to poverty. Debate on the causes, effects and measurement of poverty directly influences the design and implementation of poverty reduction programs and is thus important to the fields of international development and public administration.

Economic aspects of poverty may include material need, typically including the necessities of daily living (food, clothing, shelter, and health care). Poverty in this sense may be understood as a condition in which a person or community is deprived of, and or lacks the essentials for a minimum standard of well-being and life. These essentials may be material resources such as food, safe drinking water, and shelter. Poverty also describes a (persistent) lack of wealth and income, or wealth and income disparities.

Social aspects of poverty link conditions of scarcity to aspects of the distribution of resources and power in a society. These aspects of poverty may include access to information, education, health care, social status, political power, and the opportunity to develop meaningful connections with other people in society. Poverty may also be understood by those who experience it as an aspect of social relationships and need, including social exclusion , dependency , and diminished capacity to participate in society, including as a result of being deprived of access to education and information.

The World Bank's "Voices of the Poor," based on research with over 60,000 poor people in 60 countries, identifies a range of factors which poor people identify as part of poverty'[4]. These include

- precarious livelihoods
- excluded locations
- physical limitations
- gender relationships
- problems in social relationships
- lack of security
- abuse by those in power

- disempowering institutions
- limited capabilities, and
- weak community organizations.

Critics argue that some measures reflect pejorative and sometimes racialized colonial stereotypes of poor people as powerless victims, and passive recipients of aid programs.

Poverty elevation is still an unfinished agenda of under developed countries/developing countries of the world in general and India in particu

About 260 million people both in rural and urban areas were officially estimated as living below poverty line at the turn of the new millennium.The magnitude of the continuing poverty is reflected in the fact that a significant chunk of our population are deprived of basic developmental need like schooling, housing, water, health, sanitation and electricity . It needs proposes a strategy for attacking poverty in three ways: Promoting opportunity, facilitating empowrment, and enhanching security5.

- Promoting opportunity: Poor people consistently emphisis the centrality of material opportunities.This means jobs ,credit, road, electricity, markets for their produce ,and the schools, water,sanitation, and health services that underpin the health and skills essential for work.
- Facilitating empowerment: The choice and implementation of public actions that are responsive to the needs of poor people depend on the interaction of political,social, and other institutional processes.Access to market opportunities and to public sector services is often strongly influenced by state and social institutions,which much be responsive and accountable to the poor people.
- Enhanching security: Reducing vunerablity to economic shocks, natural disasters, ill health, disability, and personal violence is an intrinsic part of enhancing well-being and encourages investment in human capital and in higher-risk, higher return activities .

There is recognition of the fact that impact on poverty and deprivation must be ended as soon as possible. Many governments all over the world pursue economic planning as a means to way out of the problem of poverty. Increase in GDP or GNP is considered to the measuring rod for the progress of the economy and consiquently for the rolling back from poverty level of the ecomomy.

ISBN: 978-91-987581-0-8

Experience of all over world in the recent years had seen that there has grown disillusionment both in rich and poor countries about the pursuit of growth as a main socio-economic objective.This view has echoed again and again at the United Nations World Summit for Social development held at Copenhagen in March1995 . The problem of poverty and inequality seem to have taken precedence over the problem of growth. In this connection, Mahbubul Haq (former minister of planning , Pakistan) expressed, "We were taught to take care of our GNP as this will take care of poverty.Let us reverse this and take care of poverty as this will take care of the GNP.[6] Search for newer approaches and instrument of poverty alleviation continues. In this context, Self help Groups (SHGs) and microfinance have emerged as an innovative and potential instruments for poverty alleviation and socio-economic empowerment of the poor. Experience of micro credit delivery through SHGs many countries reveals that poor and humble persons make investment wisely and earn returns. However, the flow of financial assistance to them was too marginal to enable them to cross the poverty line.

The essence to create a grassroot organisational base to enable the down trodden people to come together, to analyse their issues and problems themselves, and to fulfil their needs was strongly advocated. In fact, experience shows that some of the successful group-based participatory programmes have made significant improvement in the conditions of living poor women.

The concept of self-help group has gained its significance, especially after 1976 when Prof. Mohammed Yunus of Bangladesh began experimenting with micro-credit and women SHGs. A strategy was made in Bangladesh with a sense of economic eradication in poverty eradication 'by empowering the poor women'. SHGs (small informal associations) were created for the purpose of enabling members to reap economic benefit out of mutual help, solidarity and joint responsibility. The benefits include mobilisation of savings and credit facilities and pursuit of group enterprise activities. The group-based approach not only enables the poor to accumulate capital by way of small savings but also helps them to get access to formal credit facilities. These groups by way of joint liability enable the poor to overcome the problem of collateral security and thus free them from the clutches of moneylenders. The joint liability not only improves group members' accessibility to credit, but also creates mechanisms like peer monitoring leading to better loan recoveries . Besides, some of the basic characteristics of SHGs like small size of membership and homogeneity of composition bring about cohesiveness

and effective participation of members in the functioning of the group. In general, SHGs created on the above lines of functioning have been able to reach the poor effectively, especially women and help them obtain easy access to facilities like savings and credit and empower them. Studies reveal that certain elements become crucial or critical for the successful formation and functioning of the groups. These include voluntary nature of the group, small size and homogeneity of membership, transparent and participative decision-making and effective use of funds for micro-enterprise creation. Regular meeting of the members fosters meaningful relationship among them and issues other than thrift and credit, issues on gender and social problems also get a platform for discussion. Micro finance is a cost effective tool to fight against many dimensions of the poverty challenge. The response of various microfinance initiatives, especially in Indian context, has been broadly on the following two lines[7].

1) Creation of alternative delivery mechanism for the poor: The main aim of microfinance intervention in this regard is to help the poor to reduce the difficulties they face with the bank or money lenders by creating separate institutions which can fully understood and appreciate their needs.The idea is to create pro-poor agencies or institution which can deliver financial service to the poor.
2) Reforming the formal agencies: The reforms include adapting methods and innovations tried out by NGOs and other microfinance agencies. The fast growing SHG-Bank Linkage Programme in India is one such example of the response from the formal agencies in reforming their earlier days.

❖ THE IMPORTANCE OF SELF HELP GROUPS (SHGS) IN POVERTY ALLIVAITION THROUGH ACCESSING MICROFINANCE:

The SHGs-bank linkage programme has emerged as the largest microfinance out reach programme in the world, and is also the most cost effective and fastest growing micro-finance initiative over the world. Micro-finance or a small loan is a helping hand to the poor in the fight against poverty.The High Power Task Force set up by NABARD in November 1998 defines “micro finance as provision of thrift, credit, other financial services and products of very small amounts to the poor in rural ,semi-urban areas for enabling them to raise their income levels and improve living standard”. Empirical evidence has shown that women as a group are consistently better in promptness and reliability of repayment. Targeting women through SHG programme have been a very effective

ISBN: 978-91-987581-0-8

method of ensuring that the benefits of increased income accrue to the general welfare of the family, and particularly of children. At the same time, women themselves benefit and achieve higher status when they are able to get new income.

It would be useful here to discuss the importance of microfinance as a tool for poverty alleviation. There may be various medium of micro finance, however, the most prominent and dominent among them has been through the medium of SHGs. In 1992, National Bank for Agriculture and Rural Development (NABARD) gave a fillup to the movement when it started the SHG-Bank linkage programme. This was the first major attempt to link the financial institutions with the informal groups, thereby, linking them with the market.

The term micro finance and Self Help Group(SHG) is very closely related and is considered as two sides of the same coin.The SHG represents the demand side of the system and microfinancing sector i.e. the banking sector represents the supply side .The ideal situation of the system is the equilibrium position, where the supply match the demand.The evolution of ideas in relation to credit delivery system has some parallel to the evolution of thought on economic growth and development .The idea is that in macro level credit should be delivered adequately to meet the growth process in the economy and in micro level the emphasis shifted to ensure the credit went to all segment of soceity.In order to meet these twin objectives, the expansion of organised banking is encouraged by every admistrative set up in an economy.The reality is, despite of expansion of organised banking system deep into the rural areas,a very large number of the poor continue to remain outside the fold of the formal banking system.The formal banking system with its systems and procedures was found to be inaccessible to the poor. Therefore, it is needed to find a new delivery machanism which would meet the requirments of the poor and down trodden, particularly, the women folk in the soceity. In India, during 1991-92, NABARD launched 92 pilot projects on linking SHGs with Banks, in various parts of the country. In July 1991, RBI advised the banks to participate in the pilot project and to extend finance to SHGs as per the norms and guidelines of NABARD. In February 1992 detailed guidelines were issued to the commercial banks, explaining the modalities of the pilot project. Later the scheme was made applicable to RRBs and Cooperative Banks in May 1993. The NABARD guidelines to banks for implementation of the pilot project allowed ample flexibility to the participating banks to innovative responses and observed variations in the grassroots level situations. It aimed at providing credit to

ISBN: 978-91-987581-0-8

the informal SHGs of rural poor, through the banking system, with minimal documentation and simplified procedures.

This intended to build the trust and confidence between banker and the poor group of people and encourage banking activies in a section of population that formal financial instution usually found reluctance to cover in their fold. For the SHG system developed and promoted by NABARD, they took the initiatives for linkage between SHGs and NGOs on the one hand, and the banks on the other. Several models of SHG-Bank linkage programme were tried out. As a result of these experiments, three most commonly used Models throughout the country came into existence.

❖ MODELS OF BANK LINKAGE

In order to deliver credit to the SHGs, NABARD has introduced three models under SHGs bank linkage programe as given below:

- **Model I,** the SHGs are to be organised and promoted directly by Banks without any assistance from any NGOs. The bank provided credit in bulk directly to the SHG, which might be an informal or formal body. The SHG, in turn, would undertake on-lending to its members, on terms and conditions agreed upon mutually among them. NABARD provided refinance assistance to the lending Bank. In this Model there is no involvement of NGOs
- **Model II**, NGOs act as an organiser and promoter of the SHGs, and then referred those SHGs to the Bank for lending directly either to the SHGs or to individual members. Here, NGOs stand as support to both the Banks and the SHGs, for monitoring and evaluation of the projects, proper functioning of the SHGs, repayment of the loans, training to members of SHGs, etc. NABARD provides refinance to the lending Bank.
- **Model III,** the SHGs are to be facilitated and promoted by NGO and then referred to the Bank for linkage, and the Bank finance directly to the NGO for on-lending to the SHGs. The NGO is fully responsible for making sure repayment of the loan to the Bank, with proper monitoring and evaluation of the projects of the SHG, and training of members of SHGs. NABARD provided cent percent refinance to the lending Bank.

The Self Help Group (SHG) which is defined as a homogenous group of poor people, voluntary formed to save small amounts within their earning and to mutually agree to contribute to a common fund which is on–lent to members for meeting their credit needs, either for consumption or income generating activities, on terms and other conditions mutually

ISBN: 978-91-987581-0-8

agreed upon by the group member. Later on the group approaches the banks for lingkage programme for assisting larger fund for operation of productive purposes. Such an approach of financing operation have benefited both for the borrower and the banks.

Over 90% of the groups have been set up by women which enables amelioration of the socio-economic conditions of their families and also brings enormous social change by empowering them. The thrift habit among the poor has been propagated as never before. The poverty alleviation process has been hastened on account of proper utilization of the saving and loans by the group members. The loan recovery rate of over 95% showed that the SHGs could use the bank credit effectively and in a responsible manner.

Another impact evaluation study by NABARD (2001) had found that 86% of the members of SHGs belong to the weaker sections . On account of the SHGs-Bank Linkage Programme the value of the assets of the group members had increased by 59%.There was a threefold increase in the average annual savings of each member and doubling of borrowings per annum. Besides, the members had improved their communication, learnt handling problem situations and there was a general increase in the level of self –confidence.

Through these three different SHGs bank linkages models banks are encouraged to make loans to the Self Helf Groups in certain multiples of the accumulated savings of the Self Help Group.The bank loans are given without any collateral and at market interst rates.They continue to decide the terms of loans to their own members. Since, the group own accumulated savings are part and parcel of the aggregate loans made by the group to their members, peer pressure insures timely recovery of loan. In most cases, there is a Self Help Promoting Institution/NGO which enables to the Self Help Groups to function effectively.

Self Help Groups brings about benefits both for the members, for banks and Self Help Groups Promoting Institutions or NGOs as indicated below:

For members:

- Discuss and help each other to solve common problems
- Collect and use own savings to make interest bearing small loans to each other
- Learn basics of financial intermediation
- Learn to appreciate others' needs and their own needs

- Start handling resources of a size much beyond their individual capacities.
- Realising that resources are scares and that have cost
- Learn that repayment is not difficult , with regular saving habit
- Use peer press use as and effective substitute for collateral security
- Win the confidence of the formal banking systemthrough mature financial behavior ,leading to futher access to need based funds

Learn to interact with the external environment in a meaningful way, leading to increase self esteem and confidence for Banks:

- Benefit from reduced transaction costs through economies of credit and

Learn to externalize credit supervision and servicing to the groups themselves

- Benefits from mobilization of small savings through groups , gaining access to low-cost funds
- Accept peer pressure within the Self Help Groups as an excellent substitute for the colleteral securities, leading to more than 95% repayments
- Get timely repayments leading to faster recycling of funds
- Recognize self helf groups as the appropriate medium for expansion of business of rural branches for wider coverage of clients
- Recognize the prospects of ripple effect in quality among their clients
- Building good well among the rural client
- Benefit from refinance facilities from NARBARD for better fund management.

For NGOs:

- Find SHGs as complimentary to their core functions
- Use the synergy of social and economic programmes for better impact on the poor
- Deepen and widen the outreach to the poor through creedit plus approach
- Gain recognition as socio-economic change agents
- Use the avenue for performing financial intemediation in underbanked areas
- Act as meaningful agents between banks and the poor

ISBN: 978-91-987581-0-8

- Perform the role of propagators of innovative financial services delivery approaches

❖ CONCLUSION AND OBSERVATIONS:

It is based on the available evidence and experience about the role of microfinance in poverty alleviation and large scale failure of both state and market to meet the savings, credit and insurance needs of the poor. Micro-financing: Shift from the traditional banking system Micro-financing has turned out to be an effective strategy for formal financing agencies. Group lending minimizes transaction cost and at the same time the members of a group can avail small loans through that group. The chance of mis-utilisation is minimal and there is assured repayment because of peer monitoring by the group. The group concept has enabled the rural poor to develop the savings habit and minimise extravagance. For the SHG members, the system has been found beneficial because of minimal procedural formalities, access to institutional credit without collateral offering, full autonomy in the selection of activity, and the availability of thrift for meeting urgent needs. The skill needed for filling the application forms and the absence of procedural formalities have made the programme customer-friendly. Besides, the flexible repayment schedule enables them to repay as and when it is convenient. The group will see to it that prompt repayment is made, as they are likely to get repeat loans. The micro-sized, supplementary income-generating activities pursued by the members defy the conventional standards of unit cost and unit size prescribed by banks and government departments. The smaller unit size allows women to pursue the activities in their spare time and contribute to the family's income. Right from the mid-eighties of the past century micro-finance has become a key strategy for poverty alleviation and empowerment of women in southern State of India. More than 90 percent of the (SHGs) groups in this region are women groups. In some areas, men groups and mixed groups also exist. There has also been an increase in the flow of funds for micro-enterprises through various promotional agencies. Though NGOs were the forerunners in this field, the early nineties marked a new era for micro-finance programmes in the State with the evolution of the Community Development Society (CDS) model women groups in various part of our country. Further the setting up of the poverty eradication programme of the various State Government has given a boost to the SHG strategy. There is a general tendency to consider SHGs as a panacea for all the ills of the rural community. This is evident from the mushroom growth of self-help groups in the country. In many

cases it has been a blind replication of success models without considering the intricacies involved in group formation and sustainability.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.008

CAUSES OF INCREASING POPULATION IN INDIA

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❖ ABSTRACT:

The total number of people living in a particular area in a particular time is known as the population. It is a summation of all the living organisms of the same group or species which live in a particular area. It includes the demographic and social characteristics like reproduction sex, caste etc.

The size of the population is always changing in response to fertility, mortality and migration. The actual size of the population can be explained on the basis of the particular place and in a particular time. The population is one of the important factors which helps to balance the environment, the population should in a balance with the means and resources. If the population will be balanced, then all the needs and demand of the people can be easily fulfilled, which helps to preserve the environment of the country.

Keywords: *Effect of over population, causes, Higher Risk of Disasters and Pandemics, Solutions, Population Policy.*

❖ INTRODUCTION:

Population Studies is broadly defined as the Scientific Study of human Populations. Major areas Studied include broad population dynamics; Fertility and family dynamics, health, aging and mortality and human capital and labor markets. Researchers in population Studies also focus on methodology. population Studies is an interdisciplinary area of study, Scholars from demography. Epidemiology, Sociology, economics, anthropology and Various other disciplines study populations.

ISBN: 978-91-987581-0-8

❖ POPULATION GROWTH:

is the increase in the number of people in a population. Global human population growth amounts to around 83 million annually or 1.1% per year. The Global Population has grown from 1 billion in 1800 to 7.9 billion in 2020. The UN Projected population to keep growing and estimates have put the total population at 8.6 billion by mid-2030. 9.8 billion by mid 2050 and 11.2 billion by 2100. However some academics out side the UN have increasingly developed human population models that account for additional downward pressures on population growth in such a scenario population would peak before 2100. A Popular estimate of sustainable population is 8 billion people. World human population has been growing since the end of the Black Death. Around the year 1350. A Mix of technological advancement that improved agricultural productivity and sanitation and medical advancement that reduced mortality have caused an exponential population growth. In some geographies, this has slowed through the process called the demographic transition. Where many nations with high standards of living have seen a significant slowing of population growth. This is in direct contrast with less developed contexts, where population growth is still happening. However the global human population is projected to peak during the mid 21st Century and decline by 2100.

Population growth alongside over Consumption is a key driver of environmental concerns, such as biodiversity loss and climate change, due to resource intensive human development that exceed planetary boundaries. International policy focused on mitigating the impact of human population growth is concentrated in the sustainable Development Goals which seek to improve the standard of living globally while reducing the impact of society on the environment.

❖ INDIA'S POPULATION:

The current population growth rate is 1 percent, which means India will add over 13 million people this year. In contrast the death rate is 7.21 per thousand. India's current population is estimated at 1.3 Billion. Nearly 17.7 percent of the world's population lives in India. We are catching up with China whose population is 1.4 Billion and has 18.47 percent of the global population. India is expected to surpass China as the world's most populous nation by 2024.

ISBN: 978-91-987581-0-8

❖ IMPLICATIONS OF POPULATION GROWTH:

India is not growing uniformly The latest National Family Health Survey (NFHS).

- The poorest wealth quintile has a TFR of 3.2 Children per woman.
- The second lowest wealth quintile has a TFR of 2.5 Children per woman.
- The richest wealth quintile has a TFR of 1.5 Children per woman.

This shows that population growth is more concentrated in economically weaker sections of society.
Population growth acts as a hurdle in addressing effectively the problem of poverty. Hunger and malnutrition and also in providing the better quality of health and education.

❖ CAUSES OF INCREASING POPULATION:

The two main common causes leading to over population in India

1) The Birth rate is still higher than the death rate.We have been successful in declining the death rates but the same cannot be said for birth rates.
2) The fertility rate due to the population policies and other measures has been falling but even then it is much higher compared to other countries.

The above two causes are interrelated to the various social issues in our Country which are leading to over population.

1) Early marriage and universal marriage system.

Even though the marriageable age of a girl is legally 18 years. The concept of early marriage still prevails. Getting married at a young age prolongs the child bearing age. Also in India marriage is a sacred obligation and a universal practice, where almost every woman is married at the reproductive age.

2) Poverty and Illiteracy

Another factor for the rapid growth of population is poverty impoverished families have this notion that more the number of members in the family, more will be the numbers to earn income. Some fell that more children are needed to look after them in their old age. Also hunger can be cause of death of their children and hence the need for more

ISBN: 978-91-987581-0-8

children. Strange but true, Indian still lags behind the use of contraceptives and birth control methods. Many of them are not willing to discuss or are totally unaware about them illiteracy is thus another cause of over population.

3) Age old Cultural norm

Sons are the bread earners of the families in India. This age old thought puts considerable pressure on the parents to produce children till a male child is born.

4) Illegal Migration

Last but not the least. We cannot ignore the fact that illegal migration is continuously taking place from Bangladesh and Nepal is leading to increased population density

❖ CONTROL OF INCREASING POPULATION:

Social measurs

1. Minimum age of marriage
2. Raising the status of woman
3. Spread of education
4. Adopt orphan children
5. Social security schemes

Economic measures

1. More employment opportunities
2. Providing incentives

Other measures

1. Medical Facilities
2. Spreading awareness

❖ CONCLUSION:

Rapid population growth is detrimental to achieving economic and social progress and to sustainable management of the natural resource base. But there remains a sizeable gap between the private and social interest in fertility reduction and this gap needs to be narrowed policies and programs that influence health, education, the status of women and the economic value of children in turn influence attitudes toward childbearing family planning and people's ability to control family size. Efforts to reduce fertility through explicit population policies, therefore should be integrated with policies to improve health, education and the status of women.

ISBN: 978-91-987581-0-8

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.009

POPULATION EXPLOSION AND ITS IMPACT ON ENVIRONMENT IN INDIAN SCENARIO

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❖ ABSTRACT:

In the past, population growth was to some extent limited due to death of children and short life span. But now a days population explosion, i.e. a rapid increase of human population is putting an incredible strain on the environment. While developed countries continue to pollute the environment and deplete its resources, developing countries are also damaging as well due to compliance of their industrial advancements and economical development. India is facing the problem of population explosion accompanied with environmental degradations such as deforestation, loss of biodiversity, air and water pollution, water crisis, land degradation etc. Unsustainable use of environmental resources by a section of the poor people to meet their livelihood is notably observed. Poverty may be one of the common causes of population explosion and environmental degradation. Proper socioeconomic status of the population must be maintained to restrict the exploitation of environmental resources. So, everyone should aware about the problem of unsustainable population growth associated with the environmental degradation.

Keywords*: Population explosion, environmental degradation, poverty, India*

❖ INTRODUCTION:

A population is defined as a group of individuals of the same species living and interbreeding within a given area. Members of a population often rely on the same resources, are subject to similar environmental constraints, and depend on the availability of other members to persist

over time. Demography is the study of the characteristics of populations. It provides a mathematical description of how those characteristics change over time. Demographics can include any statistical factors that influence population growth or decline, but several parameters are particularly important such as population size, density, age structure, fecundity (birth rates), mortality (death rates), and sex ratio (Dodge 2006). Large populations experience their own problems. As they approach the maximum sustainable population size, known as carrying capacity, large populations show characteristic behaviour. Populations nearing their carrying capacity experience greater competition for resources. Between 1959 and 2000, the world's population increased from 2.5 billion to 6.1 billion people. According to United Nations projections, the world population will be between 7.9 billion and 10.9 billion by 2050.

❖ TRENDS OF POPULATION GROWTH IN INDIA:

India, being a vast fertile country, situated in the southern-part of Asia. India is one of the oldest civilizations in the world, with a rich heritage and myriad attractions. The great urban culture of the Indus valley civilization, a society of the Indus River valley that is thought to have been Dravidian speaking, prospered around 2500 BCE. Population growth rate is the average exponential rate of growth of the population over a given period. It is expressed as a percentage. High fertility has been observed in many developing regions, coupled with low fertility in more-developed regions.80 percent of the global population now lives in less-developed nations. The combination of a continuing high birth rate and a low death rate is creating a rapid population increase in many countries in Asia, Latin America and Africa and people generally lived longer.

The first registered population census in India was conducted by British periodically from 1865, then in 1881 onward to the year 1947. Since from independence in 1947, a census has been conducted every 10 years, and the first census by Ministry of Home Affairs happened in 1951. The Indian population in 2021 is estimated to be 1.39 Billion (139 Crores), According to Unique Identification Aadhar India, updated December 2020, by mid of year 2020 the projected population is 1,370,508,600. With roughly one-sixth of the world's total population, India is the second most populous country, after China and US is the third populous country in the world. India is projected to be the world's most populous country by 2024, surpassing the population of China. It is expected to home to more than 1.5 billion people by 2030 with the current birth rate of 1 person per second and death rate every 1 person per 3 seconds and migrant rate every

ISBN: 978-91-987581-0-8

1 person per 2 seconds. Population explosion, which refers to the rapid and dramatic rise in population, is a major problem of India.

Migration is one of the major reasons of population explosion. Much of human migration follows a rural-to-urban pattern, and, as a result, the Earth's population is also increasingly urbanized. Population growth is the primary force producing large urban centres in developing countries. Only one-third of the world's population lived in cities in 1960. By 1999, the percentage had increased to nearly half (47 percent). The areas of rapid growth of population continue to be associated with net in-migration resulting from:

1) The development of manufacturing industries, mining, trade, and miscellaneous services, all leading to acceleration in the process of urbanization,
2) The development of irrigation and reclamation of land bringing about increased intensity and extension in farming, and
3) Infiltration from neighbouring countries, particularly from Bangladesh.

❖ ENVIRONMENTAL CHALLENGES DUE TO POPULATION EXPLOSION:

Population growth presents problems with respect to employment opportunities. The predicted flood of manpower cannot be totally absorbed by the organized sector; it is argued that the agricultural sector is the only one which can help the country during this period of high population growth. To support this large and rising population, India will need to rapidly increase its average crop yields 2-3 times the present level for a modest improvement process. The expected population growth will also have consequences on environmental deterioration and water supply contamination. The distribution of people around the globe has three main implications for the environment.

i) As less-developed regions cope with a growing share of population, pressures intensify on already dwindling resources within these areas.
ii) Migration shifts relative pressures exerted on local environments, easing the strain in some areas and increasing it in others.

iii) Urbanization, particularly in less-developed regions, frequently outpaces the development of infrastructure and environmental regulations, often resulting in high levels of pollution.

The utilization, overuse and misuse of physical resources (land, air, water, soil and minerals) increased manifold due to the growth of human population. So, population explosion may lead to following environmental degradations -

❖ DEFORESTATION:

Forests are an important natural resource of India. They have moderate influence against floods and thus they protect the soil erosion. Forests also play an important role in enhancing the quality of environment by influencing the ecological balance and life support system (checking soil erosion, maintaining soil fertility, conserving water, regulating water cycles and floods, balancing carbon dioxide and oxygen content in atmosphere etc. The total forest cover in India (2021) is **7,12,249** square kilometres which is **21.67%** of the total geographical area. India has added 3,976 sq km of forest cover from 2017 to 2019. The status of forest cover in India (2021) is as follows-

Types of forest cover	Description	Percentage of total geographical area (%)	Area (Square Kilometre)
Very dense forest	All lands with tree canopy density of 70% and above.	3.02	99,278
Moderately dense forest	All lands with tree canopy density of 40% and more but less than 70%.	9.39	3,08,472
Open forest	All lands with tree canopy density of 10% and more but less than 40%.	9.26	3,04,499
Scrub	Degraded forest lands with canopy density less than 10%.	1.41	46,297

Source:https://geographyhost.com/forest-cover-in-india-important-statistics/

As the population grows, more and more forests are cleared. The two most common reasons for deforestation are to make houses for increased number of people to live in, and to use wood as a fuel in the industries. Rapid industrialization, urbanization and over-exploitation have resulted not only in decline but also in permanent loss of forest cover to an alarming rate. The major driver behind all these factors is the uncontrolled

ISBN: 978-91-987581-0-8

population growth of humans which leads to the dramatic increase in the demand for wood and forest products.

According to UN Food and Agricultural Organization (FAO), deforestation is the conversion of forest to another land use or the long-term reduction of tree canopy cover below the 10% threshold. Forest areas around the world are majorly cleared for agriculture, logging, mining and large-scale developmental projects. The loss of forest cover happens for many purposes:

1. To clear space for the production of crops like wheat, maize etc.
2. To create a grazing pasture for animals reared to fulfil the rising demand for meat.
3. For logging purposes, i.e., to meet the demand for wooden products like furniture or the production of charcoal.
4. For mining purposes, as most of the precious resources like Oil, gold, diamond, copper etc are found in and around forests.

The common disturbances that were being observed during the field survey (2017–2019) include fire, grazing, fuel wood collection, forage removal, litter collection, collection of Non-Timber Forest Products (NTFPs), lopping, thatch collection, root collection, soil removal, etc. The forest's canopy cover plays a major role in regulating the global climate, with a carbon sink capacity of around 90-140 billion metric tons. With the current deforestation trends, the release of even the smallest portion can lead to acceleration in global warming.

❖ LOSS OF BIODIVERSITY:

`Rapid population growth also causes intangible damage like climate change, which is yet another important factor behind the deteriorating biodiversity & ecosystems.

`The chemicals used in the mining process also degrade the quality of soil and ends up in water bodies, polluting them and harming the riverine ecosystems. To meet the growing demands, agricultural expansion happened, terrestrial land use was changed. Almost 50 per cent of the global land area is used for agriculture, causing an estimated 80 per cent extinction threat to animal and bird species.

❖ AIR AND WATER POLLUTION:

Air pollution is not the only environmental damage being done by the increasing population. Now a days, water pollution is also one of the increasing problems due to the population explosion. Water is considered the essence of life. As in the case of air pollution, the increasing

population calls for increasing numbers of factories. These factories lead to various kinds of pollution, including water pollution. Also, India being an agrarian country, the water pollution also comes from pesticides used for agriculture. The increased population size is leading to increased pollution, which in turn is leading to a more hostile environment for human beings themselves.

❖ WATER CRISIS

India is suffering from one of the world's worst national water crises. In fact, it is considered the centre of the global water and sanitation crisis. More than 50% of the Indian population has no access to safe drinking water and about 200,000 people die every year for lack of access to safe water. While India's aquifers are currently associated with replenishing sources, the country is also a major grain producer with a great need for water to support the commodity. As with all countries with large agricultural output, excess water consumption for food production depletes the overall water table. Many rural communities in India who are situated on the outskirts of urban sprawl also have little choice but to drill wells to access groundwater sources.

India's water crisis is often attributed to lack of government planning, increased corporate privatization, industrial and human waste and government corruption. The 2018 Composite Water Management Index (CWMI) noted that 6% of economic GDP will be lost by 2050, while water demand will exceed the available supply by 2030. In addition, water scarcity in India is expected to worsen as the overall population is expected to increase to 1.6 billion by year 2050. To that end, global water scarcity is expected to become a leading cause of national political conflict in the future, and the prognosis for India is no different.

❖ LAND DEGRADATION

The land serves as storage for water and nutrients required for plants and other living micro-macro-organisms. The demand for food, energy and other human requirements depends upon the preservation and improvement of the productivity of land. The loss of arable land has been caused by a number of factors, many or most of which are tied to human development. The primary causes are deforestation, overexploitation for fuel wood, overgrazing, agricultural activities and industrialization. On the global basis, the soil degradation is caused primarily by overgrazing (35%), agricultural activities (28%), deforestation (30%), over exploitation of land to produce fuel-wood (7%), and industrialization (4%). Over the

ISBN: 978-91-987581-0-8

past fifty years, while India's total population increased by about 3 times, the total area of land under cultivation increased by only 20.27 percent from 118.75 million hectares in 1951 to 142.82 million hectares in 2001. Most of this expansion has taken place at the expense of forest and grazing land. Despite past expansion of the area under cultivation, less agricultural land is available to feed each person in India.

The spread of green revolution has been accompanied by over exploitation of land and water resources and use of fertilizers and pesticides have increased many folds. The extent of agricultural intensification and extensification is characterized by an increase in cropping and irrigation intensity and higher use of chemical fertilizers, pesticides and insecticides. The process of agricultural extensification and intensification is leading to land degradation, overexploitation of underground water resources, increased use of chemical fertilizers leading to eutrophication and water pollution. Due to the increasing cropping intensity, irrigation intensity and excessive use of chemical fertilizers, agricultural intensification results in water logging, salinization and alkalinization of croplands and eutrophication of water bodies and ill health of oceans and thus leads to reduction in biodiversity.

❖ POVERTY AND ENVIRONMENTAL DEGRADATION

The outcomes of high population growth rates are increasing number of people below poverty line, an increasing population density, and pressure on natural resources. The country's population growth and poverty are imposing an increasing burden on the country's limited and continually degrading natural resource base. The natural resources are under increasing strain, even though the majority of people survive at subsistence level. Human population growth leads to a decrease in per capita income growth, which tends to lead to an increase in poverty, which is in turn linked to poaching. It is a vicious cycle.

ISBN: 978-91-987581-0-8

Figure 1: Relationship between poverty and environmental degradation

Poverty is amongst the consequences of population growth and its life style play major role in depleting the environment. Poor people are forced to degrade forest resources to meet their fuel demands for cooking or for earning livelihood for their survival. The unequal distribution of resources and limited opportunities cause push and pull factor for people living below poverty line that in turn overburdened the population density in urban areas and environment get manipulated by manifolds, consequently, urban slums are developed in urban areas.

Currently, about 60 per cent or an estimated 812 million people of India live below the poverty line and if the population growth rate is not arrested or abated even now, the problem may wreck the country's social fabric, increasing the level of unemployment and under-employment even more and further affect the benefits of economic development being imparted to people at the lower strata.

❖ CONCLUSION:

Mahatma Gandhi once said, “The world has enough for everyone's need, but not enough for everyone's greed.” Only through sustainable living, sustainable development and sustainable population growth people can combat the threat and save the planet. Over the years, most of the governments have taken various steps to control the tremendous

ISBN: 978-91-987581-0-8

population growth. However, despite their efforts; the growth rate has accelerated tremendously. Sterilisation and other methods dealing with the issue do not found to be effective as a whole. The real and better solution lies in spreading awareness among people only by changing their attitudes and habits which has been deep rooted in their minds, attitudes and values. It should be known that population control will not come to an end of all the environmental problems, but it will minimise to some extent to eradicate such problems.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.010

SKILL DEVELOPMENT IN INDIA: NEED, CHALLENGES AND WAYS FORWARD

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❖ ABSTRACT:

skill of the Indian workforce in the age group of 15-59 and which was found to extremely low i.e. around 38% of the workforce are not even literate, 25% are having below primary Globalization, knowledge and competition have intensified the need for highly skilled workforce in both the developing and developed nations as it enables them to accelerate their growth rate towards higher trajectory. For Indiaor up-to primary level of education and remaining 36% has an education level of middle and higher level whereas only 10% of the workforce is vocationally trained (with 2% formal and 8% informal training). The study also found that both the Government and its partner agencies have undertaken various measures/initiatives for the effective implementation of the skill development system in the economy, but still development is critical from both socio-economic and demographic point of view. Therefore, the present paper attempts to study the present skill capacity, challenges in front of skill development initiatives in India along with their solutions. The skill capacity has been assessed in the form of general education and vocational training level faces a number of unresolved issues/challenges that need immediate attention of the policy makers. Hence, skill development initiatives of the government should focus on these obstacles and develop the programs accordingly to resolve these hurdles for the complete success of the skill development initiatives.

Keywords: *Skills Capacity; Challenges; Ways Forward; India*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

Globalization, knowledge and competition have intensified the need for highly skilled workforce in both the developing and developed nations as it enables them to accelerate the growth rate of their economy towards higher trajectory. Today all economies need skilled workforce so as to meet global standards of quality, to increase their foreign trade, to bring advanced technologies to their domestic industries and to boost their industrial and economic development. Thus, skills and knowledge becomes the major driving force of socio-economic growth and development for any country. As it has been observed that countries with highly skilled human capital tend to have higher GDP and per capita income levels and they adjust more effectively to the challenges and opportunities of the world of work.

For India, skill development is also critical from both socio-economic and demographic point of view. For the economy to grow at 8% to 9%, with the targeted growth rate of 10% for secondary, 11% for tertiary and 4% for agriculture sectors, a multi-faceted and highly efficient skill development system is imperative. Further, India is destined to be a contributor to the global workforce pool on account of demographic bonus, with the growth rate of higher working age population as compared to its total population and home to the second largest population (with a headcount of around 1.4 billion by 2025) in the world with distinct advantage of having the youngest population with an average age of 29 years as against the average age of 37 years in China and the US and 45 years in Western Europe (FICCI, 2014).

The broad objectives of the present paper are to study the present skill capacity, the various challenges in the development of effective skill system along with their ways forward for the success of skill development initiatives in Indian context. In order to this, the study is divided into the following sections: Section-II discuss the data and methodological issues; Section-III depicts the findings pertaining to present skill capacity, challenges and ways forward for the success of effective skill development programs in India and Section–IV conclude the study

❖ OBJECTIVES OF THE STUDY

1. To study the present skill capacity of India.
2. To study the challenges faced by skill development system in India.
3. To suggest possible solutions or ways forward.

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❖ DATA AND METHODOLOGY:

The proposed study mainly is descriptive in nature. It solemnly based on secondary data and information which is collected from the concerned sources as per need of the research. The relevant books, documents of various ministries/departments and organizations, articles, papers and web-sites are used in this study.

❖ FINDINGS / RESULITS:

India's transition to one of the largest and fastest growing global economies during the last decade has been a remarkable phenomenon. In order to sustain its growth trajectory, an efficient and continuous system of skill development for its workforce is critically imperative for India. Therefore, this section is devoted to portray the current skill capacity of India; the major challenges in the successful implementation of skill development initiatives along with their way outs or suggestions.

❖ PRESENT SCENARIO OF SKILL CAPACITY OF INDIA:

In order to capitalize the demographic dividend, India will need to empower its workers with the right type of skills. Thus this section depicts the present skill levels of the Indian workforce in the age group of 15-59 years in the form of their general educational levels and vocational training levels.

- The drop-out rates of educational institution was estimated to be 50% in the age group of 5-14 years and86% after 15 years of age and in contrast to this the participation rate of the workforce rises rapidly after 14 years of age and it results in a semi-literate workforce which finds it difficult to absorb higher form of skills.
- 38% of Indian workforce is illiterate, 25% has education below primary or up to primary level and remaining 36%has an education level of middle and higher level.
- 80% of Indian workforce does not possess any marketable skills.
- Only about 2% have received formal vocational training and 8% non-formal vocational training, thereby implying that very few new entrants to the work force have any marketable skills as compared to developed economies such as Korea (96%), Germany (75%), Japan (80%) and United Kingdom (68%). In-nutshell, it can be said that despite making considerable progress in terms of literacy, high incidence of illiteracy cripples the Indian workforce

even today. The above facts are a stark reminder that India's demographic dividend can rapidly convert into a demographic nightmare if skills are not provided to both new and existing workforce. Thus, there is a need for increasing capacity and capability of skill development programs.

- **Demand & Supply Mismatch:** The demand made by the industries and supply of labour-force mismatch leads to aggravate all types of skill development initiatives of the Government and its partner agencies as:

➢ The number of people formally trained in a year is only 1,100,000 by Ministry of Labour and Employment and approximately 3,200,000 trained by 17 other central government ministries.

- **Geographical Problem:** It is another serious problem plaguing the labor market and has a more serious impact in larger economies like India as the geographical set-up or outreach of the people for skills in India are uneven and in dismal share:

➢ The states with much higher economic growth rates have more new jobs with lower rate of labour-force while on the other hand; the states with slower economic growth rates have higher population growth rates with fewer new jobs. Thus laggard states need to rely on migrant workers so as to cope with this challenge.

➢ Majority of formal institutions are located in urban areas as compared to rural areas and even private sector institutions are also reluctant to operate in rural areas. Hence, large proportions of rural population do not have any formal vocational training institutions.

➢ Districts notified as backward have serious paucity of formal skill training as majority of skill development institutions in these locations emphasized only on basic livelihood skills and that is generally provided by NGOs or provided by other agencies as a part of social development programs. Therefore, these types of skills are often not formally assessed and as a result are not recognized for employment by industrial sectors.

- **Way forward:** Thus an ideal scenario is one in which supply of labour can be transformed into skilled workforce which is easily absorbed by the industrial-sectors. However, in India a small portion of labour force is actually undergoing for formal training.

ISBN: 978-91-987581-0-8

It has been observed that there are more people than the available jobs at the low skills level, while there are more jobs at the high skills level than those available for such jobs. This demand and supply mismatch indicates that there is a serious mismatch between the education and skills that the youth attain and what the labor market demands. Therefore, in order to create a people-centric approach for skill development, it is required that the skill development initiatives needs to be coordinated with demand and supply scenarios across geographies, industries and labour markets so that new skills required by industry or changes in supply of labour are speedily adjusted with adequate and efficient training programs.

- **Vocational Training:** India is progressively moving towards knowledge economy, where skills are widely recognized as the important lever of economic growth, but the perception about vocational education is still doubtful i.e. it is generally meant for those who fail to get admission in the formal system. Thus, it still need time to be considered as a viable alternative to formal education.

- As it was observed in India, around 90% of the jobs are skill-based i.e. they require some sort of vocational training whereas in reality only 2% of the population (in 15-25 years age group) enrolled for vocational training in India as compared to 80% inEurope and 60% in East Asian countries.

- The current capacity of vocational training is 31 lakh against an estimated annual capacity of 128 lakh workers whereas the overall national target of skilling is 50 corer of workers by 2022 i.e. India needs to impart vocational training to at least 300–350 million people by 2022 which is significantly lower than the government target of 500 million.

- Moreover, the private sector provide skill training as required by service sector mainly to educated youth (especially 12thpass) and largely in urban regions. Ultimately, hundreds of workers in unorganized sector do not get any kind of skill training which results in low productivity levels and employability gaps among majority of workforce.

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- Due to lack of awareness about industrial requirements and the availability of matching vocational courses, most of the prospective students in the country do not go for vocational education.

- **Skill development for women:** In India, women also form an integral and substantial part of the workforce; but the working percentage rate of women in total labor force is declining.
- The share of women workforce (between 25-54 years of age) is about 30% in 2010 as against 39% in 2000, which is quite below as compared to 82% in China and 72% in Brazil. All it depict the under-representation of women in the workforce and results in the wastage of the demographic dividend to India.

- **Private sector participation:** The current situation in respect to the participation of the private sector is as follows:
- The private sector is not involved adequately in curriculum development and policy formulation related to educational and vocational training.

- Mostly private sector institutes are located in urban areas therefore rural population remains lags behind. Furthermore, due to high cost of these institutes the weaker or disadvantaged section also unable to get proper skill training.

- **Multiplicity of Institutional Framework:** Over the past few decades, India has witnessed significant progress in the skill development landscape as various types of organizations have been set up both at national and at state level.

- Around 17 ministries,2 national-level agencies, several sector skill councils, 35 state skill development missions and several trade and industry bodies comes forward with a view to push the national skill development agenda.

- Given this mind-bogglingly complex institutional setup with overlapping and conflicting priorities and little co-ordination and standardization ultimately resulted in fragmented outcomes with limited impact.

- **Informal & Formal Sector Skill-Gap:** As the Government of India has set a target to impart the necessary skills to 500 million

people by 2022 in the Twelfth Five Year Plan, whereas in reality the country is facing a significant skilled manpower challenge over the next decade.

- In India, around 12 million people are expected to join the workforce every year whereas the current total training capacity of the country is around 4.3 million, thereby depriving around 64% entrants of the opportunity of formal skill development every year.
- Furthermore, out of approximately 0.4 million engineering students graduating every year in India, only 20% are readily employable.
- Around 93% of the Indian workforce is employed in the unorganized or informal sector, which lacks any kind of formal skill development training.
- Barely 2.5% of the unorganized workforce reportedly undergoes formal skill development in comparison to 11%of organized sector.
- In addition, only around 12.5%and 10.4% of the workforce in the unorganized and organized sectors, respectively, undergoes informal skill development. This indicates that around 85% of the work force in the unorganized sector d

- **Infrastructure Challenge:** One of the important requirements for the proper implementation of the skill and training development programs is the availability of the basic infrastructure for the same. It has been noticed that many skill development institutions suffer from lack of proper infrastruc

planning for skill development initiatives which incorporates local employment demand and skill requirements. Thus, it is imperative for the success of skill development system that market institutions work efficiently and well connected with educational and vocational training institutions. As the main objective of education and vocational training is employment. Therefore educational and vocational system has to be linked to the job market in such a way that it must be competent to provide relevant information about the growing employment opportunities, types of skills required by different jobs, and where and how the skills can be acquired. And this will ultimately lead to enhance the socio-economic relevance of education and vocational training along with strengthening the performance of the market institutions in the economy.

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❖ CONCLUSION:

To make India internationally competitive and to boost its economic growth further, a skilled workforce is essential. As more and more India moves towards the Knowledge economy, it becomes increasingly important for it to focus on advancement of the skills and these skills have to be relevant to the emerging economic environmentdemographic dividend, an efficient skill development

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.011

GENDER DIMENSION DEVELOPMENT IN INDIA: EMPOWERING WOMEN THROUGH THE VARIOUS EDUCATIONAL SCHEMES IMPLEMENTED BY THE GOVERNMENT OF INDIA

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❖ ABSTRACT:

Education not only makes women literate but it also acts as a tool for their empowerment. But In Indian society, basically in rural areas women are not getting the chance to attend any educational institutions. In traditional Indian society, sons are always considered as assets whereas, girls are considered as liability. So, spending money on their education is not considered as priority. They are only seen as a good daughter, a good mother or a good homemaker. Therefore, attending schools or getting education is also not possible for them due to the prevalence of various age old existing social evils, beliefs, taboos, religious faiths and so on. If they attend school or spend their time to get education, then who will look after the household chores? Moreover, if they become literate they might have been taking parts in various activities outside their homes or might have been asking questions regarding the existing patriarchy which are not at all considered to be "good". This will be considered as an 'immoral' act or a great 'sin'. In other words, they should be only a silent listener and should pay their full attention towards daily chores at home. But women can play a very important role in the upliftment of socio-economic development of a nation. So, it is very important for the government to consider education for female folk as a national issue and should spend fund on them to make them educationally empowered so to make India a true democratic country in reality. In this paper, the researcher wants to bring forth the various educational schemes for girl child as implemented by the Indian government for their empowerment.

Keywords*: Education, women, patriarchy, literate, empowered*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

"Be self-reliant, be industrious
Work, gather wisdom and riches
All gets lost without knowledge
We become animal without wisdom
Sit idle no more, go, get education."
(Go, Get Education- Savitri Bai Phule)

Women empowerment is a debatable topic of today's global world. In vedic period, women of India got equal status with that of men and thus this period produced scholars like Ghosha, Lopamudra, Maitreyi and Gargi. They were the epitomes of intellectual and spiritual attainments. But in the modern days, women have to fight for their various rights including educational right; most of the times, they are subjected to discrimination and violence in terms of their gender.

The Indian constitution has given utmost importance to provide equal status and opportunities for both men and women since it has been penned down. There are various Articles, Clauses, etc. in the constitution that clearly states about the provisions for equality among all the citizens of India as well as support for the weaker section of society which includes women, children, differently-abled persons, Scheduled Tribes (STs) and Scheduled Castes (SCs). For instance, the Article 14 of the Indian constitution grants all citizens equality before the law of the land. Article 15 states that the state shall not discriminate against any citizen on the ground of religion, caste, sex, etc. Again, Article 16 states that there should be equality of opportunity in matters of public employment irrespective of sex, religion, caste etc. Article 45 is upon the provision for free and compulsory education for children until they complete the age of fourteen years. Article 46 is on the promotion of educational and economic interests of the STs and the SCs and other weaker sections of the society.

Thus, it has been seen that the Government of India has been trying to support and give a good life to all its citizens, especially, the weaker section as mentioned above. So, women should be provided equal opportunities and education regardless of their caste, religion, etc. at par with men. Though these provisions are there in the constitution, but due to the weak economic base of our Indian society, parents prefer not to send their children, especially, their daughters to school. Instead, they would prefer either to send them to do manual labour so to earn little money or to sit for child marriage. Thus, The Right of Children to Free and

ISBN: 978-91-987581-0-8

Compulsory Education Act or Right to Education Act (RTE), 2009 aims to provide free and compulsory education for children between the age group of 6 to 14 years under Article 21A of the Indian Constitution. It aims to give education to all children of India irrespective of caste, creed, sex, religion, etc. under this particular age group. But in reality, it has been seen that for a girl child this 'free' and 'compulsory' education is like a distant dream to be achieved. From time to time the Indian government has been trying to formulate various effective educational policies, schemes, reforms, reservation, etc. to make their condition or status better in Indian society. But various statistical surveys show that these initiatives have failed to give a chance to access for girls to get enrollment in schools or to pursue for higher education. As a consequence, women are subjected to child marriage, child labour, rape, murder, molestation and so on or have to sit on the pavements for begging.

The Census Report, 2011 shows that women are lagging behind as far as literacy rates are concerned (Male-82.14%, Female-65.46%). Again, according to National Family Health Survey (NFHS-5) male literacy at India level in 2021 stands at 84.4% and female literacy stands at 71.5%. There may be various reasons in this male-female gap in literacy rates. In India, under the influence of patriarchy, the birth of a boy child is very welcoming with grand celebrations and merry- making gatherings. He is like an asset for the family and a lot of money has been spent on his upbringing. Whereas, a girl child is seen as a burden on the family and thus gets least importance regarding the expenses on her upbringing like rearing, health, education, etc. Moreover, most of the important decisions have been taken by a male member of the family. On the other hand, a female member is always thought to be good at taking care of the family members, begetting children as well as rearing them. Thus, her status is subordinated to that of a man in every aspect in the society. But as we know that a society is consisted of both man and woman. The growth of a nation equally lies on the hands of both of them. Thus, she should be given equal opportunities and status so to bring prosperity not only to the society but for the whole of the nation. Thereby, the various educational policies of India have given the priority to provide education to female folk so to change the age old tradition of 'abla nari' to an empowered woman.

❖ EDUCATION IN INDIA CONCERNING WOMEN EMPOWERMENT:

Before the independence of India, there were glorious examples of people who encouraged and fought hard for female education which could

bring dignity and respect for them. Among them, Savitribai Phule (1831-1897), the first lady teacher of India had made a tremendous revolution against the caste system of India as well as for the upliftment of women education. Chandraprabha Saikiani (1901-1972), brought a historic change regarding female education in Assam. Besides, Indira Miri (1910-2004), popularly known as Mereng had put her effort in promoting education in the North East Frontier Agency (NEFA).

After getting the independence from the British rule on August 15, 1947 Indian government got the chance to mould educational policies according to the needs and aspirations of its citizens. Since then, Education Department in the Centre has developed in a full-fledged Ministry under the Central Government. The setting up of the University Education Commission which is popularly known as the 'Radhakrishnan Commission' in 1948 was a major landmark to set goals and objectives for higher education in India. It was the first education commission of independent India. Along with its various aims of education, it has given due priority to women education also and thus it stated: 'There cannot be educated people without educated women'. After that the Secondary Education Commission was appointed by the Government of India on September 23, 1952 under the Chairmanship of Dr. A.L. Swamy Mudaliar which is popularly known as the 'Mudaliar Commission'. The main aim of this Commission was to study deeply the various problems of secondary education and to suggest measures for reforms on aims of education, teaching arrangements, the relationship of secondary education with primary and higher education and so on. For girl's education, it had provided same education as for the boys through co-education but there should be provision of home science teaching for girls. It has also recommended for opening of girls' schools in the areas where required. Then in the year 1964 the Government of India appointed an Education Commission under the Chairmanship of Dr. D.S. Kothari which is popularly known as the 'Kothari Commission'. The basic priority of this commission was on the progress of the nation with the means of education. Thus, the Education Commission opened its report as: *'the destiny of India is now being shaped in her classrooms. This, we believe, is no more rhetoric. In a world based on science and technology, it is education, that determines the level of prosperity, welfare and security of the people'.* The National Policy on Education (NPE), 1986 recognised the empowerment of women is possibly the most critical precondition for the participation of girls and women in the educational process. The main features of the implementation strategy on women has consisted of, 'to

ISBN: 978-91-987581-0-8

gear up entire education system to play a positive interventionist role in the empowerment of women; to encourage educational institutions to take up active programme to enhance women's status and further women's development in all sectors; to widen women's access to vocational, technical and professional education at all levels'. Following this policy, there came up Mahila Samakhya programme in 1988 which recognized that education can be an effective tool for women's empowerment. Besides, prior to these recommendations, educational panel of the Planning commission recommended on July 1957 that, 'A suitable committee should be appointed to go into various aspects of the question relating to the nature of education for girls at the elementary, secondary and higher stages and to examine whether the present system was helping them to lead a happier and useful life'. Thus, the Government of India appointed the national committee on women's education under the Chairmanship of Smt. Durgabai Deshmukh. Moreover, the National Council of Women was established in 1958 to ensure the equal rights of women in society. Its major concern has been on promoting women's education in India along with socio-economic empowerment.

❖ PRIMARY EDUCATION IN INDIA:

The Sarva Shiksha Abhiyan (SSA) is a flagship programme of Government of India for the achievement of Universalization of Elementary Education (UEE) in a time bound manner. It is being implemented in partnership with State Government to cover the entire country and address the needs of 192 million children in 1.1 million habitations. It was launched in 2001-2002 with the aim to provide useful and relevant elementary education to all children in 6 to 14 age group by 2010. It has a special focus on girl's education. In the Manual for Planning for Appraisal (2004) it has been surveyed that majority of girls, especially adolescent girls, are deprived of education owing to various factors such as distance to schools, domestic chores, sibling cares and so on. So, the role of SSA has been found immense as it not only focuses on girl's education but also to ensure the availability of primary schools within one kilometer of the habitation of residence of children and upper primary schools within three kilometers of the habitation. In addition, in 2003 the National Programme for Education of Girls at Elementary Level (NPEGEL) was launched and implemented in Educationally Backward Blocks (EBB) to address the needs of girls who are 'in' and 'out' of school. It has given importance on the prevention of girls from dropping out of schools at primary level. It follows up on girls' enrolment,

attendance and learning achievement by involving village level women's and community groups. Beside this, the Kasturba Gandhi Balika Vidyalayas have been set up in 2004 in educationally backward blocks where schools are at great distances and is a challenge to the security of girls which often compel them to discontinue their education. These are residential upper primary schools for girls where 75% is reserved for Scheduled Castes (SCs), Scheduled Tribes (STs), Other Backward Classes (OBC) and other minor communities and 25% is for the girls from the Below Poverty Line (BPL) families.

❖ SECONDARY EDUCATION IN INDIA:

As SSA has taken the responsibility of elementary education, Rashtra Madhyamik Shiksha Abhiyan (RMSA) has come up as a flagship scheme of Government of India in 2009 to enhance access to secondary education with quality improvement and equity. In its revised programme in 2013, it has given emphasis on the Girls Hostel Scheme and National Incentive to Girls specially to encourage girls in secondary level of education.

❖ HIGHER EDUCATION IN INDIA:

India has occupied world's third position in higher education system after China and the United States of America. The Rashtriya Uchchatar Shiksha Abhiyan (RUSA) is a centrally sponsored scheme, launched in 2013 to provide strategic funding to eligible State higher educational institutions to improve their quality of education and delivery of services to students. It has also taken a number of steps to promote women's education like opening of women colleges in states like Jammu and Kashmir, Himachal Pradesh, Manipur, etc. as well as creation of women's universities across the country to facilitate higher studies to women.

❖ BETI BACHAO BETI PADHAO (BBBP):

Beti Bachao, Beti Padhao (Save girl child, educate girl child) is a Central Government Sponsered Scheme by GOI. This scheme was launched on 22 January 2015 with the tagline 'The Happiness of a Nation lies in the Dignity of its Daughters' with the overall goal of the scheme to celebrate the girl child and enable her education. It was launched by honourable Prime Minister, Narendra Modi from Panipat, Haryana on the occasion of International Day of the Girl Child as a mark for the eradication of female foeticide against the issue of declining Child Sex

ISBN: 978-91-987581-0-8

Ratio (CSR) in India. It acts as a campaign of the Government of India that aims to generate awareness and improve the efficiency of welfare services intended for girls in India. Under this scheme there is an additional scheme, namely, Sukanya Samriddhi Account which encourages parents to build a fund for the future education and marriage expenses for their female child. This account can be opened at any Indian Post office or branch of authorized commercial banks.

❖ UDAAN: A PROGRAMME TO GIVE WINGS TO GIRL STUDENTS:

It is a project launched by Central Board of Secondary Education (CBSE) under guidance of Ministry of Human Resource Development (MHRD). It was launched to address the low enrolment of girl students in prestigious engineering institutions and engineering entrance examination. It is going to provide a platform for empowerment of girl students and will provide better learning opportunities for them. It will be acting like a support for the deserving girl students to pursue higher education in engineering programmes and would assist them to prepare for IIT-JEE examinations to crack through to the best technological institutes in the country while they would be in 11^{th} and 12^{th} standards.

❖ SAINIK SCHOOLS:

The Sainik School was established in 1961 by V.K. Krishna Menon, the then Defence Minister of India to rectify the regional and class imbalance amongst the officer cadre of the Indian Military and to prepare male students mentally and physically for entry into the National Defence Academy (NDA) and Indian Naval Academy (INA).Since then, it has been seen that there are 33 Sainik Schools all over India which have the provision for entry only for boys. But 75^{th} Independence Day of India, 15^{th} August 2021 has been like a red letter day for girl aspirants to enroll themselves in Sainik Schools. It was announced by honourable Prime Minister of India, Narendra Modi that the Sainik Schools will be opened for the enrolment of as well to fulfil their aims and to show their capacities in the field of defence. But before this historical announcement, Mizoram has already set the example to be the first state in India to enroll girl aspirants in Sainik Schools in 2018. It opens the doors of quality training of girl cadets at par with boys for their empowerment in defence sector also.

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❖ GOVERNMENT TECHNICAL UNIVERSITY FOR WOMEN:

Indira Gandhi Institute of Technology was established by Department of Training and Techincal Education, Govt. of Delhi, in 1998 as the first woman Engineering College in India. But this institute was converted to Indira Gandhi Delhi Technical University for Women (IGDTUW) in 2013 vide Delhi Act 09 of 2021, as a non- affiliating University to facilitate and promote studies, research, technology, innovation, incubation and extension work in emerging areas of professional education among women, with focus on engineering, technology, applied sciences, architecture and its allied areas with the objective to achieve excellence in these and related fields.

❖ CONCLUSION:

The above mentioned schemes and initiatives that have been taken by the Government of India for the upliftment of women has been gaining a good momentum for their empowerment to be independent in every aspect of our society. As free and compulsory education is there by dint of SSA, child labour has been diminishing day by day. Parents prefer to send their daughters to school instead of sending them for bonded labour under unruly masters. Moreover, RMSA and RUSA are also playing great role to provide education in secondary and higher level of studies. Thus, a large number of girl's enrolment has seen in secondary and higher levels of education instead of getting married and begetting children very early in life. As a consequence, they are getting 'wings' to excel in the field of education and to bring glory to our nation.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.012

DEVELOPED AND DEVELOPING ECONOMY MEANING AND CONCEPT

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❖ ABSTRACT:

Economic development is the process by which developing countries become developed economies. In other words, the process by which countries with low living standards become nations with a higher standard of living. Economic development also refers to the process by which health, welfare, and the level of education in general society improve. During development there is a shift in people from agriculture to industry, and then to jobs. The average life expectancy, for example, is one of the consequences of economic development. Improved productivity, higher literacy rates, and better public education, are also results. In Simple words economic development is about improving the quality of life. 'Improved living standards' refers to higher levels of education and learning, staff income, health, and years of life.

Keyword*: Economic Development, Enhanced Production, Literacy, Health, Lifespan.*

❖ INTRODUCTION:

- **Developed Economy: Definition and Concept.**

A developed economy is a sign of a developed country with a high level of economic growth and security. Common criteria for assessing the level of national development per capita income per household or product, industry standard, standard of living, and value of technology infrastructure. Non-economic factors, such as the Human Development Index (HDI), which measures national standards of education, literacy, and personal health, can also be used to assess economic or developmental status. The most common metaphor used to determine whether the economy is developing or developing is per capita gross domestic product

(GDP), although there is no solid basis for the economy to be considered as development or development. Some economists consider $ 12,000 to $ 15,000 per person's GDP as sufficient for a developed state while others do not consider a developed country unless the individual GDP is above $ 25,000 or $ 30,000. The highest GPA shares in 2019 were 65,111 US dollars. In lands where segregation is difficult, economists are turning to other factors to determine the state of development. Standard life measures, such as infant mortality and life expectancy, are effective although there are no set limits on these measures. However, most developed economies face the death toll of less than 10 per 1,000 live births, and their citizens live to be 75 years or older on average. Individual high GDP alone does not provide an improved economic situation without other factors. For example, the United Nations is still looking at Qatar, which has one of the highest GDP in the world in 2019 at $ 69,688, a developing economy because the country has extreme income inequality, lack of infrastructure, and limited education opportunities for wealthy citizens. Examples of developed countries include the United States, Canada, and most of western Europe, including the United Kingdom and France.

❖ DEVELOPING ECONOMY: DEFINITION AND CONCEPT:

The Developing economy also known as the less developed economy or is a nation with an underdeveloped industrial base, with a lower Human Development Index (HDI) compared to other countries. On the other hand, since the late 1990's, developing economies have been showing higher growth rates than developed ones. There is no general, agreed standard of what makes a developing country comparable to a developed country and which countries are eligible for these two categories, although there are areas that are referred to as GDP per capita compared to other nations. Also, the common denominator of a poorly developed economy should not be confused with a less developed country. Terms such as "emerging countries," "least-developed countries," and "developing countries" are often used to refer to countries that do not enjoy the same level of economic security, industrial development, and growth as developed countries. The term "third-world country" to describe the world today is considered old and invading. The United Nations Conference on Trade and Development notes that the less developed countries in the world are considered to be the most disadvantaged in their development — many of them for local reasons —

ISBN: 978-91-987581-0-8

and are at risk of poverty. "Proponents of globalization often claim that globalization contributes to the development of impoverished economies and to the development of improved living standards, higher wages, and the use of modern technology. These benefits have been proven primarily in the Asia-Pacific region. We have already said that globalization comes with obstacles and need to be considered when foreign investment enters a developing economy.

❖ DIFFERENCES BETWEEN THE DEVELOPED AND DEVELOPING ECONOMY:

- **GDP (Gross Domestic Product)**

In addition, developed countries have a much higher GDPS while less developed countries have a much lower GDPS. The GDP of developing countries, on the other hand, takes a median price between the two.

- **HDI (Human Development Index)**

Developed countries have very high HDI, while less developed countries have very low HDI. The HDI of developing countries, on the other hand, occupies a median value between the two.

- **Technology and Utilities**

People in developed countries have easy access to the latest technological advances, enjoy better health care, education, and other services, while people in developing countries may have access to technology, and health care, education, and other services are at a higher level. On the other hand, the vast majority of people in developed lands have no access to education, health care, or other basic services, and most do not have access to technology.

- **Quality of Life**

The standard of living in developed countries is high, while the standard of living in underdeveloped countries is very low. The standard of living in developing countries are somewhere in the middle.

- **Examples**

Norway, Denmark, Austria, the US, Switzerland, and Canada are some examples of developed countries. India, Indonesia, Nigeria, Saudi Arabia, Russia, and South Korea are some examples of developing countries.

ISBN: 978-91-987581-0-8

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ISBN: 978-91-987581-0-8
DIP: 18.10.9198758101.013

TOWARDS DEVELOPMENT IN POST PANDEMIC INDIA

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❖ ABSTRACT:

The Post Pandemic World needs to rise and shine. There is an urgent need of development. As usual, Women have taken a lead to rebuild their homes, their careers and their own self confidence. Women enter entrepreneurial careers to gain a sense of accomplishment and achievement, as opposed to their male counterparts, who start their businesses for the sake of growth opportunities and profit potential (Hillstrom). Covid-19 presents a proverbial golden opportunity for women entrepreneurs. Women from all sectors and segments of the economy are responding to this extraordinary shock with zeal, agility, and optimism. Vital ecosystem participants must step forward to support women in India and thus unlock this demographic asset. This chapter is an attempt to portray the Post Covid-19 scenario for women entrepreneurs, their trials and tribulations and ways to overcome the same.

Keywords: *entrepreneur, Covid-19, adversity, development*

❖ INTRODUCTION:

The word "entrepreneur" is derived from the French words "entrée" which means "to enter" and "prendre" which means "to take," which connotes "undertaker," but in common terms, entrepreneurs are those who start their own company. They are, nevertheless, the true geniuses who help to strengthen the economy (Rani, 1996). In any culture, the entrepreneur is a powerful force to reckon with. Entrepreneurs are people with a vision, they play a critical part in any country's economic growth (Vinze, 1987).

ISBN: 978-91-987581-0-8

Women are gaining more knowledge and competing equally with their male counterparts in every domain as a result of urbanisation and increased industrialisation. They contribute equally to economic development, whether in the organised or unorganised sectors, as a self-employed person or as an entrepreneur. Women's involvement in productive activities has risen steadily over the ages. However, they are primarily employed in the unorganised sector. (Vinze, 1987).

For women, entrepreneurship is an important option because it not only allows them to be financially independent, but it also allows them to pursue a variety of lifestyle options. It also encourages them to be self-determined and to speak out against discriminatory practises. According to some experts, greater female economic independence promotes geopolitical stability and world peace (Forbes).

Women entrepreneurs in India have faced adversity and criticism on their path to self-sufficiency. Before they could establish themselves as independent entrepreneurs, they had to overcome family opposition and social constraints (Vinze, 1987). Women have their own motivations for starting their own businesses. Women enter entrepreneurial careers to gain a sense of accomplishment and achievement, as opposed to their male counterparts, who start their businesses for the sake of growth opportunities and profit potential (Hillstrom).

Indian history bears witness to the fact that entrepreneurship has always been a male domain (Panchanatham, July 2011). However, increasing educational qualifications, social awareness, and the desire among women to be self-sufficient has prompted more women to pursue entrepreneurship as a career.

❖ ROLE OF WOMEN DURING THE PANDEMIC

Due to supply chain interruptions, the pandemic has impacted self-employed women (including mompreneurs and women of self-help groups), who account for over half of all working women in India. Women-owned businesses have been struck worse by the epidemic than men-owned firms, particularly in the hardest-stricken industries. In addition, nonpayment of past salaries and current arrears has exposed these women and their families to economic shocks.

In the immediate aftermath of the lockdowns, between March and April 2020, an estimated 17 million to 19.3 million women (Misra and Patel 2021) were unemployed (Abraham et al 2021). It's worth noting that women are overwhelmingly represented in high-impact sectors like commerce and services. Personal and non-professional services, which

ISBN: 978-91-987581-0-8

include small-business owners such as tailors, dressmakers, petty shopkeepers, barbers, and beauty salon owners, as well as domestic help and part-time workers, had higher volatility than other industries. Male employment plummeted by 30% and female employment fell by 43% as a result of the lockdown (Abraham et al 2021).

During the pandemic, more women-led businesses (72 percent) reported cash shortages than male-led businesses (53 percent) (Buteau and Chandrasekhar 2020). When compared to men, more women entrepreneurs (69 percent) reported deferring loan payments (50 percent). However, two studies (Buteau and Chandrasekhar 2020; Chawla et al 2020) discovered that women were more confident than men in the full recovery of their businesses. In fact, they showed signs of adapting to the pandemic's changes, with more than 54 percent already making a "business shift" such as adding new products and services. Another 24% intended to make a business change by the end of the year. (Sunil 2020). For example, Shiji, from Kerala turned into an entrepreneur during the Lockdown as she had to tend to her daughters and parents after losing her job with a motorcycle shop during the pandemic. She searched the internet and talked to a farmer in Gujarat and started making papads with vegetable extracts.

While COVID-19 has a disproportionate effect, recovery has been in favour of men. When compared to the pre-pandemic period, men's employment levels were 9.5 percentage points lower than women's, with men's employment levels rising by August 2020. (Deshpande 2020). After controlling criteria such as caste, religion, age, degree of education, employment arrangement, industry, and state of domicile, women were eight times more likely than males to have lost their jobs. Self-employment may have provided a "cushion" for those who have lost jobs in both the formal and informal sectors (World Bank 2020).

Women have been hit harder due to Covid-19 as compared to their male counterparts. They bore extra responsibilities of household chores and caregiving which made a huge impact on their mental, physical and psychological well-being. In most of the homes, support from the male members of the family was minimal which led to less time being spent on their entrepreneurial efforts by the women. Despite these hardships, most women felt that the time they spent in caregiving, running a household, or assisting their spouse's business had remained the same. Others believed that time spent on household work (43 percent) and unpaid work (38 percent) had increased during the pandemic. This is supported by questions about stress levels, in which women entrepreneurs consistently

reported moderate to extremely high levels of stress regarding household responsibilities, staying locked in, and increased expenses.

❖ LESSONS LEARNT - POST COVID-19 SCENARIO:

Generally, businesses owned by women-owned in India are service-oriented, smaller, and less capital-intensive, which led to faster adaptation to changing environments than larger or more capital-intensive businesses. Clothing manufacturers quickly adapted to manufacturing safety equipment (masks, gloves, PPE kits), coaching centres and gyms dramatically increased their clintele by holding "virtual classes," and food and beverage businesses shifted to a new slogan, "vocal for local", positioning to reach a wider audience digitally are examples of the adage, ‘Change is the only Constant’.

A majority of the entrepreneurs' businesses have not recovered to pre–Covid-19 levels. Following a sharp drop in March and April as a result of the lockdown, business growth is now about one-third of pre–Covid-19 levels. Only a few entrepreneurs have been able to return to pre–Covid-19 levels. Enterprises that had already experimented with or adopted digitalisation in various aspects of their business model recovered the fastest.

Despite short-term recession, entrepreneurs are optimistic about the recovery. According to a survey conducted, ninety percent of entrepreneurs believe they will be able to survive the crisis, with two-thirds believing major changes to their business model and cost structure will be required. Eighty percent of entrepreneurs expect demand to return to pre-lockdown levels by the year end.

Women have been quick to change their business models in order to be more relevant. In response to Covid-19, 54% of the women we interviewed have already changed their business model, and another 24% plan to do so by December. Only 6% believe they will be unable to change their business model. Approximately 60% of women have included new products or have started offering new services, 35% of them have shifted over to digital sales and delivery channels, 26% have reoriented supply chain or sales marketing function. While many of them have undergone fresh training a few of them have picked up new skills to be ahead of time. Covid-19 has proved to be a blessing in disguise for working women in India. There is a definite shift in increased recognition and support for women's contributions to family income. Because of the widespread negative impact on jobs and incomes, there is a greater familial and societal acceptance of women working formally, which can strengthen

ISBN: 978-91-987581-0-8

women's role in providing financial support to their families. Thirty percent of respondents believe there will be an increased need to work due to economic uncertainty, while 20% believe there will be a greater acceptance of work among family and community.

Quite surprisingly, up to 30% of women believe that working from home increased their productivity and allowed them to prioritise better. Simultaneously, Covid-19 has pushed the broader ecosystem to rapidly adopt digital business methods. Transactions have moved online as suppliers, customers, and employees adopted remote models; and as B2B commerce has scaled up, entrepreneurship has become more accessible to women. Beyond the difficult near-term circumstances, these shifts toward virtual or remote interactions have the potential to create a more enabling environment for women, who frequently face competing responsibilities that limit mobility. 45 percent of our respondents believe that increased adoption of remote work will make it easier for them to run their business successfully in the future.

Governments need to play a critical role in recognising and elevating female entrepreneurship as a key for reviving economic activity in the current environment. Priority initiatives include a state-led "call to action" for women to directly participate in the economic reconstruction effort, backed up by tailored government-led digital interventions to attract and empower women-run businesses. Multiple Digital India initiatives, for example, such as the engagement of small and medium-sized enterprises (SMEs) and the Aatmanirbhar Bharat Innovate Challenge, should be tailored to drive greater participation and enablement of women. Better still, Azadi ka Amrit Mahotsav and Ek Bharat Shrestha Bharat Campaigns can include schemes and competitions for women entrepreneurs.

The Government must move quickly to promote gender equality in the post-COVID era by financially boosting women-led enterprises. Schemes that bring together the public and private sectors to speed up technology adoption, innovation, and digital skills training for people with disabilities need to be implemented to revive the economy of the nation in general and motivate women in particular. Funds should be earmarked for MSME's and emergency loans must be created to streamline requirements for small businesses.

Women entrepreneurs should have access to adoption, innovation, and digital skills training, as well as improved financing and tax help. Programs, possibly in collaboration with state governments, aimed at assisting women entrepreneurs in starting and scaling businesses in high-

growth sectors such as EdTech, B2B commerce, health and nutrition should be initiated.

Women-focused Covid-19 recovery programmes, which include capacity building, data tracking, and infrastructure enablement, need to be implemented through collaborations between private and non-governmental organizations.

The most important change required is the change of perception in society, by celebrating the educational, health, and economic benefits of women's labor-force participation. Men (and families) who model positive behaviours should share domestic responsibilities. Formal and informal networks will help foster inclusivity in virtual and physical interactions. This will help reduce the gender gap in society and lead the nation towards development.

External shocks have a powerful impact on societies. This crisis presents a proverbial golden opportunity. Women from all sectors and segments of the economy are responding to this extraordinary shock with zeal, agility, and optimism. Vital ecosystem participants must step forward to support women in India and thus unlock this demographic asset.

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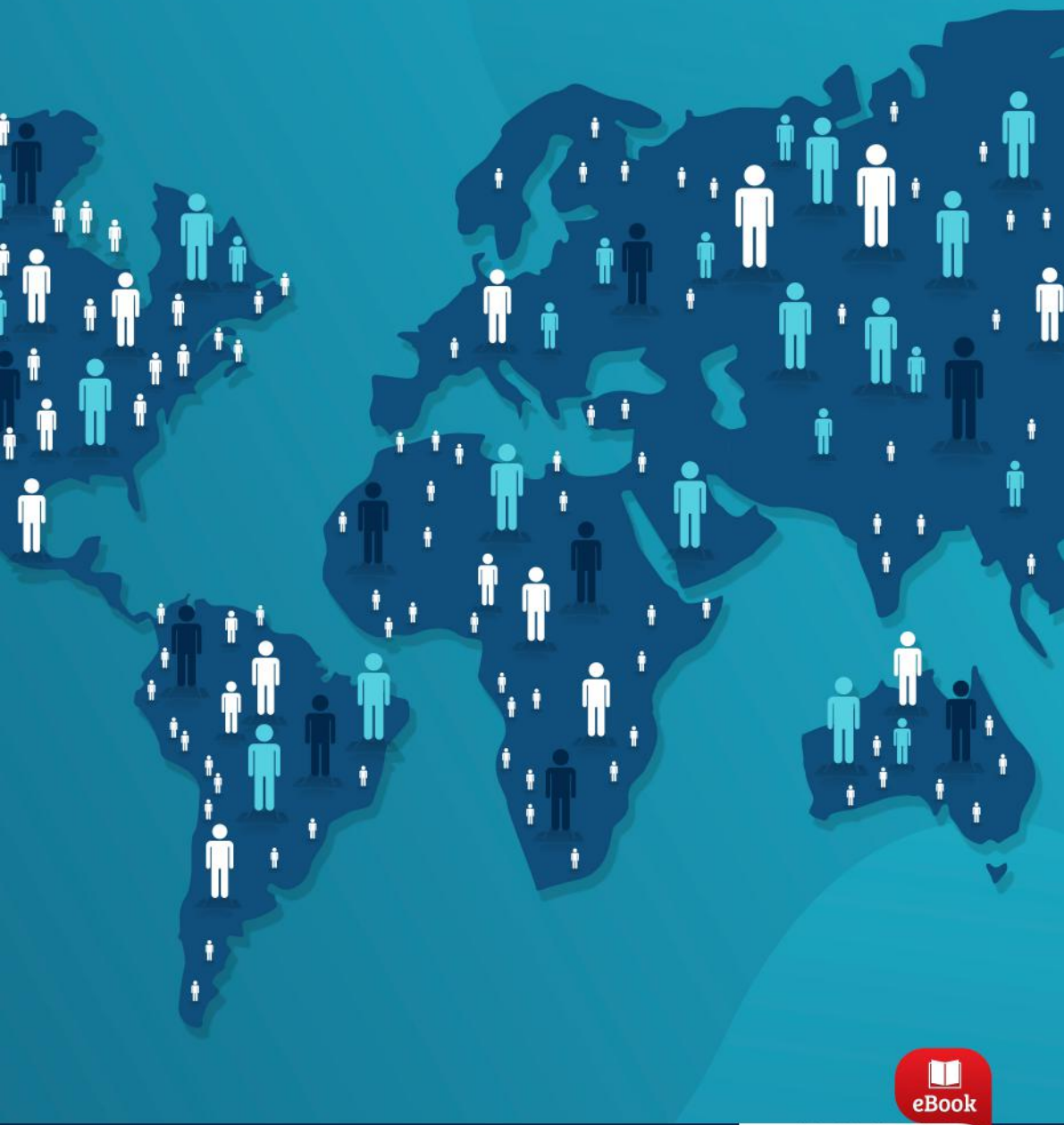

eBook

ISBN 978-91-987581-0-8

red'shine Publication SWEDEN

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Smart and Sustainable Cities: A Systematic Review

Smart Cities for India

National Conference on Sustainability IN Built Environment(NCSBE 2020)

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***Abstract* - To support the rapid increase in economy and urbanization and to mitigate the issues emerging due to continuous growth and development there is an urgent need for a reasonable plan of action and a unified approach. The concept of smart and sustainable cities has turned up as one of the smartsolutions. However, urban areas in a developing country like India lack not only basic amenities but also the basic infrastructure because of different reasons which range from improper administration and absence of appropriate planning, management and evolving lifestyles. This paper attempts to find out the need and relevance of the smart city projects that are undertaken by the government of India by comparing the ongoing or already completed projects internationally. This was done by comparingthe initiatives undertaken by the government of India to the initiative undertaken by Dubai and Singapore in the light of smart characteristics derived from the definitions of smart cities. The paper ultimately seeks to evaluate the challenges faced by the Indian government and planners while implementing the smart city proposals. The results convey thatdevelopment of a city, as a smart and sustainable city depends on local setting factors and project management.**

Key words-Implementation approaches, Indian Perspective, Smart cities, Smart Dubai plan, Smart Nation Singapore, Sustainability.

SMART CITIES: INTRODUCTION

People relocate to urban communities essentially for work. To help themselves with congenial living, they likewise need a good quality of all the basic amenities may it be housing or utilities like water, sanitation, power, clean air, medicinal services, security, amusement, and so on. Production units located in cities become an agglomeration economy which gives simple access to employment and different components of manufacturing. In this scenario, Smart Cities are the ones which are dedicated to impart all these facilities. A great foundation, straightforward online procedures that make it simple to set up and run any venture effectively are significant for the prosperity and success of not only the nation but its citizens as well. There exists many definition of a smart city. It means different to different people, state, or a country. One of the definitions suggests a Smart City is a city well performing in 6 characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens: Economy, Mobility, Environment, People, Living, Governance (Giffinger, 2007). Increase in population of urban areas has led to enormous increase in the consumption of resources. This has, in turn, created another challenge of creating smart cities that are sustainable.U4SSC defines a sustainable smart city as "an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects" (U4SCC, 2016). This implies that sustainability should be among thestrategic goals of Smart Cities.

METHODOLOGY

The vision, primary issues and priorities of the citizens of any city play a significant role in planning and management of smart cities. Since every city has varyingpositive and negative qualities, their particular paths to building up a smart city are likely to be different.This papermakes an attempt to compare the different paths taken by three growing national initiatives, namely India, Dubai and Singapore. The choices of countries/ states were made based on the Global Competitiveness Report (GCI)and Network Readiness Index (NRI).

TABLE 1
THE GLOBAL COMPETITIVENESS INDEX 4.0 2019 RANKINGS OF SELECTED COUNTRIES

Country	2018-19	2019-20
Singapore	2	1
UAE	33	25
India	58	68

Table 1 and Table 2 give an idea that Singapore is an all-rounder in terms of economy and network-readiness. India is at the lowest position whereas UAE is almost averagely placed between Singapore and India.Present methods and ways to deal with the implementation process of smart cities

TABLE 2
NETWORK READINESS INDEX-2019 RANKINGS OF SELECTED COUNTRIES

Country	2018-19	2019-20
Singapore	1	2
UAE	26	29
India	91	79

in different nations are majorly determined by initiatives taken by the government and motivating factors for public-private involvement. However, Global Competitiveness Report and Network Readiness Index can be another mode of kick start for the nations to drive their smart city goals. Covering 141 economies and presented by the World Economic Forum yearly, Global Competitiveness Report measures national competitiveness defined as the set of institutions, policies and factors that determine the level of productivity and long term economic growth of a nation. It gives ranking on 12 drivers of growth including infrastructure and ICT adoption amongst others (WEF, 2019).Similarly, assessment of network readiness of more than 120 economies is done every year using the Network Readiness Index provides holistic framework for assessing the multi-faceted impact of ICT on society and the development of nations (Portulans Institute, 2019).

From the viewpoint of Smart city execution, the above two markers are a decent beginningby which countries can determine where they stand amongst other countries on the smart city parameters and therefore how they should move forward with smart city solutions. While NRI will mention thedigital readiness of the country that is indispensable for smart solutions, Competitiveness positioning will givenoticeable knowledge on how the public-private models will work under the given conditions and rules for smart cities.

Next,the perspectives of a smart city of the three selected nations were obtained by analyzing smart city vision statements and smart city implementation approaches.Local reports and guidelines from the states on Smart city plans ofSingapore, Dubai and Indiawere studied in detail for exploringtheir visions and initiatives.

I. Singapore: The Smart Nation Plan

The Smart Nation plan for Singapore was launched in November 2014. The vision statement given by the Prime Minister Lee Hsien Loong in 2014 is:

"Therefore our vision is for Singapore to be a Smart Nation – A nation where people live meaningful and fulfilled lives, enabled seamlessly by technology, offering exciting opportunities for all. We should see it in our daily living where networks of sensors and smart devices enable us to live sustainably and comfortably."

The amalgamation of public and private sector is playing the key role in achieve this vision. According to U4SSC,Singapore has aimed to achieve this by integrating the aspect of 'smartness' into its city planning and incorporating ICTs into economic and domestic sectors, to improve energy efficiency at the household and business level and to promote intelligent sustainable buildings, efficient water management, better education and awareness related to smart initiatives (U4SSC, 2016).

Key pillars that support Smart Nation goals aredigital economy, digital government and digital society(Pillars of Smart Nation, 2020). People, all the private organizations and public firms have a key role to play in achievement of the goals. According to recent reports, Singapore is persistently driving the ICT revolution and digital movements, particularly e-administration and smart city solutions.According to a report published by the Singapore Authorities on Smart City vision, an all-inclusive and extensive plan has beenillustratedwhich includes institutes of higher education in Singapore and health facilities, funding for research and development work and quickly developing network of new businesses related to technologies. The Next Generation smart city plan of Singapore is based on the presumption that comprehensive use of ICT by the government and private companies will help not only in better livings but also prominent business openings. This is validated by the fact that Singapore offers most promising and encouraging business and development conditionsacross the world and is profoundly positioned for the nature of its administrative structure. To achieve the goal of digitalization throughout Singapore, numerous strategic national projects have been identified. A good caseexample of this is the 'virtual Singapore.'It is the 3D digital platform that will empower the government, organizations and society to run simulations and make amendments in the planning using a high-scope city model of Singapore. This helps in making the long-term decisions on infrastructure and resource-planning (Initiatives, 2020).

II. Dubai: Smart Dubai 2021

In March 2014, Sheik Mohammed made an announcement to change Dubai into a Smart City. The objectives of Smart Dubai plan include **smart living, smart economy, smart people, smart mobility, smart environment, and smart governance**. In a new announcement, he has envisioned Dubai to be the happiest city on the earth. The official website of smart city 2021 Plan was explored in detail to understand the vision and initiatives taken by UAE government(Smart Dubai 2021, 2020).

"We are making Dubai the happiest city on earth by embracing technology innovation making Dubai a more seamless, safe, efficient and personalized city experience for all residents and visitors."

The Smart Dubai initiativeorganizes its ultimate objectives over a deliberately created set of key pillars (Fig. 1). These are Efficient, Seamless, Safe and Personalized. The pillars give an unmistakable perspective on the effect the city needs to make, tandem with all public and private partners.

FIGURE 1
PILLARS OF SMART DUBAI INITIATIVE

FIGURE 2
THE CITY'S TRANSFORMATION AGENDA: SMART DUBAI 2021

The above city's transformational Agenda (Fig. 2)characterizes a city wide approach to deal with the accomplishment of four objectives of Smart Dubai.The methodology highlights 6 key areas and 100 initiatives to tackle these areas of interventions. These 6 areas of intervention are:

- Transportation
- Communication
- Infrastructure
- Electricity
- Economic services and
- Urban and environmental planning

In a nut shell, the plan focuses on creating positive impact on three major areas including citizens, finance and economics and overall city environment including resource and infrastructure. All this is achieved by harnessing technology and ICT innovations.

On realizing that the consumption of resources and efforts that were put in were being doubled because of the absence of government-wide electronic shares services (ESS), The Dubai Government ESS initiative came into conceptualization which evolved as Smart Dubai initiative in 2014. Due to the implementation of ESS, the need for government entities to individually invest in ICT equipment and installation has considerably reduced. Consequently, this plan has led to reduced carbon emissions and a positive impact on the environment(U4SSC, 2016).

III. India: The Indian Smart Cities Mission

The process of urbanization is ever increasing throughout the world, and India is no less impacted by it.India, a developing nation, is seeing a rapid shift of people from rural to urban areas which increased to 31 % in 2011 and is likely to grow to 40% by 2030 and more than 50% by 2050. Due to this enormous boom in the population size of cities, the government is facing challenges related to infrastructure and delivery of services. Serving to the ever increasing needs of urban areas, authorities have come up with the solution of smart cities. Smart Cities Mission is a national initiative by the Ministry of Urban Development to build a foundation for 100 smart cities in five years (FY 2015-16 to FY 2019-20) (Gupta & Hall, 2017).

Smart Cities Mission Guidelines issued by the government of India does not have a holistic and comprehensive approach for the vision of smart cities. This is due to the fact that Indianstates and cities have diverse characteristic and therefore, one Smart City vision cannot be implemented to all the urban areas. Every city needs to figure its own idea, vision, strategic arrangement for a Smart City Plan.

The main objective of the Mission is to drive monetary development and enhance the standard of living of the citizens, their well-being and welfare by an area-based development of neighborhoods that has three segments:

1. city improvement (retrofitting),
2. city renewal (redevelopment) and
3. city extension (greenfield development)

All these initiative and smart solutions are applied pan-city to cover larger parts of the specific urban area.

The MoUD initiated the SCM through the IndiaSmart Cities Challenge. To take part in this challenge, Indiancities competed for central government funding by submitting a smart city proposal (SCP).As of now, 60 cities (from the list of 100 proposed smartcities) have been shortlisted in the SCM and provided withinitial funding for SCP implementation (Gupta & Hall, 2017). These cities will contend with each other in order to come up with designs and become models. For this, sustainability has been mentioned as the key component by the government. With the increasing frequency of natural disasters, abnormal weather patterns and the looming threat of global warming, the concept of a smart city must be merged with sustainability for the welfare of people and our planet as a whole (Ratan, 2015).

ANALYSIS AND FINDINGS

The reasons of why India is holding a backseat in becoming a smart nation were analyzed through the studies of the overall nature of Singapore and Dubai as a nation.

Firstly, what matters is the population size. India is a vast nation in terms of population. Justifiably, Singapore and UAE are smaller ones with digital infrastructure already developed and in place. This is already established by their rankings in the WEF reports. So, a country like India which is a developing country with a large population size definitely needs to first establish itself as a good infrastructure ready nation at a smaller, may be district level before plunging itself straightaway for a larger goal of smart cities.

Secondly, as stated above, the smart city model of Singapore is based on its infrastructure and relies largely on its public-private partnership. Also, the participation of citizens has been instilled under strong government initiatives for 30 years. Henceforth, their vision for smart cities is driven by KPIs. They have set up different stages of

KPIs to be accomplished in specific terms particularly on transportation and energy utilization. Monitoring this implementation work by the government is a task and Singapore no doubt is excelling in it by prioritizing their KPIs. On the other hand, Dubai, one of the seven emirates of UAE is under focus by its federal government, and is closely similar in population size and economic profile to the Singapore. UAE model is to empower "smart districts" contending each other to accomplish the objectives of smart city while the Dubai Government is effectively giving an incorporated digital stage for managing data, infrastructure and resources. From Indian viewpoint, detailed point by point levels of introspection is required to permeate the targets and more extensive guidelines for the Smart City Plans which can be converted into feasible models are needed.

In a nut shell, Smart Nation model of Singapore is more KPI driven with clear order that it is feasible by rousing and empowering public-private associations. Similarly, Dubai Smart City plan puts weight on government empowerment and unified data control. The two methodologies are legitimate given their targets and guidelines and will additionally be evolving as Smart City ventures advance.

TABLE 3
COMPARISON OF THE SMART CITY FEATURES OF SINGAPORE, DUBAI AND INDIA
SOURCE: AUTHOR

Characteristics	Singapore	Dubai (UAE)	India
1. Smart Energy	Smart Urban Energy Smart Environment Clean and renewable energy	Smart Environment Smart District Certification Smart remote working Tools	Energy Management
2. Smart Building	Smart Building Green mark Certified Buildings (80%) Zero energy Building in 5 yrs. Smart Towns	Smart Buildings Centralised Mgmt. of Building Assets Security and Access control Lighting Management HVAC & CWS Management	Energy efficient and Green Building
3. Smart Security	Smart Security Smart Elderly Alert System	Fire Alarm System Management Smart Homes Home Energy Management Home safety & Security Home Automation Home Health Home Infotainment	
4. Smart Technology	Smart Technology Broadband Penetration (100%) LTE Coverage Smart Home Solutions (50%house hold)	Smart ICT Infrastructure Unified Control Centre Wireless Communication Predicts Analytics Platform (for collaborative social activities)	
5. Smart Mobility	Smart Mobility 70% traffic by Public Transport Real time travel Information by mobile/Web 40% rebate on purchase of Green Vehicles	Smart Mobility Infra for Smart Roads , Bridges, Tunnels Intelligent Transport system Smart Traffic Parking management	Urban Mobility Smart Parking Intelligent Traffic Management Integrated Multimodal Transport
6. Smart Infrastructure	Smart Infrastructure Smart Water Meters Digital innovations in planning	Smart Infrastructure Smart Water Irrigation Smart Waste management Smart Sewage Water	Water Management (smart meters, leakage, Water quality, management Waste Management (waste to energy, compost reduction of C&D waste)
7. Smart Governance	Smart Governance Inter-ministerial committee for sustainable development OneService App	Smart Governance Public realm Fidelity management	E-Governance and Public Info, grievance redressal Electronic service delivery Citizen Engagement –Citizen Eyes & Ears Video crime Monitoring
8. Smart Healthcare	Smart Healthcare Integrated Health Info system Cloud computing Model in Healthcare	Infra Management Including Procurement Operations managed Managed security	Tele medicine
9. Smart Citizen	Smart Citizen Commute to work by Public Transport (50%) 100% population access to sanitation, Waste Recycle 65%	Digital Services	Incubation, Trade Facilitation centre Social development Centre
			Components of sustainability: ----------

Next, a comparative analysis was done keeping smart city characteristics as major parameters of comparison. Listing of these characteristics is based on compilation of various definitions of smart cities. These smart characteristics are:

1. Smart Energy
2. Smart Building
3. Smart Security
4. Smart Technology
5. Smart Mobility
6. Smart Infrastructure
7. Smart Governance
8. Smart Healthcare
9. Smart Citizen

Table 3 compares the smart city features as provided by the governments of Singapore, Dubai and India. Noticeably, all three nations are taking steps forward towards sustainability. It is very evident from the studies that 'smartness' to a large extent results in sustainability. However the proportion of incorporating the features which lead to sustainability, visibly, is different (table 4).

TABLE 4
COMPARISON OF THE COMPONENTS OF SUSTAINABILITY
SOURCE: AUTHOR

Characteristics	Singapore	Dubai (UAE)	India
1. Smart Energy	+ + +	+	+
2. Smart Building	+	-	+
3. Smart Security	-	+	-
4. Smart Technology	-	-	-
5. Smart Mobility	+	-	-
6. Smart Infrastructure	+	+ + +	+
7. Smart Governance	+	-	-
8. Smart Healthcare	-	-	-
9. Smart Citizen	+ + +	-	-

All three countries are in favor of moving towards smartness in energy and are providing features resulting in energy efficiency. Smart and sustainable building aspects have gained popularity in Singapore and India whereas Dubai is only focusing on smart parameters. Smart security feature has been dealt by Singapore and Dubai in good capacity, which remains absent in India. Similar trend has been seen for smart technology. However Dubai takes a front seat in initiating sustainable parameters in the above two features by proving home energy management and unified data control through ESS respectively. All the nations are working to provide smart mobility solutions and smart governance, with Singapore leading on the sustainability front in both. Importance of Smart infrastructure, mainly water is clearly visible in the corresponding features of all three nations.Sustainability feature is lacking in the smart healthcare parameter of all three nations. Singapore is leading in making its citizens smart, followed by Dubai and then India.

It is clearly evident from table 4 that India is lagging behind in the development of smart and sustainable cities. This is due to various challenges faced by Indian Smart City Mission in its execution and rollout.

One of the major challenges is to replace the existing infrastructure of a city to prepare it for smart city. Any city can only become a sustainable smart city once it has achieved the level of a developed city. An underdeveloped city or a developing city will face a lot of struggle in reaching the goal of becoming a sustainablesmart city.

Furthermore, managing a multivendor environment is a difficult task. Programming and software framework in Indian urban areas contains components provided by various merchants. Subsequently, the potential required to deal with complex mixes of smart city solutions created by numerous sellers turns out to be huge. That is why features like security and technology are absent from the components of smartness as well as sustainability.

Moreover, another area of concern is the sort of business and work opportunities these smart urban areas will create. No doubt that the smart city will act as a focal point of financial development, it ought to likewise give the correct blend of means of living to those moving to it. Else, the relocation of individuals will keep on representing a danger to the social and financial situation of the city. Innovative solutions corresponding to Smart governance, smart healthcare and smart citizens will surely help in dealing with this challenge.

CONCLUSION

The findings of this research has uncovered that there is no common definition of Smart City worldwide. Similar is the case for smart sustainable cities. The definitions for smart cities focussed primarily on the performance of transportation, healthcare, education and government. On the other hand definitions for smart sustainable cities majorly focused on impact on the environment, well-being of citizens, mobility and administration.

The current patterns and evolution examples of any individual Smart city rely generally upon the local setting factors. Also, development of a smart city greatly depends upon teamwork. The team includes government, policy makers, urban planners, engineers, vendors and citizens. Understanding,assessingand merging their viewpoints is of utmost importance to tackle the smart city development challenge. Policy makers subsequently should comprehend these constants and variables and shape the strategies accordingly for the development of smart cities in their countries.

In a nut shell, a city, which is in the initial stage of development as a smart city should learn from the positive and negative experiences of other successfully developed smart nations and this trend is expected to continue in the future as well. A smart and sustainable city will definitely lead to a better future where cities understand the role of earth, air, water, nature and its citizens,

RECOMMENDATIONS FOR FUTURE AUTHORS

The present study focuses on comparison of three nationalities.Future research could be directed towardsstudying case examples of other smart city projects

globally to discover different design choices for the development of smart cities and to discover different pathways followed. A probe can also be made on the levels of smartness and sustainable aspects acquired by a nation by recommending unified standards for smart areas.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to Ar. Mohammad Aamir and Ar. Mohammad Saquib.They have guided and supported us in every manner during the research. They have been very kind and patient while correcting our doubts. Without their encouragement, this research would not have been possible. We would also like to thank our family for the continuous support in achieving the goal. Finally and above all we are grateful to Almighty for making this research a successful one.

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Decay of Vernacular Architecture in Rural India

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Abstract
The cultural traits and attributes give vernacular architecture a range of values, which makes it into an individual built heritage resource, which is irreplaceable. Continuity is maintained through generation by keeping alive these traditions that forms the essence of vernacular architecture but at the same time also assimilates new values, making then valuable. While in the past, the techniques and approach was strictly local and bound to tradition, nowadays, the use of new building techniques has introduced elements and styles that are totally foreign to the local environment. The new imposes itself on the old and on the surrounding landscape and, while ignoring any reference to typologies, layout, building techniques, it has a strong visual impact on the landscape. The heritage value of vernacular architecture is under threat due to socio-culture change occurring in modern society as a result of globalization. This is bringing people closer, assimilating ideas and concepts which cater to with current trends and practices in building construction, thereby putting the vernacular building tradition at risk. Migration from the villages left only a handful knowing the skills of vernacular craft and architecture. Time has come, where a serious thought has to be given to find a sustainable and local solution to keep the skill living. The upcoming gap between the local and nature has to be preserved. The essence of vernacular architecture needs to be maintained because in true terms it is the 'Architecture of masses'. As a consequence the scenario becomes disturbing which stand out against historical farmsteads in ruin. New buildings are the result of international border-free architecture, introduced by industrialization, which tends to ignore any local values. This paper explores the meaning and importance of Vernacular Architecture in India and tries to intervene the factors leading to the loss of the same in Indian villages. An attempt is also being made to find probable solutions in keeping Vernacular Architecture thriving.

Keywords: Globalization, Heritage, Industrialization, Masses, Migration, Socio culture, Vernacular architecture

1. INTRODUCTION

India is a country which is known for its rich history and culture. There is abundant reservoir of local knowledge in every part of the country. The vernacular building technologies in India are being passed down from generations to generations with the local climate, available materials and the strong cultural ethos. Vernacular enables Indian people to create their own solutions with respect to their micro possibilities.

"The architectural language of the people' with its ethnic, regional and local 'dialects". (Oliver, 1997) Unnoticeably, new India is growing disregard for traditional architectural language around the world due to modern building technology quickly spreading a "loss of identity and cultural vibrancy" through what the Architectural Review recently described as "a global pandemic of generic buildings." (Stott, 2016)

People have come to see steel, concrete and glass as architecture of high quality, whereas a lot of vernacular methods including adobe, reed or peat moss are often associated with underdevelopment. Ironically, these local methods are far more sustainable and contextually aware than much contemporary architecture seen today, despite ongoing talks and debates about the importance of sustainability. As a result of these trends, a tremendous amount of architectural and cultural knowledge is being lost.

2. ISSUES

The onset of industrialization and modernization has started the dilution of this knowledge transfer. The vernacular skills are fast disappearing as the construction is time taking, skill based and there is lack of understanding of materials and their usage. From igloos to bamboo houses, from thatched roofs to terraced roof, people create shelter and comfort in unique structures in response to their locations on the globe. (Praharaj, 2014). A lack of understanding of materials and their usage has led to a slow decay of vernacular architecture. This was the result of repeated cycles of trial and error and the experience of generations of builders, which satisfies the occupants' demands for thermal comfort and durability. Different regions of India have different types of indigenous building technology. History reflects how over the years man has responded to the evolving ecological system surrounding him by developing various systems to mitigate the adverse impacts of environment. His response has been recorded in terms of his lifestyle, work patterns and

the built spaces. Vernacular architecture evolved over time, reflecting environmental, cultural, technological and historical context of a specific location on which it was built. (Nguyen, A.T., Reiter, S., 2017).
The traditional buildings are very good examples of bioclimatic architectural design. The wisdom embodied in vernacular architecture needs to be conveyed over the generations to show our gratitude and respect towards nature and our culture. The technological advancement amalgamated with science has brought us at the cross roads where we have to wisely choose between healthy environment and urbanization. The ills of urbanization in the form of ecological imbalance, increased pollution, increased anxiety levels, social exclusion, spatial segregation etc. has again forced us to recall and learn from the traditional vernacular system and blend it with modern technology. Globalization has brought a drastic shift in the construction techniques and materials used (from traditional materials towards steel and concrete) in the villages.

3. RATIONALE

A G K Menon believes that because of our education most Indian architects feel like strangers in their own land. They have lost touch with the values of tradition especially rural society. Only a handful of architects practicing in India today are sensitive towards the sustainable and vernacular architectural principles of Laurie Baker. Trupti Doshi of Puducherry has a philosophy that buildings are meant to complement their environment, not compete with it. She has taken a step forward to revive traditional craftsmanship, harness local talent and build addressing the local needs of the people. (Eartha, 2017)
So culmination of modern ideas and traditional techniques is the answer to address our present day challenges of development. We need to focus on developing a quantitative understanding of behavior of vernacular structures so that we can analytically improve upon them and integrate them to plan new settlements and upgrade the existing ones.

4. AIM

This paper aims to explore the probable reasons behind the decay of vernacular architecture in rural areas of India where the foundation is local & regional. Also we will try to go through possible recommendations by taking the problem back to its roots in Indian scenario.

5. OBJECTIVES

- To understand the importance of vernacular architecture in contemporary context.
- To figure out the issues which are forcing vernacular architecture to stick out from villages.
- To establish the fact of loss of vernacular from rural areas through literature surveys.
- To recommend the probable solutions for revival of vernacular architecture in rural India.

6. CASE STUDY

The inroads of development into hill settlements, increase in population, restrictions in felling of trees have forced the village people to move away from the traditional use of building techniques and materials. Villagers now prefer cement and brick over stone and wood for construction of their buildings. These new materials and buildings styles have also become a status symbol of them. This is truly being reflected in the villages of Himachal Pradesh. Cuddled in the backdrop of majestic peaks of Sharangcha, situated at the height of 2500 m above mean sea level, Dodra and Kwar are two beautiful villages in remote part of Himachal Pradesh. These villages got connected to the outer world with the help of motorable road in 2009.
These villages are well known for their indigenous character of slated roofed, wood and stone houses, with the distinct design of a cowshed on the ground floor, living quarters on the floors above and an attic for storing ripe grain at the top. This traditional style is known as Kathkuni style of architecture.

FIGURE 1
LOCATION MAP OF ROHRU VILLAGE

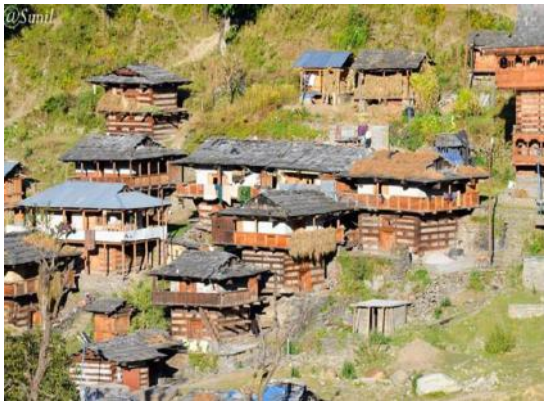

FIGURE 3
OVERVIEW OF THE VILLAGE

FIGURE 2
STREET PATTERN OF THE VILLAGE

Development in the form of connectivity has widened the scope of urbanization in the villages but at the same time has hit the vernacular buildings styles hard. People have opened up to availability of new building materials and technology. Locals now believe that brick and RCC structures are clean as compared to the traditional ones.

The traditional Kathkuni walls are 18" – 25" thick. Issues associated with space crunch have started cropping up due to increased population. This has affected the lower castes the most. These people already have less space and on top of that most of the space is lost in the walls. Thus the net livable space achieved is very less. But if the structures are build using brick they get more livable areas. The stone staircase is steep and the elderly face difficulty to move around. Now with the option of brick the locals have started preferring it to ease their movement.

FIGURE 5
TRADITIONAL WOOD HOUSES -II

FIGURE 4
TRADITIONAL WOOD HOUSES -I

Kathkuni houses act as catalyst in case of fire as they are majorly built of stone and wood. Stone and wood have become costly compared to brick and cement. Also their availability has started becoming difficult. Supreme court has put a blanket ban on felling of trees in 2019. The state government of Himachal Pradesh has put regulations on quarrying of stone.

New techniques and development attracts people to shift on contemporary materials over local material. Also the villagers are attracted with the appearance of new materials which makes their buildings looks good. Even the government buildings have switched to Kathkuni. The new Bus terminal of the town has adopted RCC structure with some visual appearances factors in the roof to visually blend in the context of the town.

RCC has gained so much popularity that even during restoration of temples the compound walls are now being replaced by RCC walls. Today in these villages of Dodra and Kwar only 20% structures are left which

reflect purely vernacular style while majority have switched to modern materials. The designing space has been improved over time as per the need from single unit to multiple units separated. The orientations of the buildings were mostly chosen on the basis of topography, solar movement and wind direction. Design features have been mostly influenced by the local skill.

FIGURE 6
GOVERNMENT POST GRADUATE COLLEGE

`

FIGURS 7
COLLEGE IN MODERN STYLE OF ARCHITECTURE

FIGURE 8
VILLAGE BUS TERMINAL OF RCC STRUCTURE

FIGURE 9
MODERN CONSTRUCTION OF BUS TERMINAL

7. ANALYSIS

Globalization has caused the people to change the vernacular pattern of living. This is being clearly reflected in the housing patterns in rural areas of Himachal Pradesh and Orissa. The cost of maintenance and acute shortage of skilled craftsmen are also responsible for loss of rich architectural heritage of the region.

Vernacular buildings retain some indigenous construction techniques for thermal comfort. With the passage of time such buildings are vanishing due to change in functional requirements. New buildings are being constructed in the contemporary style ignoring the lessons of vernacular architecture with the introduction of alternative building materials. The retrofitting of old buildings is also done using present day materials. Lack of integration of new constructions to the local environment and social context has started causing serious damage to the environment. In Himachal Pradesh inorder to avail the view of the hills dwellings are constructed as a large enclosed glazed space with no provision for ventilation and protection from the sun. To maintain comfort levels in summer people are increasingly dependent upon air-conditioning aggregating to climate change and global warming.

The race of changing of architecture in the rural context fails to fulfill some of the sustainability criteria such as economic, social and environmental aspects while the vernacular architecture showed its sustainability. One should promote vernacular practices to ensure sustainable economic development and positive social change with many projects of rural tourism through encouragement of community participation and mobilization.

8. CONCLUSION AND RECOMMENDATIONS

"Tradition and modernity are two sides of the same coin, no society referred to itself as traditional before the first few centuries, and the idea of the traditional did not arise until the invention and articulation of the modern. To understand the tradition-modernity dialectic, its historic continuum and its effects on the built environment, it is important to focus on one of the most significant aspects of modernity itself, that is, modernity as an experience." (Sayyad, 2014).

Being a developing country where every day many people are fighting for their daily survival we need to focus on every possible way in which we could generate livelihood for all. People in global cities are submerged in high stress levels and in order to ease their stress levels they want to go back to the times when life was slow and people were contended with whatever they had. Giving that experience is what has been tapped upon nowadays to ensure the conservation of our culture and traditions as well as to generate livelihood. Rural areas are best examples to achieve this. Undoubtedly they will emerge as an important instrument for sustainable human development including poverty alleviation, employment generation, environmental regeneration and development of remote areas. It would also lead to advancement of women and other disadvantaged groups in the country apart from promoting social integration and international understanding.

Our case study reflects that still there are rural areas where the essence of vernacular architecture in the form of tangible and intangible heritage exists but it is at the verge of decay. Promoting rural tourism would help both the economy as well as the village's identity. There are many a success stories of Indian Villages like Kangra Valley villages, Rakhigarhi village in Haryana, (Anima, 2019), Holipura, Agra (Qureshi, 2016) etc, where through community participation the concepts of vernacular culture were developed and enhanced tourism of the village, marketed the same and benefitted socially and economically out of the efforts.

By preserving our indigenous architecture, we can achieve much larger number on the scale of rural tourism by tapping following potentials.

- Identifying the villages with immense potential for development of rural tourism destinations to showcase core competencies of rural India
- Proper documentation of tangible and intangible heritage of rural & tribal areas of India for promotional campaigns
- Amalgamating local architecture with modern technology to enhance the style without losing its true character.
- Restructuring and liberalization of policies to promote vernacularism of the region.
- Encouragement for financial investments in rural areas and human resource development.
- Encouraging the local people to involve in vernacularism at all levels for their benefit only.
- Promotion of public-private partnerships.
- Improving the service quality with a focus on creativity and innovation.

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ICAST94

ASSESSMENT OF SOLAR HUB POTENTIAL AT NEIGHBOURHOOD LEVEL – CASE STUDY COIMBATORE, TAMIL NADU, INDIA

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Executive Summary

The global agenda of sustainable development and communities emphasises on the role of adoption of cleaner and greener energy sources. Renewable energy resources presently account for India's 23.39% of the total installed generation capacity. There is an ever-increasing demand for energy in spite of the rising prices of oil & other fossil fuel / depletion of fossil fuels. The Government of Tamil Nadu is committed to mitigate the climate change effects by bringing out policies conducive to promote renewable energy generation in the State. The state of Tamil Nadu has a solar potential of approximately 17.67Gwp out of which the installed capacity with the state is only 1143.412MW. This clearly states that there is huge potential in the direction of solar power within the state. When we look at the city of Coimbatore we find that the city has around 305 sunny days in a year and an average annual radiation of about 5.08 kWh/m^2/day, with maximum radiation being received during the first half of the year. Currently there are few solar projects running successfully within the city. Through this research paper we are proposing solar hub at the neighbourhood level consisting of many solar initiatives like solar roof top, solar street lights, solar benches and solar bus stops, etc. and aim at reduction of carbon emission. The paper explores a framework for the assessment of the potential for the development of solar - hub at neighbourhood level by considering features like land ownership, land use, building use, building height, tree canopy and roof area availability.. Also the current electricity usage of the ward is high, 14 MU and the ward is a hotspot area due to the high amount of carbon emissions. Based on the sun path, the building heights and shaded and non-shaded areas, the site zoning is done, identifying the potential locations where rooftop panels can be installed in the site. Potential have been further assessed by quantifying the various benefits of such a solar hub including the environmental and social impacts of the development of such a project. Focus on the reduction in the carbon emissions with respect to the energy production and consumption has been quantified in the paper.

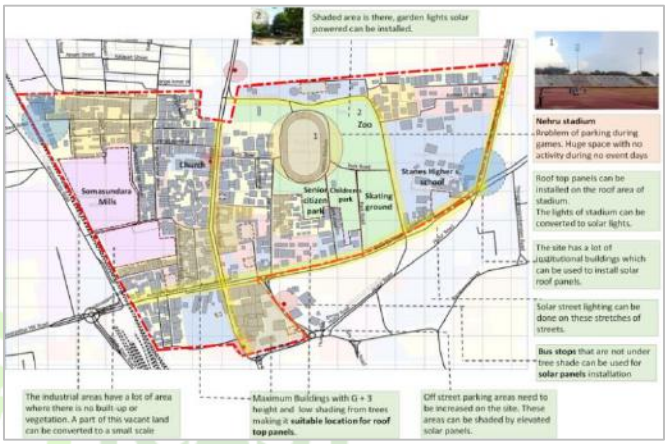

Figure 7 Solar hub potential in ward no. 72 Coimbatore, Tamil Nadu (Source: Based on analysis)

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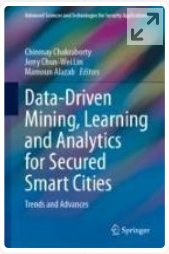

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Data-Driven Mining, Learning and Analytics for Secured Smart Cities

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Editors: (view affiliations) Chinmay Chakraborty, Jerry Chun-Wei Lin, Mamoun Alazab

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Series Title	**DOI**	**Publisher**
Advanced Sciences and Technologies for Security Applications	https://doi.org/10.1007/978-3-030-72139-8	Springer Cham
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Softcover ISBN	**eBook ISBN**	**Series ISSN**
978-3-030-72141-1	978-3-030-72139-8	1613-5113
Series E-ISSN	**Edition Number**	**Number of Pages**
2363-9466	1	X, 383
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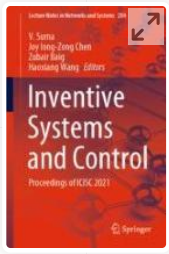

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About this book

This book presents selected papers from the 5th International Conference on Inventive Systems and Control (ICISC 2021), held on 7–8 January 2021 at JCT College of Engineering and Technology, Coimbatore, India. The book includes an analysis of the class of intelligent systems and control techniques that utilises various artificial intelligence technologies, where there are no mathematical models and systems available to make them remain controlled. Inspired by various existing intelligent techniques, the primary goal is to present the emerging innovative models to tackle the challenges faced by the existing computing and communication technologies. The proceedings of ICISC 2021 aim at presenting the state-of-the-art research developments, trends, and solutions for the challenges faced by the intelligent systems and

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978-981-16-1395-1	2367-3370	2367-3389
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Agriculture & Allied Sciences

Innovations in Agricultural and Biological Engineering

Novel Processing Methods for Plant-Based Health Foods

Extraction, Encapsulation, and Health Benefits of Bioactive Compounds

Editors: Megh R. Goyal, PhD, PE
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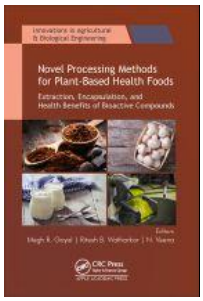

In Production
Pub Date: August 2022
Hardback Price: $179.95 USD | £139.00
Hard ISBN: 9781774910740
Pages: Approx. 351p w/index
Binding Type: Hardback
Series: Innovations in Agricultural and Biological Engineering
Notes: 14 color and 12 b/w illustrations

This new volume presents an array of new and emerging techniques in the food processing sector, focusing on the extraction, encapsulation, and health benefits of bioactive Compounds. It illustrates various applications of novel food processing extraction and encapsulation techniques along with the health and safety aspects of plant-derived bioactive compounds and functional foods

Some of the sustainable and green extraction techniques discussed include novel extraction techniques, such as microwave-assisted extraction (MAE), ultrasonic assisted extraction (UAE), supercritical fluid extraction (SFE), accelerated solvent extraction (ASE), and rapid solid-liquid extraction (RSLE).

The volume also covers the principles and methods of encapsulation, its role and application in protection and stabilization and as a targeted delivery system for enhanced nutritional health benefits. Various encapsulation methods, such as spray drying, spray cooling/chilling, fluidized bed coating, coacervation, liposome entrapment, extrusion, inclusion complexation, etc., are discussed in detail for application in the food industry.

Novel Processing Methods for Plant-Based Health Foods: Extraction, Encapsulation, and Health Benefits of Bioactive Compounds also highlights the potential of nutraceuticals and biological active compounds in human health, various sources, consumers' acceptance, safety aspects, and their application in development of functional foods.

This volume offers many tremendous applications in different areas of the food industry, including in food processing, preservation, health-promoting properties, and safety and quality evaluation of plant-based foods. The book provides a wealth of information and will be an excellent reference material for researchers, scientists, students, growers, traders, processors, industry professionals, and others on the emerging food processing approaches for extraction and encapsulation of plant-based bioactive compounds and health-promoting properties of plant-derived nutraceuticals and safety aspects in production of functional foods.

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Smart and Sustainable Cities: A Systematic Review

Smart Cities for India

National Conference on Sustainability IN Built Environment(NCSBE 2020)

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***Abstract* - To support the rapid increase in economy and urbanization and to mitigate the issues emerging due to continuous growth and development there is an urgent need for a reasonable plan of action and a unified approach. The concept of smart and sustainable cities has turned up as one of the smartsolutions. However, urban areas in a developing country like India lack not only basic amenities but also the basic infrastructure because of different reasons which range from improper administration and absence of appropriate planning, management and evolving lifestyles. This paper attempts to find out the need and relevance of the smart city projects that are undertaken by the government of India by comparing the ongoing or already completed projects internationally. This was done by comparingthe initiatives undertaken by the government of India to the initiative undertaken by Dubai and Singapore in the light of smart characteristics derived from the definitions of smart cities. The paper ultimately seeks to evaluate the challenges faced by the Indian government and planners while implementing the smart city proposals. The results convey thatdevelopment of a city, as a smart and sustainable city depends on local setting factors and project management.**

Key words-Implementation approaches, Indian Perspective, Smart cities, Smart Dubai plan, Smart Nation Singapore, Sustainability.

SMART CITIES: INTRODUCTION

People relocate to urban communities essentially for work. To help themselves with congenial living, they likewise need a good quality of all the basic amenities may it be housing or utilities like water, sanitation, power, clean air, medicinal services, security, amusement, and so on. Production units located in cities become an agglomeration economy which gives simple access to employment and different components of manufacturing. In this scenario, Smart Cities are the ones which are dedicated to impart all these facilities. A great foundation, straightforward online procedures that make it simple to set up and run any venture effectively are significant for the prosperity and success of not only the nation but its citizens as well. There exists many definition of a smart city. It means different to different people, state, or a country. One of the definitions suggests a Smart City is a city well performing in 6 characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens: Economy, Mobility, Environment, People, Living, Governance (Giffinger, 2007). Increase in population of urban areas has led to enormous increase in the consumption of resources. This has, in turn, created another challenge of creating smart cities that are sustainable.U4SSC defines a sustainable smart city as "an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects" (U4SCC, 2016). This implies that sustainability should be among thestrategic goals of Smart Cities.

METHODOLOGY

The vision, primary issues and priorities of the citizens of any city play a significant role in planning and management of smart cities. Since every city has varyingpositive and negative qualities, their particular paths to building up a smart city are likely to be different.This papermakes an attempt to compare the different paths taken by three growing national initiatives, namely India, Dubai and Singapore. The choices of countries/ states were made based on the Global Competitiveness Report (GCI)and Network Readiness Index (NRI).

TABLE 1
THE GLOBAL COMPETITIVENESS INDEX 4.0 2019 RANKINGS OF SELECTED COUNTRIES

Country	2018-19	2019-20
Singapore	2	1
UAE	33	25
India	58	68

Table 1 and Table 2 give an idea that Singapore is an all-rounder in terms of economy and network-readiness. India is at the lowest position whereas UAE is almost averagely placed between Singapore and India.Present methods and ways to deal with the implementation process of smart cities

TABLE 2
NETWORK READINESS INDEX-2019 RANKINGS OF SELECTED COUNTRIES

Country	2018-19	2019-20
Singapore	1	2
UAE	26	29
India	91	79

in different nations are majorly determined by initiatives taken by the government and motivating factors for public-private involvement. However, Global Competitiveness Report and Network Readiness Index can be another mode of kick start for the nations to drive their smart city goals. Covering 141 economies and presented by the World Economic Forum yearly, Global Competitiveness Report measures national competitiveness defined as the set of institutions, policies and factors that determine the level of productivity and long term economic growth of a nation. It gives ranking on 12 drivers of growth including infrastructure and ICT adoption amongst others (WEF, 2019).Similarly, assessment of network readiness of more than 120 economies is done every year using the Network Readiness Index provides holistic framework for assessing the multi-faceted impact of ICT on society and the development of nations (Portulans Institute, 2019).

From the viewpoint of Smart city execution, the above two markers are a decent beginningby which countries can determine where they stand amongst other countries on the smart city parameters and therefore how they should move forward with smart city solutions. While NRI will mention thedigital readiness of the country that is indispensable for smart solutions, Competitiveness positioning will givenoticeable knowledge on how the public-private models will work under the given conditions and rules for smart cities.

Next,the perspectives of a smart city of the three selected nations were obtained by analyzing smart city vision statements and smart city implementation approaches.Local reports and guidelines from the states on Smart city plans ofSingapore, Dubai and Indiawere studied in detail for exploringtheir visions and initiatives.

I. Singapore: The Smart Nation Plan

The Smart Nation plan for Singapore was launched in November 2014. The vision statement given by the Prime Minister Lee Hsien Loong in 2014 is:

"Therefore our vision is for Singapore to be a Smart Nation – A nation where people live meaningful and fulfilled lives, enabled seamlessly by technology, offering exciting opportunities for all. We should see it in our daily living where networks of sensors and smart devices enable us to live sustainably and comfortably."

The amalgamation of public and private sector is playing the key role in achieve this vision. According to U4SSC,Singapore has aimed to achieve this by integrating the aspect of 'smartness' into its city planning and incorporating ICTs into economic and domestic sectors, to improve energy efficiency at the household and business level and to promote intelligent sustainable buildings, efficient water management, better education and awareness related to smart initiatives (U4SSC, 2016).

Key pillars that support Smart Nation goals aredigital economy, digital government and digital society(Pillars of Smart Nation, 2020). People, all the private organizations and public firms have a key role to play in achievement of the goals. According to recent reports, Singapore is persistently driving the ICT revolution and digital movements, particularly e-administration and smart city solutions.According to a report published by the Singapore Authorities on Smart City vision, an all-inclusive and extensive plan has beenillustratedwhich includes institutes of higher education in Singapore and health facilities, funding for research and development work and quickly developing network of new businesses related to technologies. The Next Generation smart city plan of Singapore is based on the presumption that comprehensive use of ICT by the government and private companies will help not only in better livings but also prominent business openings. This is validated by the fact that Singapore offers most promising and encouraging business and development conditionsacross the world and is profoundly positioned for the nature of its administrative structure. To achieve the goal of digitalization throughout Singapore, numerous strategic national projects have been identified. A good caseexample of this is the 'virtual Singapore.'It is the 3D digital platform that will empower the government, organizations and society to run simulations and make amendments in the planning using a high-scope city model of Singapore. This helps in making the long-term decisions on infrastructure and resource-planning (Initiatives, 2020).

II. Dubai: Smart Dubai 2021

In March 2014, Sheik Mohammed made an announcement to change Dubai into a Smart City. The objectives of Smart Dubai plan include **smart living, smart economy, smart people, smart mobility, smart environment, and smart governance**. In a new announcement, he has envisioned Dubai to be the happiest city on the earth. The official website of smart city 2021 Plan was explored in detail to understand the vision and initiatives taken by UAE government(Smart Dubai 2021, 2020).

"We are making Dubai the happiest city on earth by embracing technology innovation making Dubai a more seamless, safe, efficient and personalized city experience for all residents and visitors."

The Smart Dubai initiativeorganizes its ultimate objectives over a deliberately created set of key pillars (Fig. 1). These are Efficient, Seamless, Safe and Personalized. The pillars give an unmistakable perspective on the effect the city needs to make, tandem with all public and private partners.

FIGURE 1
PILLARS OF SMART DUBAI INITIATIVE

FIGURE 2
THE CITY'S TRANSFORMATION AGENDA: SMART DUBAI 2021

The above city's transformational Agenda (Fig. 2)characterizes a city wide approach to deal with the accomplishment of four objectives of Smart Dubai.The methodology highlights 6 key areas and 100 initiatives to tackle these areas of interventions. These 6 areas of intervention are:

- Transportation
- Communication
- Infrastructure
- Electricity
- Economic services and
- Urban and environmental planning

In a nut shell, the plan focuses on creating positive impact on three major areas including citizens, finance and economics and overall city environment including resource and infrastructure. All this is achieved by harnessing technology and ICT innovations.

On realizing that the consumption of resources and efforts that were put in were being doubled because of the absence of government-wide electronic shares services (ESS), The Dubai Government ESS initiative came into conceptualization which evolved as Smart Dubai initiative in 2014. Due to the implementation of ESS, the need for government entities to individually invest in ICT equipment and installation has considerably reduced. Consequently, this plan has led to reduced carbon emissions and a positive impact on the environment(U4SSC, 2016).

III. India: The Indian Smart Cities Mission

The process of urbanization is ever increasing throughout the world, and India is no less impacted by it.India, a developing nation, is seeing a rapid shift of people from rural to urban areas which increased to 31 % in 2011 and is likely to grow to 40% by 2030 and more than 50% by 2050. Due to this enormous boom in the population size of cities, the government is facing challenges related to infrastructure and delivery of services. Serving to the ever increasing needs of urban areas, authorities have come up with the solution of smart cities. Smart Cities Mission is a national initiative by the Ministry of Urban Development to build a foundation for 100 smart cities in five years (FY 2015-16 to FY 2019-20) (Gupta & Hall, 2017).

Smart Cities Mission Guidelines issued by the government of India does not have a holistic and comprehensive approach for the vision of smart cities. This is due to the fact that Indianstates and cities have diverse characteristic and therefore, one Smart City vision cannot be implemented to all the urban areas. Every city needs to figure its own idea, vision, strategic arrangement for a Smart City Plan.

The main objective of the Mission is to drive monetary development and enhance the standard of living of the citizens, their well-being and welfare by an area-based development of neighborhoods that has three segments:

1. city improvement (retrofitting),
2. city renewal (redevelopment) and
3. city extension (greenfield development)

All these initiative and smart solutions are applied pan-city to cover larger parts of the specific urban area.

The MoUD initiated the SCM through the IndiaSmart Cities Challenge. To take part in this challenge, Indiancities competed for central government funding by submitting a smart city proposal (SCP).As of now, 60 cities (from the list of 100 proposed smartcities) have been shortlisted in the SCM and provided withinitial funding for SCP implementation (Gupta & Hall, 2017). These cities will contend with each other in order to come up with designs and become models. For this, sustainability has been mentioned as the key component by the government. With the increasing frequency of natural disasters, abnormal weather patterns and the looming threat of global warming, the concept of a smart city must be merged with sustainability for the welfare of people and our planet as a whole (Ratan, 2015).

ANALYSIS AND FINDINGS

The reasons of why India is holding a backseat in becoming a smart nation were analyzed through the studies of the overall nature of Singapore and Dubai as a nation.

Firstly, what matters is the population size. India is a vast nation in terms of population. Justifiably, Singapore and UAE are smaller ones with digital infrastructure already developed and in place. This is already established by their rankings in the WEF reports. So, a country like India which is a developing country with a large population size definitely needs to first establish itself as a good infrastructure ready nation at a smaller, may be district level before plunging itself straightaway for a larger goal of smart cities.

Secondly, as stated above, the smart city model of Singapore is based on its infrastructure and relies largely on its public-private partnership. Also, the participation of citizens has been instilled under strong government initiatives for 30 years. Henceforth, their vision for smart cities is driven by KPIs. They have set up different stages of

KPIs to be accomplished in specific terms particularly on transportation and energy utilization. Monitoring this implementation work by the government is a task and Singapore no doubt is excelling in it by prioritizing their KPIs. On the other hand, Dubai, one of the seven emirates of UAE is under focus by its federal government, and is closely similar in population size and economic profile to the Singapore. UAE model is to empower "smart districts" contending each other to accomplish the objectives of smart city while the Dubai Government is effectively giving an incorporated digital stage for managing data, infrastructure and resources. From Indian viewpoint, detailed point by point levels of introspection is required to permeate the targets and more extensive guidelines for the Smart City Plans which can be converted into feasible models are needed.

In a nut shell, Smart Nation model of Singapore is more KPI driven with clear order that it is feasible by rousing and empowering public-private associations. Similarly, Dubai Smart City plan puts weight on government empowerment and unified data control. The two methodologies are legitimate given their targets and guidelines and will additionally be evolving as Smart City ventures advance.

TABLE 3
COMPARISON OF THE SMART CITY FEATURES OF SINGAPORE, DUBAI AND INDIA
SOURCE: AUTHOR

Characteristics	Singapore	Dubai (UAE)	India
1. Smart Energy	Smart Urban Energy Smart Environment Clean and renewable energy	Smart Environment Smart District Certification Smart remote working Tools	Energy Management
2. Smart Building	Smart Building Green mark Certified Buildings (80%) Zero energy Building in 5 yrs. Smart Towns	Smart Buildings Centralised Mgmt. of Building Assets Security and Access control Lighting Management HVAC & CWS Management	Energy efficient and Green Building
3. Smart Security	Smart Security Smart Elderly Alert System	Fire Alarm System Management Smart Homes Home Energy Management Home safety & Security Home Automation Home Health Home Infotainment	
4. Smart Technology	Smart Technology Broadband Penetration (100%) LTE Coverage Smart Home Solutions (50%house hold)	Smart ICT Infrastructure Unified Control Centre Wireless Communication Predicts Analytics Platform (for collaborative social activities)	
5. Smart Mobility	Smart Mobility 70% traffic by Public Transport Real time travel Information by mobile/Web 40% rebate on purchase of Green Vehicles	Smart Mobility Infra for Smart Roads , Bridges, Tunnels Intelligent Transport system Smart Traffic Parking management	Urban Mobility Smart Parking Intelligent Traffic Management Integrated Multimodal Transport
6. Smart Infrastructure	Smart Infrastructure Smart Water Meters Digital innovations in planning	Smart Infrastructure Smart Water Irrigation Smart Waste management Smart Sewage Water	Water Management (smart meters, leakage, Water quality, management Waste Management (waste to energy, compost reduction of C&D waste)
7. Smart Governance	Smart Governance Inter-ministerial committee for sustainable development OneService App	Smart Governance Public realm Fidelity management	E-Governance and Public Info, grievance redressal Electronic service delivery Citizen Engagement –Citizen Eyes & Ears Video crime Monitoring
8. Smart Healthcare	Smart Healthcare Integrated Health Info system Cloud computing Model in Healthcare	Infra Management Including Procurement Operations managed Managed security	Tele medicine
9. Smart Citizen	Smart Citizen Commute to work by Public Transport (50%) 100% population access to sanitation, Waste Recycle 65%	Digital Services	Incubation, Trade Facilitation centre Social development Centre
			Components of sustainability: ----------

Next, a comparative analysis was done keeping smart city characteristics as major parameters of comparison. Listing of these characteristics is based on compilation of various definitions of smart cities. These smart characteristics are:

1. Smart Energy
2. Smart Building
3. Smart Security
4. Smart Technology
5. Smart Mobility
6. Smart Infrastructure
7. Smart Governance
8. Smart Healthcare
9. Smart Citizen

Table 3 compares the smart city features as provided by the governments of Singapore, Dubai and India. Noticeably, all three nations are taking steps forward towards sustainability. It is very evident from the studies that 'smartness' to a large extent results in sustainability. However the proportion of incorporating the features which lead to sustainability, visibly, is different (table 4).

TABLE 4
COMPARISON OF THE COMPONENTS OF SUSTAINABILITY
SOURCE: AUTHOR

Characteristics	Singapore	Dubai (UAE)	India
1. Smart Energy	+ + +	+	+
2. Smart Building	+	-	+
3. Smart Security	-	+	-
4. Smart Technology	-	-	-
5. Smart Mobility	+	-	-
6. Smart Infrastructure	+	+ + +	+
7. Smart Governance	+	-	-
8. Smart Healthcare	-	-	-
9. Smart Citizen	+ + +	-	-

All three countries are in favor of moving towards smartness in energy and are providing features resulting in energy efficiency. Smart and sustainable building aspects have gained popularity in Singapore and India whereas Dubai is only focusing on smart parameters. Smart security feature has been dealt by Singapore and Dubai in good capacity, which remains absent in India. Similar trend has been seen for smart technology. However Dubai takes a front seat in initiating sustainable parameters in the above two features by proving home energy management and unified data control through ESS respectively. All the nations are working to provide smart mobility solutions and smart governance, with Singapore leading on the sustainability front in both. Importance of Smart infrastructure, mainly water is clearly visible in the corresponding features of all three nations.Sustainability feature is lacking in the smart healthcare parameter of all three nations. Singapore is leading in making its citizens smart, followed by Dubai and then India.

It is clearly evident from table 4 that India is lagging behind in the development of smart and sustainable cities. This is due to various challenges faced by Indian Smart City Mission in its execution and rollout.

One of the major challenges is to replace the existing infrastructure of a city to prepare it for smart city. Any city can only become a sustainable smart city once it has achieved the level of a developed city. An underdeveloped city or a developing city will face a lot of struggle in reaching the goal of becoming a sustainablesmart city.

Furthermore, managing a multivendor environment is a difficult task. Programming and software framework in Indian urban areas contains components provided by various merchants. Subsequently, the potential required to deal with complex mixes of smart city solutions created by numerous sellers turns out to be huge. That is why features like security and technology are absent from the components of smartness as well as sustainability.

Moreover, another area of concern is the sort of business and work opportunities these smart urban areas will create. No doubt that the smart city will act as a focal point of financial development, it ought to likewise give the correct blend of means of living to those moving to it. Else, the relocation of individuals will keep on representing a danger to the social and financial situation of the city. Innovative solutions corresponding to Smart governance, smart healthcare and smart citizens will surely help in dealing with this challenge.

CONCLUSION

The findings of this research has uncovered that there is no common definition of Smart City worldwide. Similar is the case for smart sustainable cities. The definitions for smart cities focussed primarily on the performance of transportation, healthcare, education and government. On the other hand definitions for smart sustainable cities majorly focused on impact on the environment, well-being of citizens, mobility and administration.

The current patterns and evolution examples of any individual Smart city rely generally upon the local setting factors. Also, development of a smart city greatly depends upon teamwork. The team includes government, policy makers, urban planners, engineers, vendors and citizens. Understanding,assessingand merging their viewpoints is of utmost importance to tackle the smart city development challenge. Policy makers subsequently should comprehend these constants and variables and shape the strategies accordingly for the development of smart cities in their countries.

In a nut shell, a city, which is in the initial stage of development as a smart city should learn from the positive and negative experiences of other successfully developed smart nations and this trend is expected to continue in the future as well. A smart and sustainable city will definitely lead to a better future where cities understand the role of earth, air, water, nature and its citizens,

RECOMMENDATIONS FOR FUTURE AUTHORS

The present study focuses on comparison of three nationalities.Future research could be directed towardsstudying case examples of other smart city projects

globally to discover different design choices for the development of smart cities and to discover different pathways followed. A probe can also be made on the levels of smartness and sustainable aspects acquired by a nation by recommending unified standards for smart areas.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to Ar. Mohammad Aamir and Ar. Mohammad Saquib.They have guided and supported us in every manner during the research. They have been very kind and patient while correcting our doubts. Without their encouragement, this research would not have been possible. We would also like to thank our family for the continuous support in achieving the goal. Finally and above all we are grateful to Almighty for making this research a successful one.

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Decay of Vernacular Architecture in Rural India

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Abstract
The cultural traits and attributes give vernacular architecture a range of values, which makes it into an individual built heritage resource, which is irreplaceable. Continuity is maintained through generation by keeping alive these traditions that forms the essence of vernacular architecture but at the same time also assimilates new values, making then valuable. While in the past, the techniques and approach was strictly local and bound to tradition, nowadays, the use of new building techniques has introduced elements and styles that are totally foreign to the local environment. The new imposes itself on the old and on the surrounding landscape and, while ignoring any reference to typologies, layout, building techniques, it has a strong visual impact on the landscape. The heritage value of vernacular architecture is under threat due to socio-culture change occurring in modern society as a result of globalization. This is bringing people closer, assimilating ideas and concepts which cater to with current trends and practices in building construction, thereby putting the vernacular building tradition at risk. Migration from the villages left only a handful knowing the skills of vernacular craft and architecture. Time has come, where a serious thought has to be given to find a sustainable and local solution to keep the skill living. The upcoming gap between the local and nature has to be preserved. The essence of vernacular architecture needs to be maintained because in true terms it is the 'Architecture of masses'. As a consequence the scenario becomes disturbing which stand out against historical farmsteads in ruin. New buildings are the result of international border-free architecture, introduced by industrialization, which tends to ignore any local values. This paper explores the meaning and importance of Vernacular Architecture in India and tries to intervene the factors leading to the loss of the same in Indian villages. An attempt is also being made to find probable solutions in keeping Vernacular Architecture thriving.

Keywords: Globalization, Heritage, Industrialization, Masses, Migration, Socio culture, Vernacular architecture

1. INTRODUCTION

India is a country which is known for its rich history and culture. There is abundant reservoir of local knowledge in every part of the country. The vernacular building technologies in India are being passed down from generations to generations with the local climate, available materials and the strong cultural ethos. Vernacular enables Indian people to create their own solutions with respect to their micro possibilities.

"The architectural language of the people' with its ethnic, regional and local 'dialects". (Oliver, 1997) Unnoticeably, new India is growing disregard for traditional architectural language around the world due to modern building technology quickly spreading a "loss of identity and cultural vibrancy" through what the Architectural Review recently described as "a global pandemic of generic buildings." (Stott, 2016)

People have come to see steel, concrete and glass as architecture of high quality, whereas a lot of vernacular methods including adobe, reed or peat moss are often associated with underdevelopment. Ironically, these local methods are far more sustainable and contextually aware than much contemporary architecture seen today, despite ongoing talks and debates about the importance of sustainability. As a result of these trends, a tremendous amount of architectural and cultural knowledge is being lost.

2. ISSUES

The onset of industrialization and modernization has started the dilution of this knowledge transfer. The vernacular skills are fast disappearing as the construction is time taking, skill based and there is lack of understanding of materials and their usage. From igloos to bamboo houses, from thatched roofs to terraced roof, people create shelter and comfort in unique structures in response to their locations on the globe. (Praharaj, 2014). A lack of understanding of materials and their usage has led to a slow decay of vernacular architecture. This was the result of repeated cycles of trial and error and the experience of generations of builders, which satisfies the occupants' demands for thermal comfort and durability. Different regions of India have different types of indigenous building technology. History reflects how over the years man has responded to the evolving ecological system surrounding him by developing various systems to mitigate the adverse impacts of environment. His response has been recorded in terms of his lifestyle, work patterns and

the built spaces. Vernacular architecture evolved over time, reflecting environmental, cultural, technological and historical context of a specific location on which it was built. (Nguyen, A.T., Reiter, S., 2017).
The traditional buildings are very good examples of bioclimatic architectural design. The wisdom embodied in vernacular architecture needs to be conveyed over the generations to show our gratitude and respect towards nature and our culture. The technological advancement amalgamated with science has brought us at the cross roads where we have to wisely choose between healthy environment and urbanization. The ills of urbanization in the form of ecological imbalance, increased pollution, increased anxiety levels, social exclusion, spatial segregation etc. has again forced us to recall and learn from the traditional vernacular system and blend it with modern technology. Globalization has brought a drastic shift in the construction techniques and materials used (from traditional materials towards steel and concrete) in the villages.

3. RATIONALE

A G K Menon believes that because of our education most Indian architects feel like strangers in their own land. They have lost touch with the values of tradition especially rural society. Only a handful of architects practicing in India today are sensitive towards the sustainable and vernacular architectural principles of Laurie Baker. Trupti Doshi of Puducherry has a philosophy that buildings are meant to complement their environment, not compete with it. She has taken a step forward to revive traditional craftsmanship, harness local talent and build addressing the local needs of the people. (Eartha, 2017)
So culmination of modern ideas and traditional techniques is the answer to address our present day challenges of development. We need to focus on developing a quantitative understanding of behavior of vernacular structures so that we can analytically improve upon them and integrate them to plan new settlements and upgrade the existing ones.

4. AIM

This paper aims to explore the probable reasons behind the decay of vernacular architecture in rural areas of India where the foundation is local & regional. Also we will try to go through possible recommendations by taking the problem back to its roots in Indian scenario.

5. OBJECTIVES

- To understand the importance of vernacular architecture in contemporary context.
- To figure out the issues which are forcing vernacular architecture to stick out from villages.
- To establish the fact of loss of vernacular from rural areas through literature surveys.
- To recommend the probable solutions for revival of vernacular architecture in rural India.

6. CASE STUDY

The inroads of development into hill settlements, increase in population, restrictions in felling of trees have forced the village people to move away from the traditional use of building techniques and materials. Villagers now prefer cement and brick over stone and wood for construction of their buildings. These new materials and buildings styles have also become a status symbol of them. This is truly being reflected in the villages of Himachal Pradesh. Cuddled in the backdrop of majestic peaks of Sharangcha, situated at the height of 2500 m above mean sea level, Dodra and Kwar are two beautiful villages in remote part of Himachal Pradesh. These villages got connected to the outer world with the help of motorable road in 2009.
These villages are well known for their indigenous character of slated roofed, wood and stone houses, with the distinct design of a cowshed on the ground floor, living quarters on the floors above and an attic for storing ripe grain at the top. This traditional style is known as Kathkuni style of architecture.

FIGURE 1
LOCATION MAP OF ROHRU VILLAGE

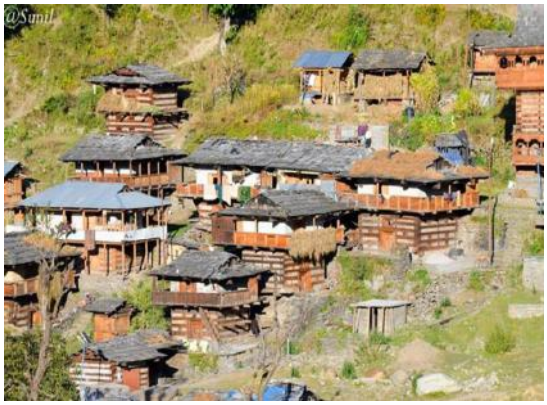

FIGURE 3
OVERVIEW OF THE VILLAGE

FIGURE 2
STREET PATTERN OF THE VILLAGE

Development in the form of connectivity has widened the scope of urbanization in the villages but at the same time has hit the vernacular buildings styles hard. People have opened up to availability of new building materials and technology. Locals now believe that brick and RCC structures are clean as compared to the traditional ones.

The traditional Kathkuni walls are 18" – 25" thick. Issues associated with space crunch have started cropping up due to increased population. This has affected the lower castes the most. These people already have less space and on top of that most of the space is lost in the walls. Thus the net livable space achieved is very less. But if the structures are build using brick they get more livable areas. The stone staircase is steep and the elderly face difficulty to move around. Now with the option of brick the locals have started preferring it to ease their movement.

FIGURE 5
TRADITIONAL WOOD HOUSES -II

FIGURE 4
TRADITIONAL WOOD HOUSES -I

Kathkuni houses act as catalyst in case of fire as they are majorly built of stone and wood. Stone and wood have become costly compared to brick and cement. Also their availability has started becoming difficult. Supreme court has put a blanket ban on felling of trees in 2019. The state government of Himachal Pradesh has put regulations on quarrying of stone.

New techniques and development attracts people to shift on contemporary materials over local material. Also the villagers are attracted with the appearance of new materials which makes their buildings looks good. Even the government buildings have switched to Kathkuni. The new Bus terminal of the town has adopted RCC structure with some visual appearances factors in the roof to visually blend in the context of the town.

RCC has gained so much popularity that even during restoration of temples the compound walls are now being replaced by RCC walls. Today in these villages of Dodra and Kwar only 20% structures are left which

reflect purely vernacular style while majority have switched to modern materials. The designing space has been improved over time as per the need from single unit to multiple units separated. The orientations of the buildings were mostly chosen on the basis of topography, solar movement and wind direction. Design features have been mostly influenced by the local skill.

FIGURE 6
GOVERNMENT POST GRADUATE COLLEGE

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FIGURS 7
COLLEGE IN MODERN STYLE OF ARCHITECTURE

FIGURE 8
VILLAGE BUS TERMINAL OF RCC STRUCTURE

FIGURE 9
MODERN CONSTRUCTION OF BUS TERMINAL

7. ANALYSIS

Globalization has caused the people to change the vernacular pattern of living. This is being clearly reflected in the housing patterns in rural areas of Himachal Pradesh and Orissa. The cost of maintenance and acute shortage of skilled craftsmen are also responsible for loss of rich architectural heritage of the region.

Vernacular buildings retain some indigenous construction techniques for thermal comfort. With the passage of time such buildings are vanishing due to change in functional requirements. New buildings are being constructed in the contemporary style ignoring the lessons of vernacular architecture with the introduction of alternative building materials. The retrofitting of old buildings is also done using present day materials. Lack of integration of new constructions to the local environment and social context has started causing serious damage to the environment. In Himachal Pradesh inorder to avail the view of the hills dwellings are constructed as a large enclosed glazed space with no provision for ventilation and protection from the sun. To maintain comfort levels in summer people are increasingly dependent upon air-conditioning aggregating to climate change and global warming.

The race of changing of architecture in the rural context fails to fulfill some of the sustainability criteria such as economic, social and environmental aspects while the vernacular architecture showed its sustainability. One should promote vernacular practices to ensure sustainable economic development and positive social change with many projects of rural tourism through encouragement of community participation and mobilization.

8. CONCLUSION AND RECOMMENDATIONS

"Tradition and modernity are two sides of the same coin, no society referred to itself as traditional before the first few centuries, and the idea of the traditional did not arise until the invention and articulation of the modern. To understand the tradition-modernity dialectic, its historic continuum and its effects on the built environment, it is important to focus on one of the most significant aspects of modernity itself, that is, modernity as an experience." (Sayyad, 2014).

Being a developing country where every day many people are fighting for their daily survival we need to focus on every possible way in which we could generate livelihood for all. People in global cities are submerged in high stress levels and in order to ease their stress levels they want to go back to the times when life was slow and people were contended with whatever they had. Giving that experience is what has been tapped upon nowadays to ensure the conservation of our culture and traditions as well as to generate livelihood. Rural areas are best examples to achieve this. Undoubtedly they will emerge as an important instrument for sustainable human development including poverty alleviation, employment generation, environmental regeneration and development of remote areas. It would also lead to advancement of women and other disadvantaged groups in the country apart from promoting social integration and international understanding.

Our case study reflects that still there are rural areas where the essence of vernacular architecture in the form of tangible and intangible heritage exists but it is at the verge of decay. Promoting rural tourism would help both the economy as well as the village's identity. There are many a success stories of Indian Villages like Kangra Valley villages, Rakhigarhi village in Haryana, (Anima, 2019), Holipura, Agra (Qureshi, 2016) etc, where through community participation the concepts of vernacular culture were developed and enhanced tourism of the village, marketed the same and benefitted socially and economically out of the efforts.

By preserving our indigenous architecture, we can achieve much larger number on the scale of rural tourism by tapping following potentials.

- Identifying the villages with immense potential for development of rural tourism destinations to showcase core competencies of rural India
- Proper documentation of tangible and intangible heritage of rural & tribal areas of India for promotional campaigns
- Amalgamating local architecture with modern technology to enhance the style without losing its true character.
- Restructuring and liberalization of policies to promote vernacularism of the region.
- Encouragement for financial investments in rural areas and human resource development.
- Encouraging the local people to involve in vernacularism at all levels for their benefit only.
- Promotion of public-private partnerships.
- Improving the service quality with a focus on creativity and innovation.

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ASSESSMENT OF SOLAR HUB POTENTIAL AT NEIGHBOURHOOD LEVEL – CASE STUDY COIMBATORE, TAMIL NADU, INDIA

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Executive Summary

The global agenda of sustainable development and communities emphasises on the role of adoption of cleaner and greener energy sources. Renewable energy resources presently account for India's 23.39% of the total installed generation capacity. There is an ever-increasing demand for energy in spite of the rising prices of oil & other fossil fuel / depletion of fossil fuels. The Government of Tamil Nadu is committed to mitigate the climate change effects by bringing out policies conducive to promote renewable energy generation in the State. The state of Tamil Nadu has a solar potential of approximately 17.67Gwp out of which the installed capacity with the state is only 1143.412MW. This clearly states that there is huge potential in the direction of solar power within the state. When we look at the city of Coimbatore we find that the city has around 305 sunny days in a year and an average annual radiation of about 5.08 kWh/m^2/day, with maximum radiation being received during the first half of the year. Currently there are few solar projects running successfully within the city. Through this research paper we are proposing solar hub at the neighbourhood level consisting of many solar initiatives like solar roof top, solar street lights, solar benches and solar bus stops, etc. and aim at reduction of carbon emission. The paper explores a framework for the assessment of the potential for the development of solar - hub at neighbourhood level by considering features like land ownership, land use, building use, building height, tree canopy and roof area availability.. Also the current electricity usage of the ward is high, 14 MU and the ward is a hotspot area due to the high amount of carbon emissions. Based on the sun path, the building heights and shaded and non-shaded areas, the site zoning is done, identifying the potential locations where rooftop panels can be installed in the site. Potential have been further assessed by quantifying the various benefits of such a solar hub including the environmental and social impacts of the development of such a project. Focus on the reduction in the carbon emissions with respect to the energy production and consumption has been quantified in the paper.

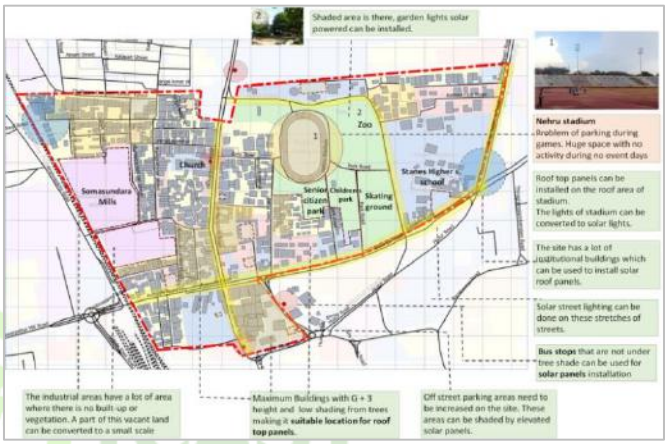

Figure 7 Solar hub potential in ward no. 72 Coimbatore, Tamil Nadu (Source: Based on analysis)

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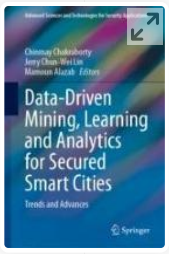

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Series Title	**DOI**	**Publisher**
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Softcover ISBN	**eBook ISBN**	**Series ISSN**
978-3-030-72141-1	978-3-030-72139-8	1613-5113
Series E-ISSN	**Edition Number**	**Number of Pages**
2363-9466	1	X, 383
Number of Illustrations	**Topics**	
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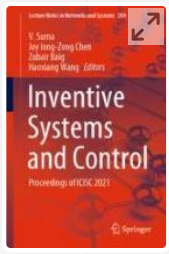

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This book presents selected papers from the 5th International Conference on Inventive Systems and Control (ICISC 2021), held on 7–8 January 2021 at JCT College of Engineering and Technology, Coimbatore, India. The book includes an analysis of the class of intelligent systems and control techniques that utilises various artificial intelligence technologies, where there are no mathematical models and systems available to make them remain controlled. Inspired by various existing intelligent techniques, the primary goal is to present the emerging innovative models to tackle the challenges faced by the existing computing and communication technologies. The proceedings of ICISC 2021 aim at presenting the state-of-the-art research developments, trends, and solutions for the challenges faced by the intelligent systems and

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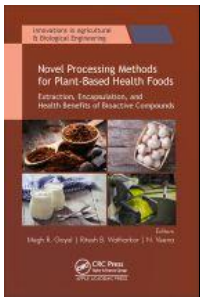

In Production
Pub Date: August 2022
Hardback Price: $179.95 USD | £139.00
Hard ISBN: 9781774910740
Pages: Approx. 351p w/index
Binding Type: Hardback
Series: Innovations in Agricultural and Biological Engineering
Notes: 14 color and 12 b/w illustrations

This new volume presents an array of new and emerging techniques in the food processing sector, focusing on the extraction, encapsulation, and health benefits of bioactive Compounds. It illustrates various applications of novel food processing extraction and encapsulation techniques along with the health and safety aspects of plant-derived bioactive compounds and functional foods

Some of the sustainable and green extraction techniques discussed include novel extraction techniques, such as microwave-assisted extraction (MAE), ultrasonic assisted extraction (UAE), supercritical fluid extraction (SFE), accelerated solvent extraction (ASE), and rapid solid-liquid extraction (RSLE).

The volume also covers the principles and methods of encapsulation, its role and application in protection and stabilization and as a targeted delivery system for enhanced nutritional health benefits. Various encapsulation methods, such as spray drying, spray cooling/chilling, fluidized bed coating, coacervation, liposome entrapment, extrusion, inclusion complexation, etc., are discussed in detail for application in the food industry.

Novel Processing Methods for Plant-Based Health Foods: Extraction, Encapsulation, and Health Benefits of Bioactive Compounds also highlights the potential of nutraceuticals and biological active compounds in human health, various sources, consumers' acceptance, safety aspects, and their application in development of functional foods.

This volume offers many tremendous applications in different areas of the food industry, including in food processing, preservation, health-promoting properties, and safety and quality evaluation of plant-based foods. The book provides a wealth of information and will be an excellent reference material for researchers, scientists, students, growers, traders, processors, industry professionals, and others on the emerging food processing approaches for extraction and encapsulation of plant-based bioactive compounds and health-promoting properties of plant-derived nutraceuticals and safety aspects in production of functional foods.

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8

Synthesis, Characterization, and Application of Modified Textile Nanomaterials

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Abstract

There is a growing concern related to the effects of textile nanomaterials. The development of textile nanomaterial has been one of the most active and important research areas in recent years. Design and synthesis of nanomaterials with a novel combination of textile material is expected to expand the demanding scope in the future. Present chapter will emphasis on the chemical nature and synthesis of textile nanomaterials by using different method such as hydrothermal, microwave, fabrication as well as the methods used to characterize them with regard to their different applications. Recent developments in textile nanomaterial have various applications in the field of sports, cosmetics, swimming, and lifestyle.

Keywords: Textile nanomaterials, nanofibers, synthesis, application

8.1 Introduction of Textile Nanomaterials

The word of nanotechnology (Nano-tech) can be applied in different fields [1–3]. This word was first time applied on textiles and also known as Nano-Tex. Later, other textile industries also started to invest in the textile nanomaterial development [4]. Nanoparticles on textile material have been the goal of different studies, to develop the fabrics with miscellaneous practical performance [5]. These nanomaterials (nano silver,

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Mohd Shabbir, Shakeel Ahmed, and Javed N. Sheikh (eds.) Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques, (167–188)

nano ZnO, and nano TiO_2) have been used as an antibacterial [6, 7], UV-blocking [8, 9], and self-cleaning [10, 11]. Textile nanomaterials can observe the high toughness for washing purpose, as owning great surface area and increase surface energy which declare more attraction for fabrics (textile nanomaterial) [12]. Improve the fastness of textile nanoparticles against washing by a specific solution [13] and other properties of fabric (tensile and bursting strength, friction and air penetrability) can also enhance by this solution [14].

Textile materials were prepared from natural occurring fibers, and have an important part in human being's life. Nowadays nanomaterials are broadly used in the advance textile industry for their appreciated properties as high quality textile materials. Natural fibers such as silk, hemp wool, and cotton are wasted throughout dispensation till further usages. Recycling of these fibers has large marketing area by a new route, because their extra-ordinary characteristics. Any other industries such as bio-medical industries required such bio-compatible materials based on these characteristics [15–17]. Some other valuable applications of textile nanocomposites are in the field of paper and paperboard applications as dry strength, surface strength agent. Textile nanomaterials were also used in cosmetics creams, nano-coatings, bio-nanocomposites, food industry, nano-barriers, pharmaceutical applications, absorbent products, oil recovery applications, and dispersion applications. Current literature works have described a new technique of synthesis of textile nanomaterials and their application in bio-medical and bio-technological fields [18–20].

The most popular textile nanomaterial is Chitosan (derivative of chitin), which is also known as the most popular bio-polymer with exceptional morphological and physiological characteristics [21–23]. These nanomaterial known as ideal polymer for textiles, food science, pharmaceuticals, agriculture and biomedical industrial application, because it has exclusive properties like as biodegradability, biocompatibility, and antibacterial activity [21, 24, 25]. New technique is quickly developing and broadly used in chemical, Pharmaceutical, food processing, cosmetics, and in the present time to textile finishing, which is known as nano encapsulation [26].

8.2 Synthesis of Textiles Nanomaterials

The selection of synthesis technique can be an important factor in identify the effectiveness of the textile nanomaterial studies. There are different methods of synthesizing textile nanomaterial such as hydrothermal [27],

combustion synthesis [28], gas-phase methods [29], microwave synthesis, and sol–gel processing with silver, ZnO and TiO_2 [30]. Synthesis of textile nanomaterial to have a better control over particle morphology, size distribution, quality, purity, and quantity, by engaging environment friendly and economical processes has always been a big task for the scientist and scholars [31].

8.2.1 Synthesis via Hydrothermal Method

Hydrothermal synthesis is commonly performed in a pressurized vessel, which is known as autoclave. Autoclave can be increased the temperature more than 100°C or until form the vapor. This type of synthesis is widely recommended for the synthesis of TiO_2 nanoparticles, which can easily be synthesized through hydrothermal treatment of peptized precipitates of a titanium precursor with water [32]. The hydrothermal method can be utilized to control morphological properties such as (size, morphology), crystalline phase, and surface chemistry through control of the solution composition, pressure, solvent properties, additives, and aging time and reaction temperature [33].

8.2.2 Synthesis via Solvo-Thermal Method

The Solvo-thermal and hydrothermal method both are the same, but the solvo-thermal process variety of solvents can be used in the place of water. This method normally has better control of the shape and size distributions and the crystallinity compared to hydrothermal method. It has been used to synthesize TiO_2 nanoparticles and also used to synthesize nano rods with or without the surfactants.

8.2.3 Synthesis via Chemical Vapor Deposition (CVD) Method

In the chemical vapor deposition process the substrate is covered with volatile precursors, which react on the substrate surface to produce the desired film. The quality of the placed materials completely depends on the reaction temperature, reaction rate, and concentration of the precursors [34]. Gracia *et al.* synthesized metal-doped TiO_2 by the same process [35]. The main feature or advantages of this synthesis method is the uniform coating of the nanoparticles or nano film. Cao *et al.* prepared Sn4+-doped TiO_2 nanoparticle films by this method and found that due to doping with Sn and observed more surface defects were present on the surface [36].

8.2.4 Synthesis via Physical Vapor Deposition (PVD) Method

PVD is also another method to preparation of thin film for the covered the substrate. In this technique films are formed precursor to product without a chemical transition. It has greater features or advantage in the place of CVD. PVD grown films have smoothness, conductivity, presence of contaminations, and crystallinity of titanium dioxide films with E-beam evaporation [37].

8.2.5 Synthesis via Template Method

The synthesis of textile nanostructure materials using template method has become very ideal through the last decade. In this method prepare numerous new materials with a regular and controlled morphology in the range of nano and micro by simply changing the morphology of the template material. The different type of templates has been studied, which utilized the synthesized the TiO_2 nanomaterials [38].

8.2.6 Synthesis via Conventional Sol–Gel Method

This method is used for synthesized various oxide materials such as nano silver, nano ZnO, and nano TiO_2 nanoparticle. The important of this technique contains high purity of the precursors, molecular scale mixing, and homogeneity of the products with a high purity of chemical, physical, and morphological properties. It is also known as multipurpose method.

8.2.7 Synthesis via Microwave Method

Various nanomaterials have been synthesized by microwave radiation. Microwave technique use of high temperature calcination for extended periods of time and allow for fast the synthesis of crystalline TiO_2 nanomaterials. Corradi *et al.* prepared colloidal TiO_2 nanoparticle suspensions within 5 min using microwave radiation [39].

8.2.8 Synthesis via Fabrication Process

Electro-spinning is the most important method among the synthesis of nanofibers.

In the electro-spinning process a high voltage is create an electricity for deposition or melt or streaming of polymer solution (Figure 8.1). Electric

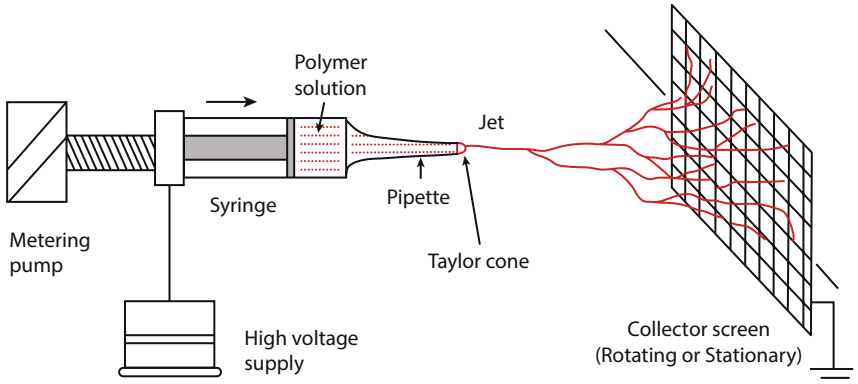

Figure 8.1 Schematic of electro-spinning.

field between the tip of capillary and a grounded collector is very high, and formed at the tip of capillary producing sub-micron diameter fibers. Different types of material were processed into nanofibers in the range of 50 to 1000 nm [40].

8.3 Characterization

Textile nanomaterial characterized by different technique such as spectroscopic, microscopic, X-ray, and other common techniques. The imaging techniques such as (SEM) scanning electron microscopy, (TEM/HRTEM) transmission electron microscopy, (AFM) atomic force microscopy, (STM) scanning tunneling microscopy have been utilized to observe the micro and nano size materials. The basic concepts of all the techniques are different but some common thing is that they observed extremely magnified image of the surface. The spectroscopic method such as (UV-Vis) Ultraviolet-Visible, Raman, infrared spectroscopy and many spectroscopic methods have been utilized to observe the optical properties of micro and nano size materials of textile. Textile nanomaterials can be analyze through X-rays technique like as (EDX) energy dispersive X-ray analysis, wide angle X-ray diffraction, (XPS) X-ray photoelectron spectroscopy, particle size analyzer. Some other common techniques also analyze the physical properties of textile nanomaterials. The basic principles of all these methods used in nanotechnology are described below (Figure 8.2).

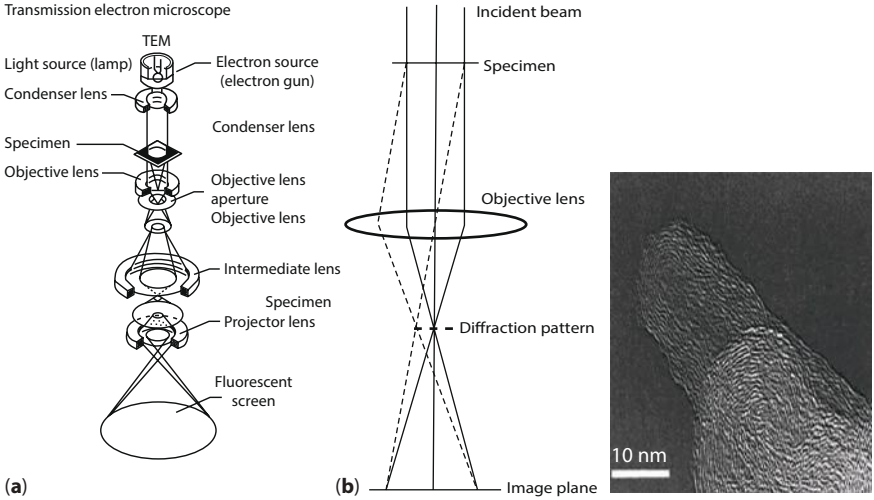

Figure 8.2 (a) Schematic diagram of transmission electron microscopy (b) TEM images of PP/MMT nanocomposites.

8.3.1 Microscopic Characterization of Textile Nanomaterials

8.3.1.1 Transmission Electron Microscopy (TEM)

The micro and nano image is formed by the electron transmeter by the sample and focused by a microscopic lens and looked on a display screen. This technique is widely used in material science, textile, metallurgy, and biological sciences. TEM images reveal the intercalation, exfoliation, and dispersion of nanoparticles in polymer matrices of textile nanomaterial, etc. [40].

High resolution transmission electron microscopy (HRTEM) is a similar imaging technique of electron microscope that allows to take image of the crystal sample at an atomic length with high resolution. This technique is a useful tool to find the nanoscale properties of crystalline material. It showed the maximum resolution is 0.8 Å.

8.3.1.2 Atomic Force Microscope (AFM)

This technique is ideal for quantitative measurement the nano scale textile material. AFM also used for surface imagining and roughness of the surface. Many types of material surface such as polymer nanocomposites, nanofinished, and nanocoated textiles were coated by nano-texture. It is a nondestructive technique and has very high three dimension (3D) [41] (Figure 8.3).

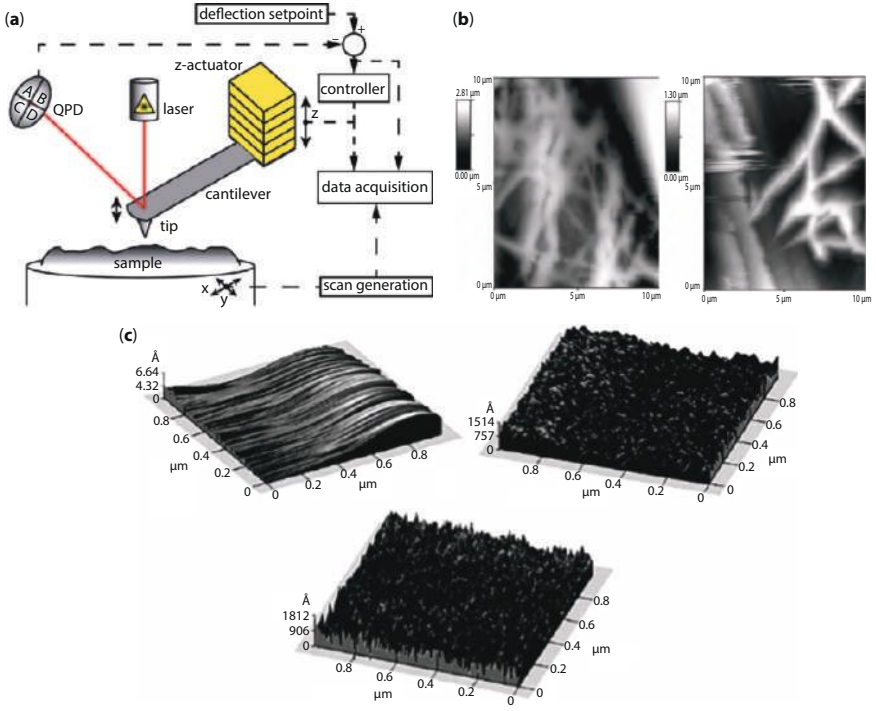

Figure 8.3 (a) Schematic diagram of atomic force microscopy. (b) nanofibers, nanofibers laid on nonwoven substrate (c) 3D views of non-contact mode AFM images of PET textile surface.

AFM can be used to identify the properties, nanostructures, surfaces, and interfaces of fibers and fabrics.

8.3.1.3 Scanning Electron Microscopy (SEM)

SEM is also an electron microscope that images is scanning of surface with a high energy beam of electrons. The SEM shows perfect 3D images with high magnifications (up to 300,000). But the images are only black and white which formed without light waves. The surface image and texture of polymer nanofibers, nanocomposites, nanoparticles, and nanocoating can be viewed through Scanning electron micrograph with high clarity by high magnification [42].

This technique can also be used to interpretation of the dispersion of nanoparticles such as carbon nanotubes, nanoclays, and hybrid POSS nanofillers and coatings on yarns and fabric samples (Figure 8.4c).

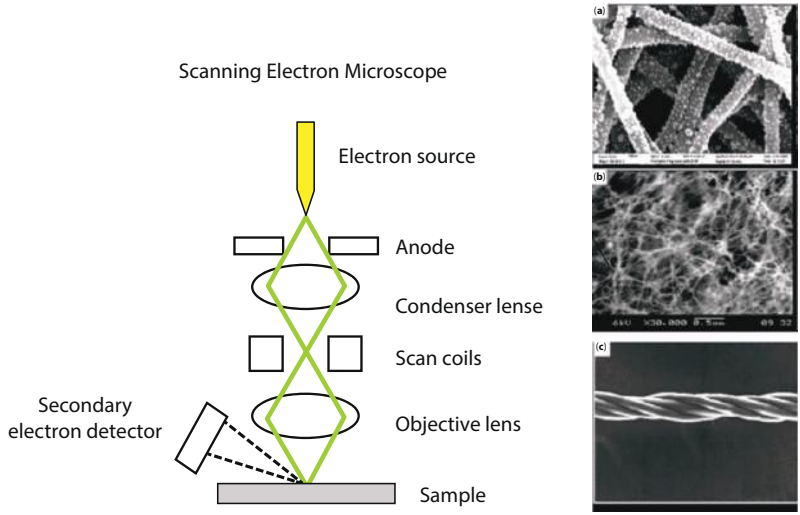

Figure 8.4 Schematic diagram of scanning electron microscopy. (a) Electrospun nylon 6 nanofibers with surface bound silver nanoparticles, (b) peptide nanofiber scaffold for tissue engineering, and (c) SEM image of plied CNT yarn.

8.3.1.4 Scanning Tunneling Microscopy (STM)

Scanning tunneling microscopy (Figure 8.5) is a minor different instrument for observing surface images with atomic scale resolution, in this technique a fine probe tip is scanned over the surface of a sample, with the help of a piezoelectric crystal, and the resulting tunneling [43].

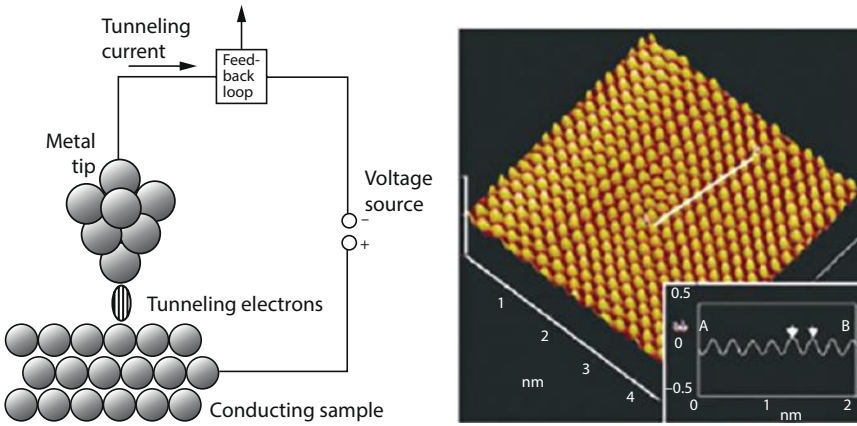

Figure 8.5 Schematic diagram of scanning tunneling microscopy and highly oriented pyrolytic graphite sheet under STM.

8.3.2 Spectroscopic Characterization of Textile Nanomaterials

8.3.2.1 Ultraviolet-Visible (UV-VIS) Spectroscopy

In the Ultraviolet spectrophotometers light source forced on reference and sample beams then output comes in monochromator, detector, and form the spectrum. The ultraviolet spectrum for a sample is obtained by exposing a sample of the compound by Xenon lamp. Spectrum was observed for absorbance versus wavelength [44] (Figure 8.6).

8.3.2.2 Raman Spectroscopy

This type of spectroscopic technique used for condensed matter physics and chemistry. It used to study vibrational, rotational, and other low-frequency modes in a system [45]. The laser light interacts with phonons or other excitations in the system, and the energy of photons being change high or low. The level of energy provides information about the energy of phonon in the system (Figure 8.7).

8.3.2.3 Infrared Spectroscopy (IR)

This technique specially used for characterization of nanomaterials. Fourier transform infrared (FTIR) spectrometer is preferred over dispersive spectrometer due to non-destructive technique. It can increase sensitivity of scan rate

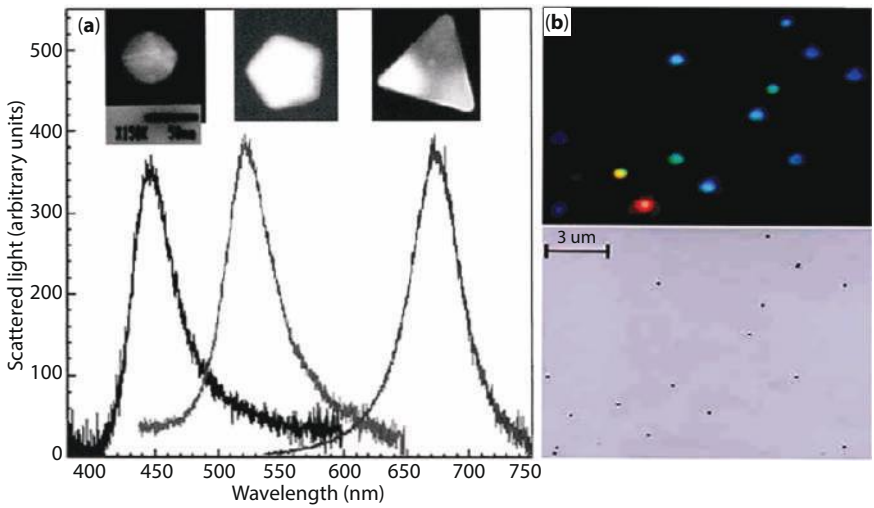

Figure 8.6 (a) UV-Vis spectroscopy of silver nanoparticles of different shapes and (b) color image of a typical sample of silver nanoparticles.

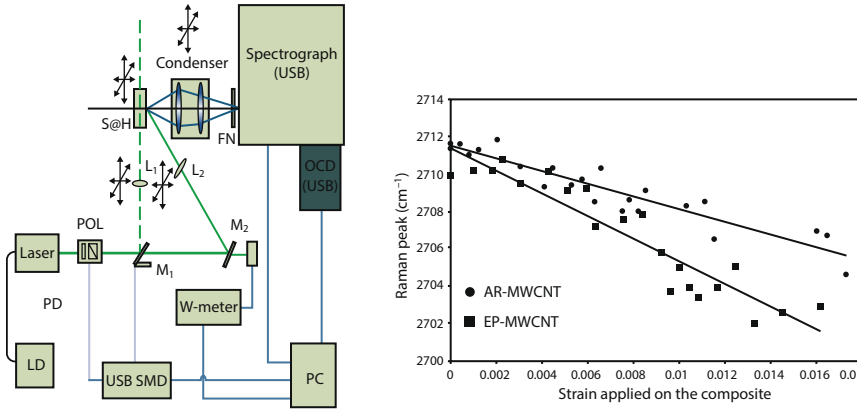

Figure 8.7 Schematic diagram of Raman spectroscopy and Shift in the Raman peak as a function of applied strain.

and co-added together to ratio of random noise. It has better optical through output and is also mechanically simple with only one moving part, etc.

8.3.3 Characterization of Textile Nanomaterials by X-Ray

8.3.3.1 Energy Dispersive X-Ray Analysis (EDX)

This technique analyzes the surface elements at different positions and provides an overall measurement of the sample. The concentration of nanomaterials at the surface can be observed using this technique. EDX contain some heavy metal ions (Au, Pd, and Ag) on the surface of nanoparticles (Figures 8.8b, c). EDX spectra have to be taken by focusing the beam at different regions of the same sample to verify spatially uniform composition of the bimetallic materials [46].

8.3.3.2 Wide Angle X-Ray Diffraction

This technique is similar to electromagnetic radiation of X-ray diffraction, but have shorter wavelength. This technique produced spectrum when electrically charged particles have sufficient energy. In an X-ray tube, the high voltage is maintained by electrodes toward a metal target. X-rays are produced and radiate in all directions.

8.3.3.3 X-Ray Photoelectron Spectroscopy (XPS)

This spectroscopy (Figure 8.9) is a quantitative spectroscopic. Surface chemical, elemental composition, chemical state, and electronic state of

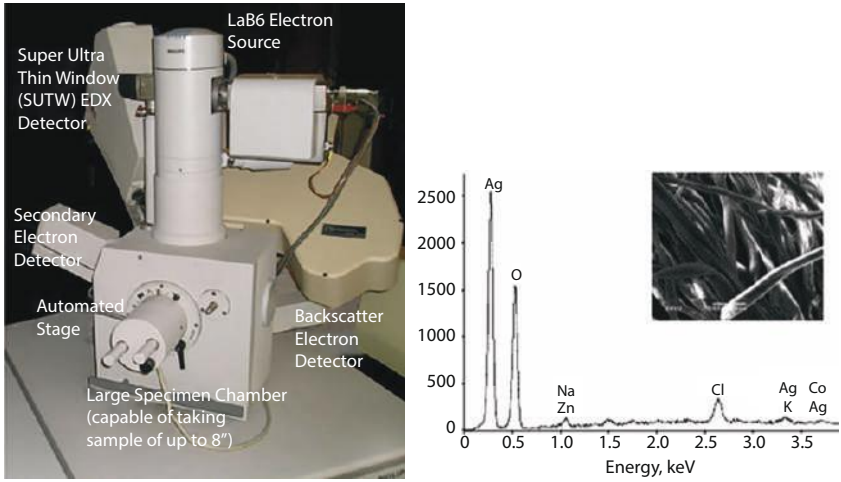

Figure 8.8 Schematic diagram of energy dispersive spectroscopy and SEM images and EDX spectra of nanoporous materials made of cotton cloth with silver nanoparticles 8.

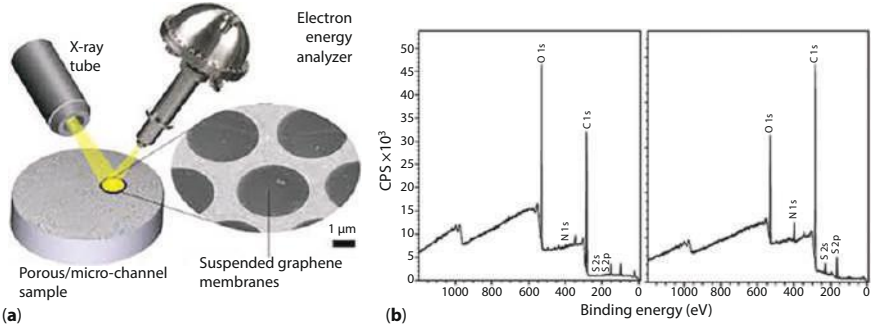

Figure 8.9 Schematic view of XPS. (a) Positively charged woven cotton fabric and (b) positively charged woven cotton fabric supporting 20 self-assembled layers of PSS/PAH.

the elements on the surface (up to 10 nm) of a material were analyzed by this technique [47]. XPS is also known as ESCA (electron spectroscopy of chemical analysis).

8.3.3.4 Particle Size Analyzer

Different techniques were available for the measurement of particle size distribution (PSD) such as optical counting methods, sieve analysis, electro resistance counting methods, laser diffraction methods, sedimentation

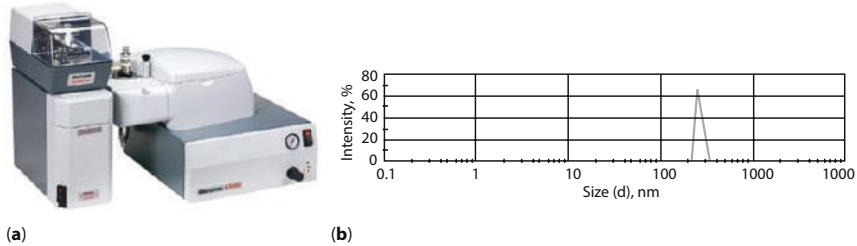

Figure 8.10 (a) Schematic diagram of particle size analyzer. (b) Size distribution of TiO_2 nanoparticles.

techniques, dynamic light scattering method, acoustic spectroscopy, etc. All of them dynamic light scattering (DLC) is regularly used for obtaining size of silver, titanium, silica, and zinc oxide nanoparticle are often used in textile substrates to get enhanced quality of the nanoparticle finished textile materials.

TiO_2 nanoparticle size and size distribution (Figure 8.10b) can be observed using DLS technique [48]. The enhanced property is dependent on the size of the sample nanoparticles. Therefore, size and size distribution performance of the nanoparticle in the dispersion as well as suspension is important before to characterize to the textile substrates.

8.3.4 Characterization of Textile Nanomaterial by Some Other Technique

The complete structural and chemical modifications of fabrics were further analyzed in terms of physical testing, determine the tensile properties, crease recovery angle, bending length, air, and water permeability.

8.3.4.1 Physical Testing

Before starting physical testing the samples were dried and conditioned at 65± 2% RH and 27 ± 2°C temperature.

8.3.4.2 Determination of Recovery Angle and Tensile Properties

Recovery angle was measured by folding and compressing the specimen under controlled condition. Tensile strength was observed as per B.S. 2576:1959.

8.3.4.3 Determination of Absorbency by Wicking Test and Bending Length

Wicking behavior of the treated and untreated samples were evaluated as per T-PACC standard method.

8.3.4.4 Evaluation of Water and Air Permeability

Water permeability test conducted using ASTM D 4491 constant head Methods. Metefem air permeability tester used ASTMD 737 test method for measurement of air permeability.

8.4 Application of Textiles Nanomaterials

Nanotechnology can offer high strength for textile material because nanoparticles have high surface energy and area and, based on this quality, improved the affinity for these materials and have to increase the strength. The overlap of nanoparticles on textile material will not affect their breathing and observation.

Now current researchers are developing nanotechnology to enhance the performances or to create extraordinary quality of textile material, which is prosperous.

8.4.1 Application Based on Properties of Textile Material

The properties of textile nanomaterials comprise oil resistance, water repellence, anti-static, wrinkle resistance, UV-protection, anti-bacterial, improvement of dye, flame retardation, ability, self-cleaning fabrics, and many more, which are described below.

8.4.1.1 Anti-Bacterial Properties of Textile Nanomaterial

Nano-sized silver, titanium dioxide, and zinc oxide are used for the anti-bacterial properties of textile nanomaterial. These metallic ions and compounds show the degree of sterilizing condition. The number of the oxygen in the air or water is changed into active oxygen by catalysis with the metallic ion and dissolves the organic substance for sterilizing effect. The use of nano-sized particles per unit area is increased, and thus anti-bacterial effects can be also increased [49].

8.4.1.2 UV Protective Properties of Textile Nanomaterial

The UV-protection property of a textile nanomaterial is improved when a dye, pigment, delustrant, or ultraviolet absorbance is complete, and the absorbed ultraviolet radiation blocks its transmission through a fabric to the skin. The excess of skin protection is required for different types of human skin, and it depends on distribution in reference to geographical location, time of day, UV radiation intensity, and season. This UV-protection is known as SPF (Sun Protection Factor). High SPF value is a better protection against UV radiation [50].

8.4.1.3 Water Repellence Properties of Textile Nanomaterial

Nano technology in the textile nanomaterial enhances the water-repelled property of fabric such as production of nano-whiskers, which are also hydrocarbons and known as cotton fiber. The addition of this fabric creates a peach fuzz effect without decrease in the strength of cotton. The particular space of the whiskers on the textile nanomaterial (fabric) is smaller than a drop of water and larger than water molecules [51]. However, liquid can still pass through the fabric, if pressure is applied.

8.4.1.4 Anti-Static Properties of Textile Nanomaterial

Static charge usually builds up in synthetic fibers such as nylon and polyester because they absorb little water. Cellulose textile nanomaterial have higher moisture ratio to carry away static charges. As we know synthetic fibers provide poor anti-static properties, so the scientist and researcher work to enhance the anti-static properties of textile materials by using nanotechnology. TiO_2, ZnO, and ATO show anti-static effects because they are electrically conductive nanomaterials. Such material helps to disperse the static charge, which is collected on the fabric. Silane nano sol improves anti-static properties, as the silane gel particles on fiber absorb water and moisture in the air by amino and hydroxyl groups in water [52].

8.4.1.5 Flame Retardant Properties of Textile Nanomaterial

Nanotechnologies has been applied in textile nanomaterials for flame retardant finish, which known by colloidal antimony pentoxide. Colloidal antimony pentoxide has a fine dispersive particle for use as a flame retardant synergist with halogenated flame retardants. Nano antimony pentoxide is used with halogenated flame retardants for a flame retardant finish to the textile nanomaterial [53].

8.4.1.6 Wrinkle-Free Properties of Textile Nanomaterial

Improved performance of nano-Tex has known as a new nanotechnology (wrinkle-free treatment). This technology preserves fabric strength and integrity, an alternative to harsh traditional processes. Conventional methods are commonly used to wrinkle resistance to fabric, resin. However, there are boundaries to applying its in fibers and resin, such as decrease in the tensile strength of fiber, abrasion resistance, water absorbency, dye ability, and breathability. To overcome the limitations of using resin, some scientist employed nano-titanium dioxide, and nano-silica [54] to improve the wrinkle resistance of cotton and silk, respectively.

8.4.1.7 Self-Cleaning Properties of Textile Nanomaterial

American company was developed nano-care, which is known as a self-cleaning cotton fabric. In the scientific terms, the fabric has been purified super-hydrophobic or super-non wet able. The nanowhiskers also make less interaction with dirt. When water is react to stained fabric, the dirt adheres to the water far better than it adheres to the textile surface and is carried off with the water as it beads up and rolls off the surface of the fabric. Self-cleaning fabrics could reform the sport apparel industry. The technology has already been used to create t-shirts and underwear that can be worn hygienically for weeks without washing [55].

8.4.1.8 Economical and Environmental Aspects of Textile Nanomaterial

The extraordinary properties of textile nanomaterials have attracted not only scientists and research scholar but also attract by businessman. The national science foundation (NSF) reported that textile nanomaterial related product and facilities will increase in 2015 with 1 trillion dollar. This amount is more than the all businesses such as telecommunications and information technology industries. In the future more than hundred billion Euros are forecast to be created by textile nanotechnology [56]. The textile nanomaterial markets could expand to US$ 1 billion. Due to huge development of textile nanomaterials, it was believed that 2 million new employment opportunities would be created in order to meet the worldwide annual production demand of US$ 1 trillion in future. Nanotechnology may impart favorably on the economical as well environment. Nanotechnology may save raw materials and also upgrade quality of life by using less resource without forgoing performance.

8.4.2 Application in Textile Industry

Nanotech enhanced the overall properties of textile material, which are seeing above based on properties. Some applications have for sport industry, space research, skin care, garments, and material technologies with better protection in environments. The modified textile material by nanotechnology is a unique method to improve the properties of the textile material, prolonging the process and also having multiple color options, etc. Nanotechnology can also be used to add new advantage such as energy storage and communications.

8.4.2.1 Textile Nanomaterial Used in Swimming Costume

The currently used swimming costumes have a plasma layer to repel the water molecules. The quality of the plasma layer is enhanced by nanotechnology that is prepared with the help of swimmer glide. The most widely recognized application is in the shark-skin costume in the Olympic swimming championship.

8.4.2.2 Textile Nanomaterial Used in Sports Goods

The quality of all sports wear has also been enhanced by textile nanomaterial. Scientists have developed naturally existing viral textile nanoparticles that have some of the toughest environments on earth and have new material for nanotechnology, a textile nanomaterial that minds their surface and interacts with the wearer. These textile-based nanosensors could provide a personalized healthcare system, which monitors your changes sign, such as responding to changes in the weather.

8.4.2.3 Textile Nanomaterial Used Inflexible Electronic Circuit

Textile nanomaterial (nano ribbon) used as chips, which are very flexible. These nano ribbons can cover the control of stretchable microscope cover slip. The researchers and scientists are describing applications in the healthcare industry and where these little, flexible electronic circuit could be used to monitor the activity of patients' brain. This circuit could also be used in surgical apparatus to monitor patients during surgery.

8.4.2.4 Textile Nanomaterial Used in Lifestyle

Nanotechnology is seen in many fields and also has application in lifestyle. Textile with the combination of cosmetics is among the first products to

use in nanomaterials. Nanotube fibers are used to make a material at least 17 times tougher than the present quality. In this view there are future developments with the use of this nanotechnology to create smart and interactive textiles (SMIT). That can be sensitive chemically, electrically, magnetically, thermally, or other stimuli.

8.5 Current Trends and Future Prospects

In the literature various studies have been describe the synthesis and characterization of nanomaterials for textile industry. Nanomaterials can be practically applied to textiles to impart antibacterial, self-cleaning, anti-wrinkle, UV protection, waterproof, and electrical conductivity functions. There have been many efforts to apply nanomaterials in the textile so far, but further research and developments would be necessary in the future. In this chapter, we have reviewed that the synthesis and characterization the textile material for different type of application. Although many researchers and scientist have been show interest for discovered more textile nanomaterials, and understand their functions. It is compulsory to increase its application for functional textiles such as sportswear, military wear, and fire safety wear, etc. Nanotechnology research in textiles has maximum possibility for the future approach but would be primarily an overview by current research progress in the simple, fast, new, and more resourceful characterization techniques for nanomaterials, nano-coatings, and nano-composites used in textile applications.

8.6 Conclusion

Textile nanomaterials have the possibility to improve the quality and stability of human life as well as industrial effectiveness in world. Still, the new textile nanomaterial may also pose harmful for the environment and decrease health safety issues. The Scientific Committee has decided that recently developed and identified nanomaterial is not risky for health and textile nanomaterials are not hazardous. There is still scientific doubt, which is not clear about the safety from textile nanomaterials by many characteristics, and therefore the safety concern of the substances must be done on a case-by-case basis. Although these are textiles, still very few studies are available in the literature, which describe the possible health risks involved with “nanotextile.”

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5

Synthesis of Nanomaterials and Their Applications in Textile Industry

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Abstract

Unexpected surface properties of nanomaterials *viz*. their relative low cost make them popular worldwide and due to this reason various type of nanoparticles have been synthesized by the researchers in last few years. After the revolutionary industrial development of twentieth century, manufacture of fabrics, natural fibers such as rayon, nylon and many others, which involve the incorporation of nanomaterials in synthetic materials and fibers, have been increased day by day with significant properties like low cost, chemical stability, and low cost production techniques. Development of nanomaterials is area of great interest for the improvement of existing functionality for the synthesis of new textile products with different properties and functions in single textile material. In last few years, significant improvement has been found in textile technologies like coloring, digital printing on textiles, and smart fabrics in which nanoparticles play key role in technological evolution because of their surface properties and for attaining new properties like flame retardant properties, antibacterial activity, and analyzed for special ultrathin fibers functionalization. In present chapter, we have reviewed the different methods for the synthesis of nanomaterials and their applications after the incorporation of nanomaterials into textiles.

Keywords: Nanomaterials, textile, fibers, antibacterial activity

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Mohd Shabbir, Shakeel Ahmed, and Javed N. Sheikh (eds.) Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques, (117–134)

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Modification of Textiles via Nanomaterials and Their Applications

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Abstract

Over the past few decades, Nanomaterials have boomed in an unprecedented way in field of textiles, due to demand for functional and durable apparel manufacturing. Nanomaterials can provide wrinkle-freeness, stain repellence, electrical conductivity, and static elimination to fibers without compromising their comfort and flexibility. Development of nanomaterials is a unique and multidisciplinary approach for textile functionalization, coloration along with UV blocking, antibacterial/microbial resistance, water repellent imparts flame retardancy, sensors, and self-cleaning property of textiles makes them a suitable candidate for smart textile material and for various end uses among all technologies. These nanoparticles can be deposited on various types of fabrics using various irradiation methods such as ultrasound, plasma, ultraviolet and gamma for maintainable coloration as well as functional finishing of various textile materials. The book chapter emphasizes on most appropriate approaches for incorporating nanoparticles in textile industry along with their advantages, recent advances, and studies concerning the use of nanomaterials in recent functional modifications such as textile coloration, UV protection, antimicrobial textile, and smart textiles of natural and synthetic textile materials.

Keywords: Nanomaterials, textile coloration, UV protection, antimicrobial textile, smart textile

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Mohd Shabbir, Shakeel Ahmed, and Javed N. Sheikh (eds.) Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques, (135–152)

Chapter 12
Outdoor Pollution Management by Nanotechnology

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ABSTRACT

Remediation of environmental pollution has become a hot issue in the world. Environmental pollution, mainly caused by toxic chemicals, includes air, water, and soil pollution. This pollution results not only in the destruction of biodiversity, but also the degradation of human health. Textile industrial effluent often contains the significant amount of synthetic and toxic dyes. Some dyes are water-soluble, dyes such as azo dyes, sulfonated azo dyes, etc. Hazardous effect of dyes results in the formation of tumor, cancer, liver or kidney damage, insomnia, diarrhea, nausea, vomiting, dermatitis, chronic asthma, coughing, headaches, and allergies in humans

DOI: 10.4018/978-1-7998-0311-9.ch012

and also inhibit growth of bacteria, protozoan, plants, and different animals. A range of wastewater treatment technologies have been proposed that can efficiently reduce toxic dyes to less toxic forms such as nanotechnology. In this chapter, the authors give an overview of the various aspects of nanotechnology to remediate industrial textile dye effluents.

INTRODUCTION

Dye is considered as colored material which can be natural, semi-synthetic or completely synthetic. Natural dyes are of natural origin and therefore it is non-hazardous in comparison to the synthetic dyes. Plastics, textile, printing, paper, leather, rubber, and paints industries are the major sources of synthetic dyes pollution (Singh & Arora, 2011). Several dyes containing effluents are released into the water streams by these sources. Textile effluent consists of large quantity of unfixed dyes as compared to other effluents which are discharged by other industries (Ali 2010). Textile dyeing industry intensively affects the earth and is considered as first water-Polluting activity (Kant 2012, Silva 2018). Human beings along with aquatic flora and fauna are affected by the discharge of contaminated dye effluents in the water streams (Korbahti & Rauf 2008, Fernandez *et al.,* 2014, Bouaziz *et al.,* 2015, Li *et al.,* 2018). For coloring of different materials, azo dyes are frequently used (Solis *et al.,* 2012).

Dyes can cause several health related problems to human body and can damage different organs such as liver, central nervous system, reproductive system, brain, and kidneys (Kadirvelu *et al.,* 2003). Water polluted by dyes at a concentration of 1.0 mg/L is not suitable for human's consumption (Malik *et al.,* 2007, Mittal & Gupta 1996). Benzidine and arylamine-based dye are harmful and found to have some carcinogenic properties (Ozcan *et al.,* 2004). Therefore, it is necessary to find economic and eco-friendly method for treatment of dye effluents (Song *et al.,* 2018).

BACKGROUND TO DYES

Colorants are basically chemicals which is responsible for imparting color to the materials on which they are applied. Pigments and dyes are the types in which dyes are classified. Both are different from each other on the basis of their solubility. The crystalline or the particulate nature of the pigments is retained during the application. But dyes on the other hand became the integral part of the material because these are soluble and can be easily diffused into the material. Polymers, paints, and inks are the materials in which pigments are used. Dyes are considered as main source

for contamination of water and it is considered as ionizing, aromatic, and colored materials. These compounds which originate from hydrocarbons such as anthracene, toluene, xylene, naphthalene, and benzene which are based on coal tar are used for coloring several materials such as greases, drugs, cosmetics, paper, food, waxes, fur, plastics, leather, textile materials, hair, and other products. Factors other than solubility are required for a coloured material to be considered as dyestuff.

The Physical Basis of Color

Dyes are colored due to adsorption of light in the visible region or in the 400-700 nm range. Color –possessing group i.e chromophore and conjugate systems i.e the system consisting of alternate single and multiple bonds must be possessed by dyes. Resonance of electrons is the force of stabilization in case of organic compounds which is exhibited by dye molecules. Presence of a chromophore which is the area of the molecule where the difference of the energy between the two separate molecular orbitals lies in the range of visible region is responsible for imparting colors to the dyes. π–π^* and n–π^* transitions occurs in chromophore and the solubility of dyes are effected by auxochromes which are present in most of the dyes. Transitions of n electrons occurred in auxochromes not the π–π^* transitions. Carboxylic acid, amino, hydroxyl, sulfonic acid groups the the various auxochromes which is present in dyes and are responsible for color of the colorant. But these functional groups are not accountable for color production (Gupta *et al.,* 2013, Janaki 2014, Mallakpour 2017, Mallakpour 2018, Saini *et al.,* 2018).

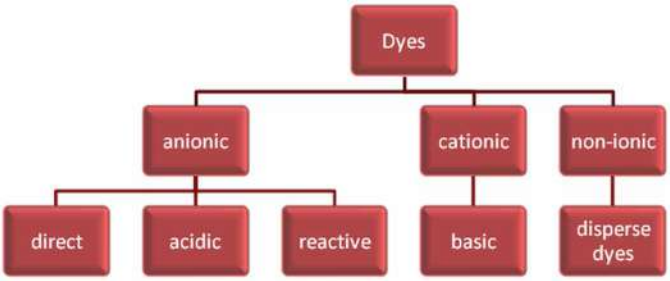
Classification of Dyes

Dyes are categorized on the basis of its chemical structure and color index (CI). Mono-azo, di-azo, tri-azo, anthroquinone, triarylmethane, and phthalocyanines are some of the general classes of the dyes. Anionic, cationic, and non-ionic are the different types of dyes which are classified on the basis of their utilization in textile industries. Yellow, orange, red, violet, blue, green, and black are the subclasses of the dyes on the basis of color.

There are generally two groups in which dyes are characterized:-

1. **Anionic Dyes:** Azine, nitroso, triphenylmethane, xanthene, and anthraquinone are the anionic dyes which are used for silk, wool, modified acrylics, nylon etc.
2. **Cationic Dyes:** Crystal violet, amaranth, and methylene blue are the cationic dyes which are used for polyacrylonitrile, modified nylons, in medicines, polyesters, and paper.

Figure 1. Classification of dyes
(Fu & Viraraghavan 2001)



Dyes are categorized according to the nature of their chromophore:-

1. **Nitro Dyes:** These dyes consist of NO_2 group (nitro group) which is attached to electron donating group such as amino and hydroxyl groups in an aromatic system.
2. **Nitroso Dyes:** These dyes are prepared on reaction of nitrous acid with naphthols or phenols. These dyes consists of nitroso group (chromophore) at orthoposition to the –OH group. These dyes are utilized in varnish industry, in paint, for rubber dyeing, and in the manufacture of pencils and wallpapers.
3. **Acridine Dyes:** These dyes are heterocyclic compounds which consist of acridine and its derivatives in their structure. These dyes are generally used for coloring mordant cotton and leather.
4. **Cyanine Dyes:** These dyes consist of delocalized charge on the two nitrogen atoms which are joined together by polymethine bridge. These dyes are used in industry, and in biotechnology for analysis and labeling because they are helpful label for nucleic acids and proteins.
5. **Oxazine Dyes:** These dyes consist of oxazine ring which act as a chromophore in which oxygen atom is attached at para-position to nitrogen atom.
6. **Thiazole dyes:** These dyes consist of thizole ring and it is mostly utilized for cotton.
7. **Anthraquinone Dyes:** These dyes are based on anthraquinone. The chromophore is provided by the resonance structure of the aromatic rings and the –CO groups. These dyes are utilized for dyeing silk, cotton, and rayon.
8. **Arylmethane Dyes:** These dyes are derived from CH_4 in which in which hydrogen atoms are replaced by aryl rings. Arylmethane dyes categorized into two subgroups:-

a. **Diarylmethane dyes:** these dyes are derived from methane in which two hydrogen atoms are replaced by two aryl groups.
b. **Triarylmethane dyes:** these dyes are derived from methane I which three hydrogen atoms are replaced by three aryl rings.

9. **Phthalocyanine Dyes:** These dyes consist of the derivatives of the phthalocyanine (tetrabenzotetraazoporphyrin) and its complex compounds with metals. The phthalocyanine dyes which are not soluble in water are generally used as pigments in the manufacture of printing colors, resins, plastics etc. the phthalocyanine dyes which are soluble in water are utilized for color fabrics.
10. **Indigoid Dyes:** These dyes consist of indigo as chromophore. These dyes are utilized for printing of cotton for dyeing proteins fibers and cellulose (Fabian & Hartmann 1980, Pisoni *et al.,* 2014, Raue & Corbett 2000).

Dye classification on the basis of the use or application is as follows:

There are some properties of dyes which are classified on the basis of their usage are:-

1. **Acid Dyes:**It is sodium salts of sulfonic acid and other acids like carboxylic or phenolic organic acids. Azo, nitro, nitroso anthroquinone, triphenylmethane, xanthenes, and azine are the different functional groups which are present in the acidic dyes. They are anionic dyes which are soluble in water and are used for dyeing silk, polypropylene fibers, nylon, polyamides, wools, and modified acrylics.
2. **Cationic (basic) Dyes:** They are called cationic dyes because colored cations are formed into the solution. Cationic dyes are also known as basic dyes and after the modication they can be water soluble. Hemicyanine, acridine, triarylmethane, thiazine, diazahemicyanine, oxazine, and cyanine are the different functional groups which are present in the cationic dyes. The positive charge carried by these dyes in their molecules is usually localized on the NH_4 group. These are used for cationic dyeable polyester, acrylic, cellulosic fibers, modacrylic, protein, and cationic dyeable nylon. Cationic dyes are utilized for dyeing dried flowers, jute, coir, cut flower etc.
3. **Disperse Dyes:** These dyes are free of the ionizing group and are insoluble in water which remained as suspended microscopic particles. Azo, nitro, benzodifuranone, anthroquinone, and styryl are the different functional groups which are present in the disperse dyes. Disperse dyes are mostly used for polyster dyeing and also used in form of aqueous dispersion for dyeing acrylic fibers, cellulose acetate, cellulose, and nylon.
4. **Direct Dyes:** These dyes are anionic dyes which are water soluble and coloured anions are produced due to ionization. For high affinity to cellulosic fibers,

this dye can be useful when applied with sodium sulfate and NaCl. Direct dyes are easily available in market, can be applied easily and utilized for dyeing leather, cotton, paper, nylon, and rayon. Direct dye without the help of other chemicals can easily hold on the cellulosic fibers.

5. **Reactive Dyes:** These dyes consist of atleast one reactive group which is able to form covalent bond with the fiber. The reactive group present in these dyes may be activated double bond or haloheterocycle. These dyes are generally used in the alkali situation and chemical bond is formed between reactive group of the dye and the –OH group on the cellulosic fiber. Bonding which occurs during dyeing leads to the fastness properties of these compounds. Due to the easy dyeing procedure, these dyes are used for dyeing cellulosics, some nylons, cottons, and rayons etc.
6. **Solvent Dyes:** These are characterized by its solubility in organic solvents. These dyes are nonpolar in nature and do not ionize in solution. Solvent dyes are used for coloring the waxes, organic solvents, plastics, hydrocarbon fuels, oil, lubricants, and gasoline etc. The compounds such as alcohols, chlorinated hydrocarbons, and liquid ammonia which are soluble in organic solvents are water insoluble is utilized for dyeing. Anthroquinone and azo group are the main groups present in these dyes.
7. **Sulfur Dyes:** These are called sulfur dyes because of the presence of sulfur-containing heterocyclic rings in their chemical structure. Sulfur dyes are synthetic organic molecules and it is utilized for the coloration of cotton, cellulosic fiber, and rayon due to the presence of sulfur group as chromophore. Sulfurization or thionization of organic intermediates leads to their ionization. These dyes are water insoluble and do not have affinity to cellulosic materials. Leuco compound is water soluble which is formed by treatment of sulphur dyes with weak alkaline solution of reducing agent or sodium sulfide and has affinity to cellulosic materials.
8. **Vat Dyes:** These are water insoluble dyes. These dyes polycylic compounds based on quinine structures which is utilized for the coloration of cellulosic fibers. These dyes are used generally used for color polyester and polyamide blends with cellulose fibers and also dyeing and printing cellulose fibers and cotton. These dyes are applied through the impregnation of fiber under the reducing conditions. It is further oxidized to insoluble form.
9. **Azo Dyes:** These dyes consist of aromatic compounds containing at least one azo group. These dyes are used for dyeing rayon, cotton, and polyester.
10. **Mordant Dyes:** Example of this dyes are dyes with metal chelating groups. These dyes are utilized for dyeing wool, cotton, and other protein fibers.
11. **Drug, Food, and Cosmetic Dyes:** These are natural and synthetic dyes. These are normally used in cosmetics, drugs, and foods, of which synthetic dyes

releated to anthraquinone, triarylmethane, carotenoid, and azo groups are the most commonly used (Hunger 2003, Gupta 2009, Janaki 2014, Parimalam 2012).

Nearly 1 lakh different types of dyes are synthesized with the rate of 9×10^6 tons/ year nowadays. These dyes are used in numerous industries including paper, colors, foodstuffs, textiles, and printing industries etc. The dye and textile manufacturing industries are responsible for the release of the color into the water. It is not easy to evaluate the quantity of dyes discharged into the water streams. It is estimated that >10,000 tons/year of dyes are consumed in the textile industries worldwide and nearly 100 tons/year of dyes are discharged into the water. The increased usage of dye causing water contamination leads to serious environmental trouble. The water quality is changed if dye is present in very small quantity (<1 ppm). Hence, for the supply of fresh water to the society there is need to remove these contaminants from the wastewater (Mu & Wang, 2016).

TECHNOLOGY FOR THE TREATMENT OF DYE EFFLUENTS

Various techniques are employed for the treatment of dye effluents such as adsorption (Baeza *et al.,* 2017), activated carbon (Yu *et al.,* 2016), osmosis (Luo *et al.,* 2017), clay-based adsorbent coating (Ab Kadir *et al.,* 2017, Azha *et al.,* 2017), membrane filtration (Dickhout *et al.,* 2017), electrochemical oxidation (Anglada *et al.,* 2007), organic resin (Nabi *et al.,* 2011a), coagulation/ flocculation (Shahadat *et al.,* 2017b), biodegradable nanocomposite (Shahadat et al., 2017b), hybrid ion-exchange adsorbents, incineration (Lin & Wu 2006), biomass (Rahman *et al.,* 2016), and nanocomposite material (Dong *et al.,* 2015). The techniques mentioned above characterized as conventional methods which involves elimination and recovery methods. Out of these techniques, adsorption is considered as most important technique for the treatment of dye effluents. Various adsorbents such as organic resin, graphene oxide, activated carbon, polyaniline, etc are used for the recovery and removal of dye effluents from the wastewater (Cazetta *et al.,* 2018, Banerjee & Chattopadhyaya 2017).

Nanomaterials

Nanotechnology refers to the study of extremely small structures in the range of 0.1 to 100 nm. The particle which lies in the range of 1-100 nm is termed as nanoparticles. Harmful pollutants including dyes, polychlorinated biphenyls, furans and dioxins, pharmaceutical and personal care products, phthalates, inorganic

pollutants, polycyclic aromatic hydrocarbons, viruses and bacteria, agrochemicals and pesticides, volatile organic compounds etc can be removed from the wastewater by using several cost effective, efficient and eco-friendly nanomaterials (Abdolmaleki *et al.,* 2017, Mallakpour *et al.,* 2017, Zare *et al.,* 2018, Prathna *et al.,* 2018, Tyagi *et al.,* 2018). Nanomaterials due to tunable pore size, high specific surface area (SSA) and related sorption sites, surface chemistry, short intraparticle diffusion distance have rapid adsorption rates and better efficiencies over wide range of pH as compared to conventional adsorbents. Low cost is needed for the fabrication of nanomaterials and only its small amount is utilized for efficient and effective dye removal. Hence for the adsorption use, these are effective in comparison to activated carbon due to less cost. Carbonaceous nanomaterials are one of the major class of nanomaterials, which comprise carbon nanofibers, fullerenes, graphene, and CNTs (carbon nanotubes). Carbonaceous nanomaterials due to higher affinity, high adsorptions kinetic and capacity are effective for dye removal from wastewater as compared to conventional activated carbon. Dyes are removed from the wastewater by π–π stacking, hydrogen bonding, covalent interaction, electrostatic interaction, and hydrophobic effect (Cai *et al.,* 2017, Shan *et al.,* 2017).

Coagulation–Flocculation

Sulfur and disperse dyes presented high coagulation and flocculation capacity while this method is not effectively applied for the color removal of acid, vat, direct and reactive dyes. Ethylediene dichloride, penta ethylene, and hexamine are the various co-polymers and ferric chloride, aluminum sulfate, copper sulfate, ferric, ferrous sulfate, and calcium chloride are the several coagulant agents which are generally used for color removal of colorants. The floc formed with the dyes is the mechanism behind the coagulation process and can be separated using filtration or sedimentation. The ability of settling of floc can be increased by dosing the polyelectrolyte during the phase of flocculation (Forgacs *et al.,* 2004). It is economic that only the separation of colorants is taking place. But the disadvantage of coagulation and flocculation process is the production of sludge (Valh *et al.,* 2011).

The characteristics of the suspended particles are changed in the coagulation method and floc are formed which sinks rapidly. The colloidal suspensions with negative charge are not effectively separated by conventional physical process. In coagulation process, electro kinetic repulsion between the particles is decreased by the addition of positive charge. Marmagne and Coste reported that in coagulation process, there is efficient removal of colour of sulfur dyes. The experiment was performed in bench flocculators, pH, temperature, and chemicals are the factors which affects the process of coagulation (Nguyen & Juang 2013).

Filtration Technology

For wastewater treatment, filtration technology is considered as a major part. Microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverses osmosis (RO) are the different filtration technology. Several promising results are shown by this technology for the color removal and for the process of water treatment, individual membrane is important. Various sorts of dyes are removed efficiently by the help of NF and UF but MF due to its large pore size is not sufficient for the treatment of wastewater. High membrane cost, high pressure, short life span, and momentous energy consumption are some of the limitations of this process and removal of organic contaminants or treatment of dyestuff are hindered by these properties. Salts rejections is better in case of RO. It is applied for recycling and gives improved results against several dye effluents in desalting and decolorizing.

Micro-Filtration

Dye baths consisting of pigment dyes as well as for rinsing baths are treated by this technique (Babu *et al.,* 2007). Chemical will remain in the dye bath which are not filtered by MF. Colloids, suspended solids or macromolecules having pore size of 0.1 to 1 micron are separated using MF and it is the pretreatment for NF or RO (Ghayeni *et al.,* 1998). For silt density index or turbidity, the performance of microfiltration is greater than 90. Poly (Vinylidene Difluoride), Poly (Ether Sulfone), Polycarbonate, Poly (Vinylidiene Fluoride), Poly Tetrafluoroethylene (PTFE), Poly (Sulfone), Polypropylene etc are the specific polymers from which MF membranes are formed. Operation at high temperature or where extraordinary resistance for chemicals are needed; carbon coated with zirconia, ceramic, carbon, alumina and sintered metal membranes, glass have been used. The operational velocities for micro and ultra filtration is 20 to100 cm/s and pressure is 20 to 100 (Ptm) (Naveed *et al.,* 2006).

Ultra-Filtration

This technique is used for the separation of macromolecules and particles, but only 31-76% dye is removed from this method. For reuse of treated wastewater for sensitive process such as textile dyeing is not permitted but for washing, rinsing etc where salinity is not a issue, the treated wastewater can be reused. UF can be used in combination with biological reactor, as pretreatment process for RO, and for metal hydroxide elimination (Naveed *et al.,* 2006). Polyvinyl chlorides (PVC), polytetrafluoroethylene (PTFE), polysulfone, acrylic copolymer, polypropylene, and nylon-6 are the various polymeric materials which are used for the formation of ultrafiltration membranes.

Nano-Filtration

This technique is used for the decoloration of effluents from the textile industries. Nanofilteration membranes are able to retain divalent ions, dyeing auxiliaries, organic compounds with low-molecular weight, hydrolized reactive dyes, large monovalent ions and they are normally made of aromatic polyamides and cellulose acetate. Nanofilteration and reverse osmosis membranes are manufactured by inorganic materials including carbon based membranes, ceramics, and zirconia. 5 to 30 Gross Flow per Day (GFD) is the flux rates for nanofilteration. By single nanofiltration, amount of removal of color greater than 90% were reported. Toxic effects of high concentration of dye > 1.5 g/L and mineral salts > 20g/L in the dye household effluents regularly reported (Tang & Chen 2002). The discharge of treated effluents in water streams is approximately unfeasible due to accumulation of dissolved solids. Textile decolorization of effluents by nanofilteration is fairly satisfactory.

Reverse Osmosis

Hydrolized reactive dyes, many types of ionic compounds, and chemical auxiliaries are removed by this technique in a single step and high quality of permeate is produced. Careful pretreatement of influent must be done because reverse osmosis is sensitive to fouling like nanofilration. Reverse membranes are generally made up of aromatic polyamides, inorganic materials, and cellulose acetate. In comparison to conventional treatments, membrane processes in combination with physio-chemical treatment has several advantages, such as decreasing the consumption of fresh water and the cost for wastewater treatment, decrease of regulatory pressure, capability to recover materials, costs of waste disposal can be decreased due to small disposal volumes. Several cost-effective applications in textile industries are associated with membrane processes (Naveed *et al.,* 2006).

Adsorption of Dyes

Adsorption is considered as an important method over other conservative approaches for dye removal from wastewater (Aljeboree *et al.,* 2014). Physical and chemical forces are responsible for the attachment of dissolved molecules to the surface of adsorbent in the process of adsorption. Wastewater treatment by activated carbon is widely employed. Combined adsorption and ion exchange or simply adsorption process is responsible for the removal of dye using activated carbon. Cost of operation, availability of adsorbents at low costs, and low initial capital are the factors which makes the wide applications of adsorption process for the elimination of textile contaminants. Various properties such as mechanically stable, ecofriendly, suitable

pore size, less processing procedures, easy accessibility, economic, compatibility, higher adsorption capacity due to large surface area, and regeneration capacity should be consisted by superlative adsorbent for adsorption of dyes (Vakili *et al.,* 2014).

Agricultural by-product, natural and modified clay (Ahmadishoar *et al.,* 2017), polymeric sorbent (Popescu & Suflet 2016), activated carbon (Tze *et al.,* 2016), industrial by-product, chitosan-based adsorbent (Çınar *et al.,* 2017), and resin (Naushad *et al.,* 2017) are the various adsorbents which are used for the removal of colouring agents.

Adsorbents

The contaminant which is absorbed is called adsorbate and the phase on which it is getting adsorbed is called adsorbent (Yagub *et al.,* 2014). Adsorbent plays a very important process in adsorption process. Great adsorption efficiency, low cost, long life, great selectivity, and broad availability are the necessary properties for the good adsorbents. Nanomaterials, activated carbon, and several low-cost adsorbents are utilized as adsorbents for removal of contaminants from wastewater (Toor 2010).

Activated Carbon

It is mostly used adsorbent for the elimination of wide variety of dyes from the contaminated water. It is non-graphitic form of carbon, internally porous microcrystalline. Micropore structures, great adsorption capacity, large extent of surface reactivity, large surface area are the factors which makes the adsorbents efficient for dye removal but the cost of fabrication and regeneration of adsorbent is too high. Extra effluent is generated during the regeneration by means of refractory method which causes loss of removal efficiency of adsorbent due to 10%–15% loss of adsorbent (Adeyemo *et al.,* 2017).

Low-Cost Adsorbents

Soluble organic dyes from wastewater are transferred to the adsorbent which is highly porous and solid surface. Adsorption is most effective and economic process for decolorization of textile effluents or dye elimination. Temperature, interaction of dye/adsorbent, pH, surface area of adsorbent, size of particle, and contact time are the main factors for the adsorption of dyes. There is need for the low-cost adsorbents due to low regeneration capacity and high cost of adsorbents. These adsorbents must present in considerable amount in nature, need minimum processing, and must be effective.

There are three categories in which low-cost adsorbents are divided:

1. By-products of industries and agriculture wastes like sugar industry mud, wood sawdust, fly ash, coal ashes, teak wood bark, wood chips, peels (banana, pomelo, garlic, jackfruit), papaya seeds, grounded sunflower seed shells, coconut tree flower, rice husk, grass waste, ground nut shell powder, rubber seed shell, neem leaf powder.
2. Various bioadsorbents like microbial, biomass, and fungi.
3. Various natural materials like glass wool, clay.

Mixed results are shown by these adsorbents and in very few cases these have adsorption capacity larger than activated carbons (Teng & Low 2012, Servos 2014, Suteu *et al.,* 2011a, Nazarzadeh *et al.,* 2018).

CONCLUSION

Dyes are natural and synthetic materials which impart color to the products and make the environment more beautiful but it is considered as harmful and can contaminant the water streams. From the literature review it is observed that there is increase in production and use of textile dyes in last few decades which cause threat to the environment. Textile sector due to large consumption of water sources is found to be considered as an important area. The presence of dyes even in small quantity is toxic to environment and should be eliminated before entering into the water stream. By mechano-physico-chemical and biological treatment procedures, dye removal from textile effluents can be achieved. Removal techniques for dye effluents from wastewater have drawn considerable interest.

Adsorption is considered as a cost effective and efficient technique for the removal of dye effluents from wastewater and hence can generate high-quality treated effluent. This chapter highlights on the removal of dye effluents from wastewater by using nanotechnology.

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KEY TERMS AND DEFINITIONS

Dye: Dye is a colored substance which provides color to another substrate through chemical bond with the substrate.

Effluent: Effluent is an outflowing of water or gas to a natural body of water, from a structure such as a wastewater treatment plant, sewer pipe, or industrial outfall, etc.

4

Conjugated Polymer Light-Emitting Diodes

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Abstract

The development of organic light-emitting diodes (OLEDs) has attracted considerable interest in innovations for our daily life and future. They have promising applications in flat panel displays, energy-saving, eco-friendly, thinner and smaller in size, lightweight, and cost-effective fabrication process. For the development of OLEDs, numerous conjugated polymers have been studied due to their semiconductor nature, which is being associated with pi bond delocalization along the backbone of the polymer chain. Conjugated polymers are highly recommended for electroluminescent devices such as OLEDs. The chapter comprises basic knowledge of polymer light-emitting diodes, their construction, device function, and use of conjugated polymers in blue, red, green, and multicolored light-emitting diodes along with challenges and their future perspectives.

Keywords: Conjugated polymers, organic electronics, OLEDs, PLEDs, band gap, blue, green, and red emission region

4.1 Introduction

Light-emitting diode (LED) is a semiconductor light source that emits light in response to an electric current [1]. In semiconductors, electron recombine with holes, releasing energy in the form of photons [2]. The color of the light (corresponding to the energy of the photons) is determined by the

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Inamuddin, Rajender Boddula, Mohd Imran Ahamed and Abdullah M. Asiri (eds.) Polymers for Light-Emitting Devices and Displays, (77–98) © 2020 Scrivener Publishing LLC

energy required for electrons to cross the band gap of the semiconductor [3]. Nowadays, organic light-emitting diodes (OLEDs) have attracted considerable attention of researchers, scientists, and industrial aspirants and bring innovation to our lives due to its unique properties such as low-cost, wide viewing angle, flexibility, lightweight, low power consumption, and thin panel thickness [4–8]. OLED device architecture includes the use of an organic carbon-based film which is made up of some conjugated polymers, sandwiched between two charged electrodes. These electrodes are the transparent anode (generally glass) and the other is a metallic cathode [9]. OLEDs have smart features of ultra-thin and fine image-quality along with lightweight as self-emitting devices [10]. Nowadays, they are very familiar to general consumers and civilians due to their uses in smartphones like Samsung's Galaxy series as well as in the manufacturing of large TV displays [11]. OLED can be fabricated by small molecules or polymers. The former can be fabricated by vacuum deposition method and polymer organic light-emitting diodes (PLEDs) are generally developed by solution deposition method [12, 13]. The latter method has attracted wide attention due to its ease of preparation and low cost [14]. The process of fabrication of PLEDs can be carried out at room temperature so that organic flexible substrate can be a platform for device fabrication [15]. This technology allows polymers to fabricate full color PLED pixels by various printing methods or techniques like dye diffusion [16], laser-induced thermal transfer [17], screen printing [18], inkjet printing [19, 20], and patterning with the photolithographic process [21, 22]. In the comparison of small molecules OLEDs, these patterning methods make PLEDs more useful in the larger size and high-resolution display [23]. For PLEDs, three colors, i.e., red [24], green [25], and blue [26] used for full-color display for which various types of conjugated polymers have been proposed and synthesized.

Conjugated polymers are commonly referred as "Organic Macromolecules" having conjugation of the single and double bond in their polymer backbone chain that makes them intrinsically conducting in nature [27]. In these organic macromolecules, the overlapping of p-orbitals takes place resulting delocalized π-electrons system which is responsible for unique optical and electronic properties [28]. In conjugated polymeric chain, injection of hole and electron *via* π (bonding) and π^* (antibonding) can create a self-localized excited state by delocalization of charge in valence and conduction bands which on emission can decay radiatively and revealed outstanding potential in electroluminescent devices [29]. The generation of charge carriers such as polarons, bipolarons, and solitons are responsible for the conduction mechanism [30].

These conjugated macromolecules show changes in electrical and optical properties when doped or functionalized by chemical species [31]. A numerous variety of conjugated polymers have been developed and evaluated since 1977, since the discovery of electrical conductivity in polyacetylene discovered [32]. These materials include polyanilines [31, 33] and their derivatives such as poly(o-phenylenediamine) [34, 35], polyluminol [36, 37], and some other polymers like polypyrroles [38], polynaphthylamines [39–41], polythiophenes [42], polyanisidine [43], polycarbazoles [44–46], polyphenylenevinylene (PPV) [47], and their derivatives [48], polyphenylenes [49], polyfluorenes [50], and polyaryleneethynylenes [51]. These have attracted numerous industries and academics for a different type of optoelectronic applications. Conjugated polymers have drawn considerable attention due to their strong fluorescence emission [52], excellent hole transport ability [53], flexibility [54], and solution processability [55–57]. Numerous reports have been published regarding enhancement of processability of conjugated polymers by blending or composite formation [58–61].

Conjugated polymers which are processable by solubility are the most promising candidate for optoelectronic devices such as LEDs [62]. Enhanced solubility and processability of conjugated polymers help in preparing an emissive electroluminescent thin film of organic compound which emits light in response to an electric current in optoelectronic devices [63, 64]. Chemical structure and extended conjugation in such type of polymers provides controlled morphology, enhanced solubility and processability for using them in OLEDs *via* preparing an emissive electroluminescent thin film of organic compound which emits light in response to an electric current [65]. In addition, extended conjugation also provides a low band gap as a functional property for these applications [66].

4.2 History, Classification, and Characteristics of Polymer OLED Material

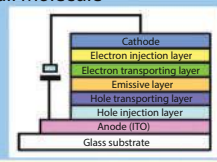
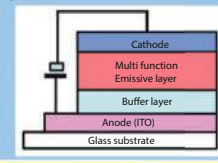
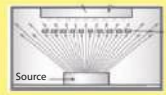
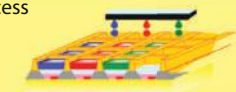
In Cambridge University, a group worked on conjugated polymers and found electroluminescence in these materials in 1989 [67]. In this finding, the device had a very short lifetime of some minute and very weak external quantum efficiency (EQE) of 0.1%. Some of the companies worked on the progress of polymer OLEDs material and optimization of these devices fastly such as Sumitomo Chemical Co. Ltd, Cambridge Display Technology (CDT), Dow Chemical and Covion, etc., and the result of the research was

achieved as several tens of thousands of hours long lifetime and high EQE of about 5%~10%.

OLEDs material can be broadly classified into two groups on the basis of emissive materials which includes small molecules based OLEDs and polymer-based OLEDs [68, 69]. Small molecules-based OLED can be fabricated by the vacuum deposition method [70] and polymer-based OLED can be developed by the solution deposition method, Table 4.1 [71]. The polymer material can be conjugated or non-conjugated further for the fabrication of OLED while dendrimers play the role of intermediate of polymers and small molecules, Figure 4.1. The multilayer device structure is used in small molecule OLEDs, and so there is a requirement of more amendments in chemical structures in addition to solubility while polymeric material to form OLEDs is willingly soluble by ink solvents and makes it a useful material for wet process or printing process discussed earlier in Section 4.1.

Copolymerized or modified conjugated polymeric materials work without a multilayer structure in OLEDs [72]. In these devices, one of the most important parameters in emission color and this is controlled by incorporation of emissive moieties into the polymeric backbone, which is generally a wide band gap structure [73].

Table 4.1 Comparison of small molecule LED and polymer LED *(Reprinted from Chizu Sekine et al., 2014 Sci. Technol. Adv. Mater. 15, 034203).*

	Small Molecule	Polymer
		
Process	Dry process (Vacuum evaporation) 	Wet process 
Patterning	Shadow mask	Printing (IJ etc.)
Structure	Complex layer structure (5-6) →Complex process	Simple layer structure (2-3) →Simple process, scalable
Material	Separated function	Integrated function
Issue	Layer structure complexity Difficulty in mask patterning	Performance (esp. LT) Patterning technology

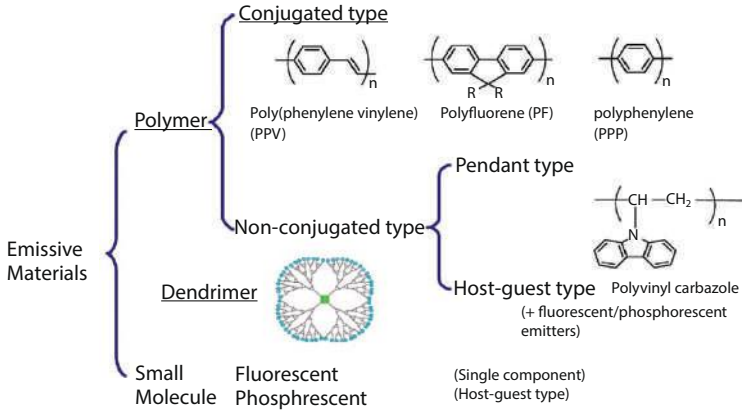


Figure 4.1 Classification of polymers according to emissive materials. (Reprinted from Chizu Sekine *et al.*, 2014 *Sci. Technol. Adv. Mater.* 15, 034203).

4.3 Polymer OLED Device Construction and Working

An OLED is a 100- to 500-nm-thick solid-state semiconductor device and about 200 times smaller to human hair [74]. The structure of OLED comprises a cathode, an emissive layer, a hole injection layer and an anode. In OLED there is an interlayer sandwiched in between cathode and anode electrodes [75]. The interlayer is composed of an organic layer in which the delocalization of pi electrons takes place and make this layer conductive in nature [76]. These materials are known as organic semiconductors due to the conductivity between conductors and insulators [77]. In organic semiconductors, their HOMO (highest occupied molecular orbitals) and LUMO (lowest unoccupied molecular orbitals) are considered as valence and conduction band present in the inorganic semiconductor [78]. An interlayer between hole injection and emissive layer makes an improvement in the device structure as well as in its performance due to cross-liking properties of the interlayer [79]. In polymer OLEDs, an interlayer is responsible for the enhancement in the emission efficiency. This layer is placed in between the hole injection layer and the emission layer. The function of this layer is hole-transporting as well as electron and exciton blocking. In summary, this layer is responsible for the separation of the hole injection layer and emission zone, as well as due to its electron blocking property, it accumulates electrons at the interface of the interlayer [80]. However, modern

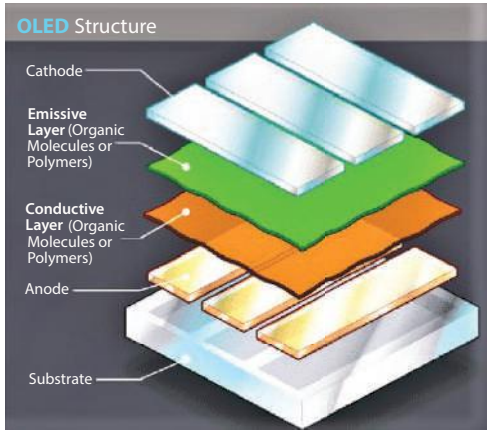


Figure 4.2 The basic OLED device architecture. Source: https://electronics.howstuffworks.com/oled1.htm.

OLEDs are fabricated by a very simple bilayer structure having a layer of emissive material and other is conductive material [9]. The basic OLED structure is shown in Figure 4.2.

Polymer OLEDs device performance is based on its emission efficiency and its lifetime. Its emission efficiency was discussed by Tokito and his labmates [81] and expressed as:

$$\Psi = \Upsilon.n_{e-h.}\Psi_{ph}.(1 - Q) \tag{4.1}$$

In the above equation, Ψ stands for electroluminescence efficiency, Υ stands for carrier balance for electron and hole, Ψ_{ph} stands for photoluminescence efficiency, and Q stands for quenching factor. It can be stated by the equation that by improving carrier balance for electron and hole, by enhancing photoluminescence efficiency and recombination rate or by suppressing cathode quenching, device performance can be improved in terms of electroluminescence efficiency.

4.4 Blue Light-Emitting Diodes

Various types of conjugated polymers have been proposed for blue light-emitting diodes which were highly soluble and reveled strong blue fluorescence or emit blue light in 350–440 nm range without any excimer

formation on longer wavelength [82–85]. For blue OLED, some phenylene chains have been polymerized by meta linkage and displayed 4.69 cd A^{-1} efficiency [86].

In this regard, carbazole is a rigid plane biphenyl monomer having a wide band gap along with its high flexibility and high luminescent efficiency which helps in modification of the molecule skeleton for its use as a key chromophore in OLEDs [87, 88]. These are extensively used in the development of highly competent blue light-emitting diodes as a key role of host and charge-transporting materials [89]. By derivatives of carbazole, Morin [90] and his coworkers developed light-emitting diodes by electron and hole transport molecules, i.e., 2-(4-biphenylyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole and N,Ń-diphenyl-N,Ń-bis(3-methylphenyl)-1,1′-biphenyl-4,4′-diamine, respectively, which showed electroluminescence in 424–432 nm wavelength (blue region) with Al and indium tin oxide as the electrodes. They also developed 2,7 carbazole based blue light-emitting copolymers with some other highly aromatic comonomers by Yamamoto or Suzuki cross-coupling reactions. These high molar mass modified with substituent species were highly water-soluble and amorphous in nature as well as these showed good redox properties and thermal stability for their application in layer blue light-emitting diodes [91].

Numerous works have also been reported on polyfluorenes that is also a blue light-emitting material [92]. Although, polyfluorenes exhibited promising features, literature suggested the tendency of forming excimers and aggregation which caused shifting of emission spectra towards longer wavelengths or showed bathochromic shift and decreases fluorescence quantum yields [93]. To remove such type of problems, scientists and research have done a number of studies and done functionalization by bulky side substituents or copolymerization with other monomers or by introduction of lithe spacers amid the chromophores [94–98]. Oligo(9, 9-dihexyl-2,7-fluorene ethynylene)s were synthesized by Tsutsui *et al.* [99] for extraordinary photoluminescence having high quantum yields as well as high oxidative and thermal stability for their use in OLED application. Chan *et al.* [100] developed poly(9,9-dihexyl-2,7-dibenzosilole) by copolymerization of monomers dibromo and bis(boronate) which showed better efficiency in a single layer light-emitting device in comparison of polyfluorene.

4.5 Green Light-Emitting Diodes

Seino and his labmates developed a green organic light-emitting device (OLED) whose power efficiency was too high (100 lm W^{-1}). This was

achieved *via* energy transfer from an exciplex and it was 1.6-times higher than green thermally activated delayed fluorescence (TADF) OLEDs [101]. Tanaka *et al.* [102] developed highly efficient green organic light-emitting diodes (OLEDs) using a conjugated polymer dipyridylphenyl moieties and fac tris(2-phenylpyridine)iridium, $Ir(ppy)_3$ as a phosphorent emitter and yield 29% at 100 cd/m^2 and 26% at 1000 cd/m^2 external quantum efficiencies which were too high and lead to 133 lm/W and 107 lm/W ultra high power efficiencies at 100 cd/m^2 and 1000 cd/m^2 respectively. A highly efficient green OLED was fabricated by using 9,9-diarylfluorene-terminated 2,1,3-benzothiadiazole derivative in Ku's lab [103] which revealed EQE (ηext) of 3.7% and maximum brightness at 168,000 cd m^{-2}. Zhu and his coworkers [104] proposed green and blue-green phosphorescent OLEDs based on tetraphenylimidodiphosphinate and iridium complex. These were highly efficient, due to shorter excited stated lifetime and better carrier transport ability along with good electroluminescence performance. 3′,5′-di(carbazol-9-yl)-[1,1′-biphenyl]-3,5-dicarbonitrile was used as a host material for green thermally activated delayed phosphorescent and fluorescent OLEDs by Cho *et al.* [105]. This materials showed high quantum efficiency close to 25%. Chen [106] and his coworkers achieved highly efficient green phosphorescent OLEDs by 1,3,5-Triazine derivatives as new electron transport-type host materials. A dicarbazole-triazine hybrid bipolar host material was developed in which dicarbazole moiety is electron donor and triazene is electron acceptor. This device was highly efficient green phosphorescent OLEDs having maximum efficiency of up to 20.0% [107].

4.6 Red Light-Emitting Diodes

Red OLEDs have an emitting layer comprising of one material during their initial development. Okada *et al.* [108] developed a highly efficient complex for red OLED by using 1-phenylisoquinoline. The complex revealed emission peak in the red region, i.e., 598–635 nm, the quantum yield of 0.17–0.32 and lifetime of those complexes ranged 1.07–2.34 μs, respectively. Jung and his labmates [109] reported red organic light-emitting devices (OLEDs) by incorporating various donor-acceptor moieties in polymeric backbone which showed emission at 637–677 nm and highest brightness of 8,300 cd m^{-2} with 4.46% maximum EQE at 7 V, the current efficiency and the power efficiency was found 3.43 cd A^{-1} and 1.64 lm W^{-1}, respectively. 3-2-(3,3-dicyanomethylene-5,5-dimethyl-1-cyclohexylidene)

vinyl-N-naphthyl-carbazole(NCz-2CN)and3,6-bis(2-(3,3-dicyanomethylene-5,5-dimethyl-1-cyclohexylidene)vinyl-N-phenyl-carbazole (PCz-4CN) which are derivatives of carbazole were used as donor-Л-acceptor for obtaining red OLEDs by Fu *et al.* [110]. They emit in red region 630–666 nm and maximum luminance of 4,110 cd/m^2 attained at 15 V. The current efficiency was found 2.09 cd/A while maximum luminous efficiency was found at 0.49 lm/W.

4.7 Multicolor Light-Emitting Diodes

Bouillud *et al.* [111] presented conjugated polymers based on fluorene with the incorporation of thiophene and phenylene moieties in their copolymer having outstanding properties of tunability of the electroluminescent properties. By changing the composition of comonomers, it has the ability to change their emission from blue to green or yellow. They also suggested hole injection and hole transport phenomena by the addition of an insulating buffer layer as well as the hole transporting material into the material. This electroluminescence efficiency was increased from 4.5 to 125 cd/m^2 by incorporation of N,N'-diphenyl-N,N'-bis(3-methylphenyl)-1,1-biphenyl-4,4'-diamine as the hole transporting layer and LiF as an insulating buffer layer.

Wong and his coworkers [112] studied the use of conjugated and non-conjugated polymeric backbone in terms of synthesis, physical properties, sample quality, and device performances for blue, green, and red OLED materials (Figure 4.3), while Chou *et al.* [113] prepared universal bipolar host by phosphine oxide and two carbazole groups for blue, green, and red phosphorescent OLEDs which was highly efficient.

4.8 Advantages of OLEDs over Other Liquid Crystal Display

OLEDs revealed many advantages with other conventional liquid crystal displays (LCDs) such as polymer OLEDs that show different colors such as red, green, blue (RGB) as well as white too which is important to many applications [114, 115]. OLEDs are biodegradable. An OLED display can be many times lighter, more flexible, and thinner compared to LCD, as well as it can display deep black levels because it works without a backlight [116]. These are much brighter as compared to LCD.

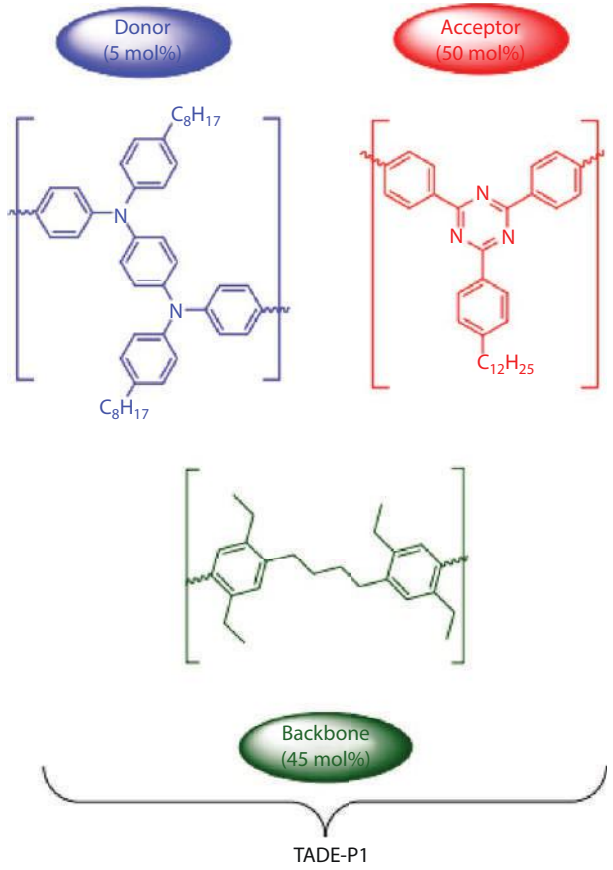


Figure 4.3 Functionalized conjugated polymer having donor (5 mol.% triphenylamine), acceptor (50 mol.% 1,3,5-triazine) and backbone (45 mol.%) with an insulating n-butyl link (*Reprinted from Michael Y. Wong, 2017, Journal of Electronic Materials. 46, 6246–6281).*

These have the active light-emitting capability as well as the OLEDs are driven by the direct current with 10-V approximate voltage [117]. They are also highly efficient in a light color so that full-color display can be realized easily and in place of early vacuum display devices, these are all-solid-state devices [118]. In addition, they have a lithe information display technology with low energy consumption and high light-emitting efficiency [119]. These devices have outstanding light-emitting properties and temperature features which least affected by temperature fluctuations and faster response time. They are easy to prepare at a very low cost [120].

4.9 Applications of OLEDs

In 2003, Kodak has used OLED in the fabrication of its first digital camera [121]. OLEDs are widely being used in the latest smartphones, DVD players, digital cameras, digital watches, etc., due to its high flexibility and foldability which helps in saving space and weight [122]. After this, numerous companies have used this technology in their products including Nokia [123], Samsung [124], etc. Since the year 2019, OLED screen is readily used in many mobile phones including Honor view 10, Nokia 6.1 plus, Samsung Galaxy A8+, Vivo V15 Pro, Gionee S11S, OnePlus 7 Pro, etc., and in TV such as Sony Bravia Android Smart OLED TV KD-55A8G, LG Smart TV OLED55C8PTA, METZ Android OLED TV M55S9A, etc. OLEDs have also applicable in high-end television systems, flat-panel displays, computer monitors, some pocket-size systems like digital cameras, portable gaming consoles, media players, android phones, and mini-screens [125–127].

These are also widely used in various multiple-input output wireless optical channels [128]. Some other applications of OLED are shown in Figure 4.4.

4.10 Challenges and Future Possibilities

OLED has a wide area of applications in different areas, but still, there are many challenges involved in this technology such as its is costly in

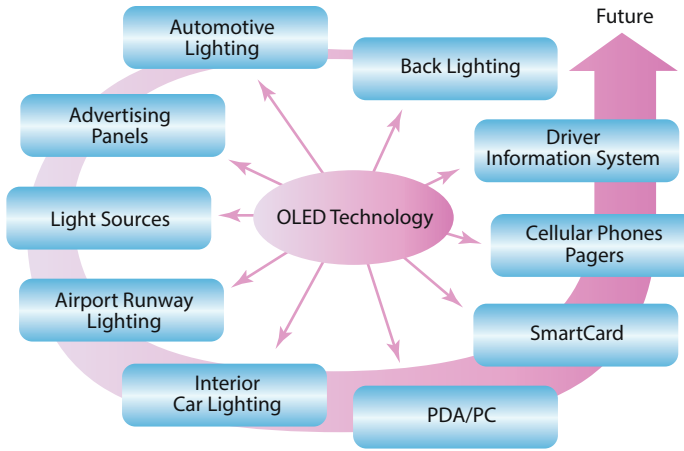


Figure 4.4 Applications of OLED. Source: https://www.elprocus.com/oled-display-technology-architecture-applications/.

comparison to LCD or LEDs. There is still a lack of a broad range of products incorporating OLEDs. Light efficiency is still low and compared to other display devices, their lifetime is shorter. Red, green, and white LEDs give longer lifetime but the blue OLED revealed a limited lifetime of 1.6 years. Technology is highly sensitive to water so can be damaged by moisture. When OLEDs compared with LCD in direct sunlight, these show worse scenario. In the future, these problems can be resolved by using various types of technologies and conjugated polymers. OLEDs can be used for curved display in the future as well as transparent displays entrenched in windows. The property of flexibility of OLEDs maybe uses in roll to roll manufacturing process which allows flexible display architecture. Flexible, stretching, and self-healing materials need to incorporate for OLED device fabrication that can also improve barrier layers to protect OLEDs from moisture and oxygen. By removal of triplet exciton from conjugated polymer backbone could expressively enhance the device stability, specifically at the initial stage of pouring, i.e., *via* the introduction of additive which quenches lead the high efficiency and device lifetime. For this, various features of polymers could be introduced in single polymer *via* its copolymerization, doping, medication, or *via* functionalization of monomers then copolymerization.

4.11 Conclusion

Great progress has been done in the synthesis of conjugated polymers for OLED device fabrication. By modification, copolymerization, doping, and other techniques, those materials are being prepared which helps in applications of electron transport materials to improve the device fabrication and performance of OLEDs. The efficiency of the OLED device is dependent on charge injection, charge transport, and emission. The combination of phosphorescent emitters and conjugated polymers is very important to achieve high efficiency. For this point of view, many functionalized or copolymerized conjugated polymers have been investigated having various features in a single polymeric material as conjugated polymers having delocalized pi electrons in their backbone possess brilliant charge carrier transport properties so by incorporation of various moieties conjugation length could be controlled or tuned for further improved modifications in OLEDs.

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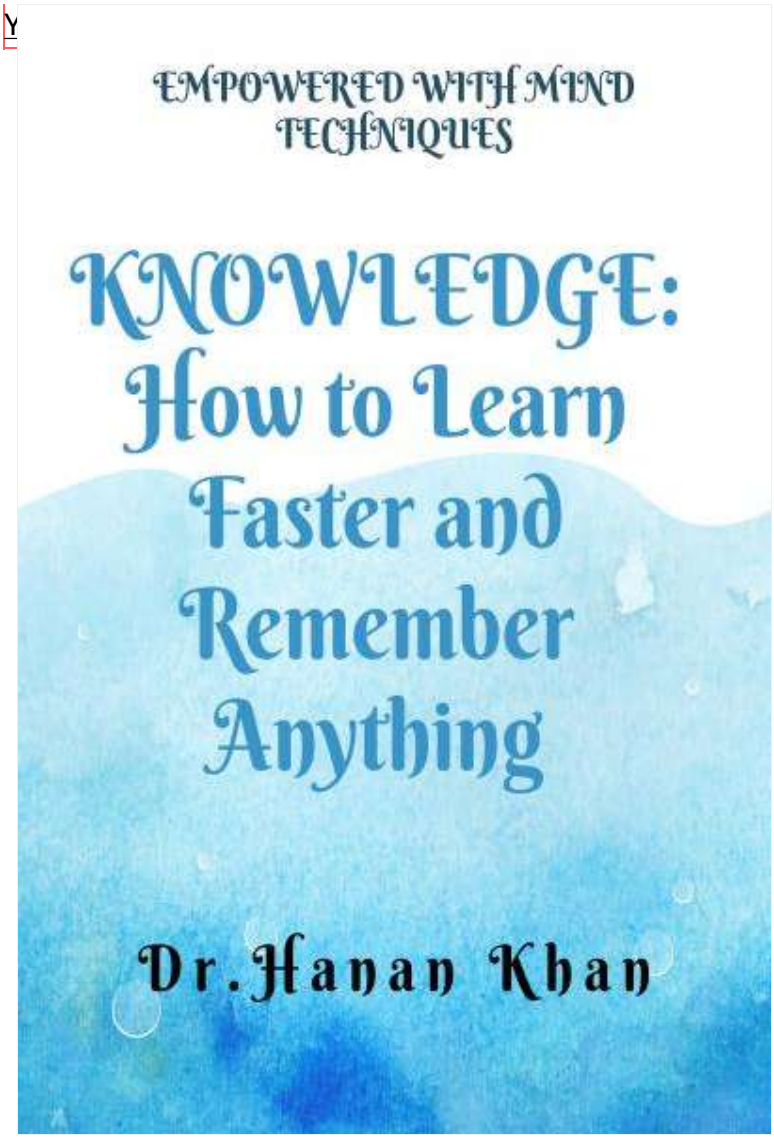

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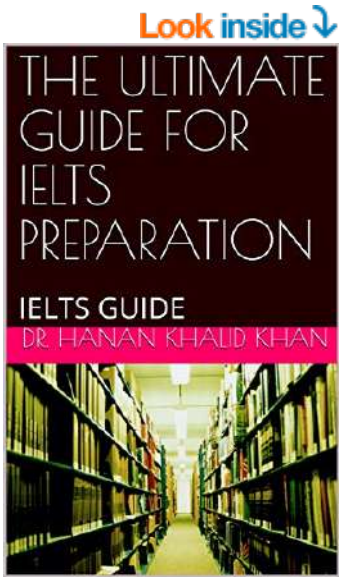

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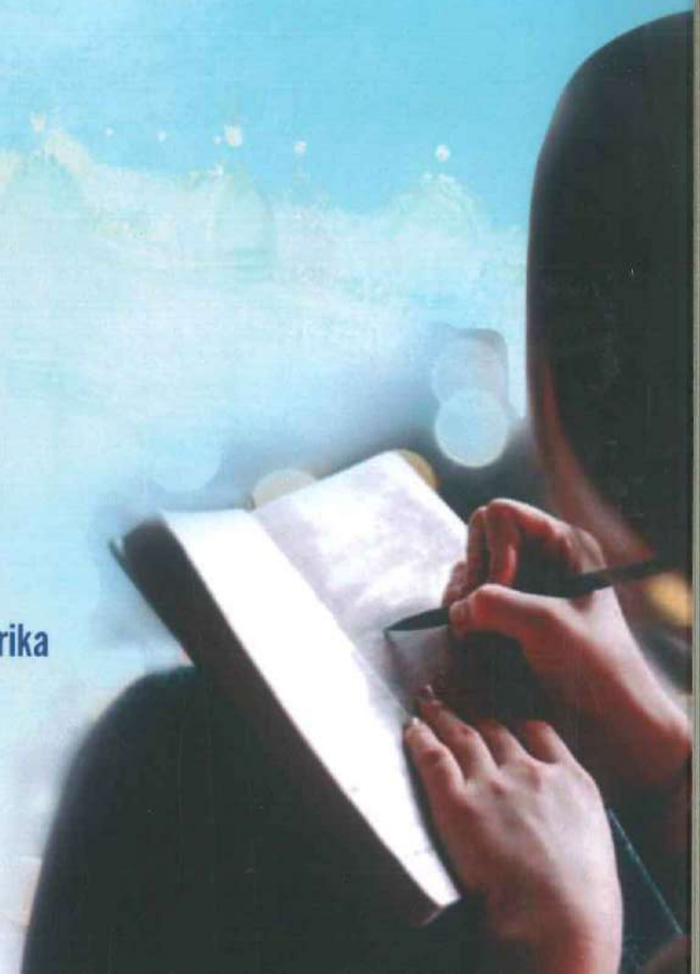

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The Issue of Identity, Hybridity and Assimilation in the Diasporic Poems of Sujata Bhatt

Rashmi Maniar, Hanan Khalid Khan and **Lavanya Paluri**

More women poets are leading to present the world in its multi-dimensions, in various ways, in Indian writings in English. In other words, they give us a complete understanding of human nature without leaving out any aspect of life. Sujata Bhatt is a well-known name among Indian women poets who write in English. She is an Indian diaspora poet who expresses herself through poetry. She uses her experiences on three continents creatively in her writing, which is rooted in multiculturalism. Sujata Bhatt's diasporic experience does not stifle her creativity; rather, it provides her with a range of viewpoints that broadens her comprehension of life's complexities. Trans-cultural migrants have become a kind of psychological refugees in this age of accelerated globalisation, as a result of crossing complex geographical and cultural boundaries. They strive to forge a sense of stability – a sense of identity – while stuck in the confluence of pluri-cultures. Her poetry engraves a homing impulse while simultaneously denying fixed-source discourses.

The picture of a home that is located at a distance – with reference to both space and time, is at the heart of the diaspora concept. For Diasporans, home is the point of origin where they come together to form their identity. While there are those who believe the two are separate, there are others who believe they are not. In academic assessments of diaspora communities, the impression of 'home' and 'homeland' is significant. The importance of home (land) in the emergence and evolution of the diaspora idea is enormous, even today. This picture of the original house is created in the mind of the first owner. generation, as well as in the diasporic consciousness of the first, second, or third generations of migrant workers Contemplation and recollection are embedded in a homeland, from which the concept of home emerges. As a result, home is a place where one lives; it is a concept that is infused with thoughts, emotions, and fantasies. Diasporans live in the mythical homelands of their forefathers

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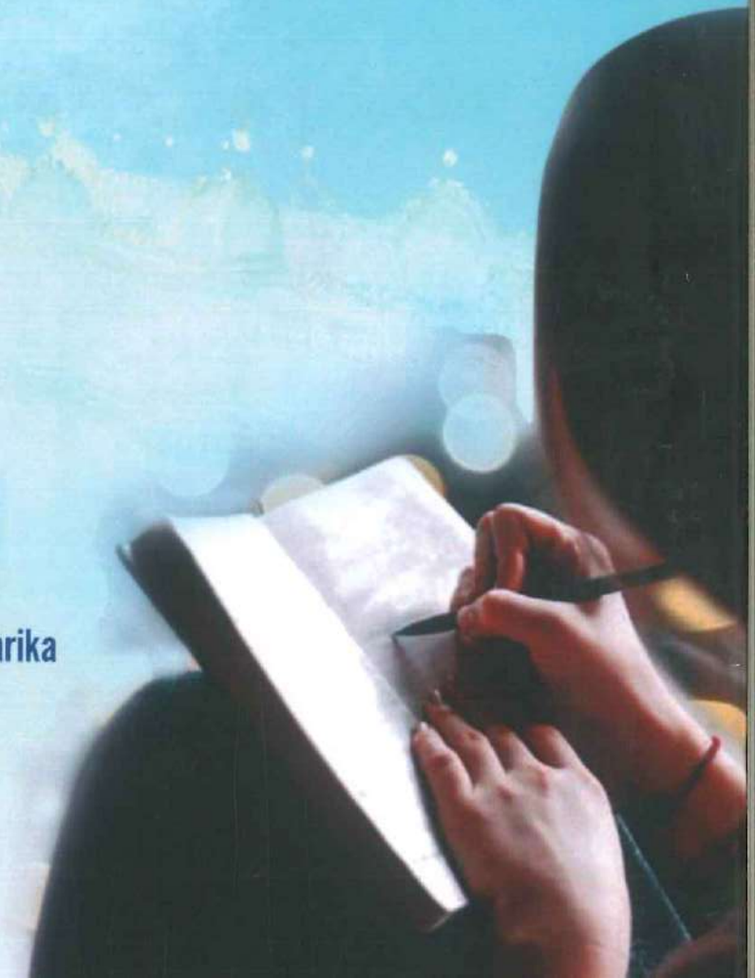

8

Identity Conflicts in Diaspora Communities

Priya Raghav and **Vandana Kaushik**

The concept of 'Diaspora' refers to the physical dispersal of the Jews all over the world from Palestine. The Webster's dictionary defines Diaspora as people settled far from their ancestral homelands. The double consciousness that people from most diaspora communities face has led to the emergence of hybrid identities. However their fate like *trishanku* is conflicted. This is something that has been well documented in literature and films. When confronted with an alien environment there are those for whom home becomes an imaginary utopian dream. The anguish to find one's roots and origin comes from being rejected as an outsider or the other. The desire of belonging somewhere, the desire of an individual to claim a country as his/her homeland is inherent in everyone. Diasporic communities are in that in between space where they are caught up between two cultures, two languages, two nations and a fractured identity. They can neither belong to the country they originated from nor can they completely assimilate with the new one. Like Salman Rushdie writes, 'Imaginary Homelands' is all about the feeling of belonging nowhere. Thus in this paper I will try to map out how complex and significant the idea of identity is for diasporic communities specifically in context of globalisation.

Introduction

The story of the Indian diaspora can be traced back to the colonial period, when the British sent Indians across their empire for various purposes. Indians worked as indentured laborers, civil service workers, or small merchants for the British. The aftermath of World War II, saw Indians migrating to various parts of the world for work, education and a host of other reasons. The Indian Diaspora is a generic term used for referring to people who have migrated from the territories that are currently within Republic of India. It encompasses NRIs (Non-resident Indians) and PIOs (Persons of Indian origins). The Indian Diaspora is estimated to be over thirty million. The importance of Indian Diaspora is significant, as it has brought economic, financial, and global benefits to India. The Indian Diaspora currently constitutes a powerful, and in some respects unique, force globally.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.001

PROBLEMS OF DEVELOPMENT OF LOWER-CLASS WOMEN

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❖ ABSTRACT:

Women have made significant contributions in many ways to the agricultural system of agricultural India. Men as well as their rural economic activities have a huge role to play. But women do not get as much wages and respect as male farmers or workers. In particular, lower-class women in many cases play a major role in the family production system and economic activities. In many cases they participate in economic activities as a complement to the family. But in terms of Indian census or other criteria, women have been repeatedly neglected. That is why we see that even if women participate in a large number of economic activities, or do a lot of work as a complement to men, in many cases they are not considered as workers. As a result, women are being identified as unemployed in economic terms. This research article highlights the barriers to women's develpoment and why they are neglected.

Keyword: *Agricultural system, Obstruction of women, Peasant-workers, Humiliation of women*

Indian lower-class women have been engaged in various manufacturing and financial occupations since ancient times. In ancient India, ‘Shudra’ women engaged in various financial activities, including animal husbandry and agriculture, and shared the financial responsibilities of the family with their husbands. There are many instances where the responsibility of repaying the debt of the husband fell on the wife. It is mentioned in Kautilya's Arthashastra.[1] Lower class women have saved upper and middle class families from being employed in various financial

ISBN: 978-91-987581-0-8

occupations and have also helped in maintaining economic balance in the society.

The vast majority of women workers employed in various sectors of the Indian economy still come from the lower castes. Although upper-middle class women are now employed in various productive and financial jobs, they are only a fraction of the female workforce.[2]According to the 1991 census, 51.56 % of males and 22.73 % of females in India are workers who are engaged in various productive activities in the economy of the country. And according to the 2001 census, 52% of male workers and 26% of female workers, the percentage of female workers here is much less than that of male workers. Because many women engaged in productive work have been shown as unemployed in the census report. These workers are further divided into 'non-workers' and 'marginal workers'.Those who have been employed for 183 days or 6 months in the previous year are 'mainly employees' as defined in the census report. And those who were employed less than 183 days in the previous year are 'marginal workers'.

Table-1
Percentage of all India Women & Men, 1991 & 2001

Men 1991	**Women**	**Men 2001**	**Women**
Workers 51.56	Workers 22.73	Workers 52.0	Workers 26.0
Mainly workers 50.62	Mainly workers 16.48	Mainly workers 87.3	Mainly workers 57.3
Marginal workers 0.94	Marginal workers 6.25	Marginal workers 12.7	Marginal workers 42.7

[Source: Census of India, 1991, Series:8 Paper 1 of 1991, Supplement; Census of India 2001, Series 1, Primary Census Abstract, Total Population.]

Table-1 shows that between 1991-2001, the percentage of female 'mainly workers' increased slightly more than 3 times, but the percentage of female 'marginal workers' increased almost 7 times.And in 2001, the rate of female 'marginal workers' (42.7 %) was three and a half times that of male 'marginal workers' (less than 183 days a year as temporary and contract workers) (12.7 %). This means that most of the female workers

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are contract and temporary workers, whose work has no security. There is also no doubt that a large proportion of women workers belong to Scheduled Castes/Scheduled Tribes and Other Backward Classes, although the latest accurate average figures for the whole of India are not available.A quote from the National Sample Survey (1977-78) is pertinently quoted here, *"The workforce participation rate among the SC/ST women is much higher compared to women from other castes and there is evidence of higher incidence of casual labor amongst these women."*[3]

Table-2
Percentage of Women & Men Workers of North-eastern India

Region	Men **1981**	Women	Men **1991**	Women	Men **2001**	Women
All India	52.67	19.67	51.56	22.73	51.9	25.6
Arunachal	58.63	45.67	54.21	39.61	50.6	36.5
Meghalaya	53.96	37.49	49.09	36.69	48.3	35.1
Mizoram	52.54	37.72	54.37	43.94	57.3	49.5
Nagaland	52.58	43.20	48.61	39.25	46.7	38.1
Manipur	46.40	39.48	45.36	37.50	48.1	39.0
Sikkim	57.22	37.61	53.60	52.74	59.4	38.4

[Source: Census of India, 1991, Series8: Paper 1 of 1991, Supplement; Census of India 2001, Primary Census Abstract, Total Population.]

Everyone knows more or less about the hard work of Scheduled Caste (Indigenous) women.Table-2 shows that the average rate of women workers is much higher than the average of women workers in the hill states of north-eastern India inhabited by tribals. In 1991, Meghalaya had the lowest rate of female workers among the 5 indigenous hill states, at 36.69 per cent. But even this lowest rate is much higher than the average rate of female workers in India (22.73%). The highest female worker rate in Sikkim is 52.74 %. This rate is almost equal to the percentage of male workers there (53.60%) and more than double the average rate of female workers across India. However, it is noteworthy that the average rate of female workers in Sikkim has increased significantly between 1981 and 1991. Between 1991 and 2001, the number of male workers in India increased slightly, but the rate of female workers increased significantly. In 2001, the female labor rate (49.5%) was highest in Mizoram. Thus, a large proportion of working women in this country are employed in 96%

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of the unorganized sector, of which agriculture and agric-related manufacturing are the major sectors.

Table-3
State-wise percentage of Women & Men Workers rural areas, 1981, 1991 & 2001

State		Farmer			Agricultural workers		
		1981	1991	2001	1981	1991	2001
Andhrapradesh	Men	45.08	39.07	34.30	31.46	37.29	34.20
	Women	25.71	24.55	27.40	62.02	63.23	53.60
Bihar	Men	51.92	50.82	37.20	33.69	36.13	42.70
	Women	26.73	33.05	24.20	65.61	60.12	62.70
Gujrata	Men	54.15	49.49	44.50	23.72	24.57	3.30
	Women	34.61	35.48	33.30	53.74	49.84	34.70
Hariyana	Men	55.48	49.78	46.90	19.15	23.52	12.80
	Women	59.39	57.17	51.90	25.72	29.04	12.70
Punjab	Men	48.81	46.11	39.08	28.12	30.32	19.90
	Women	09.72	28.03	16.10	42.59	34.09	14.30
Orissa	Men	56.91	54.52	44.40	24.70	25.37	30.00
	Women	26.26	27.77	30.60	57.21	57.50	37.20
Tamilnadu	Men	43.82	37.82	31.70	30.95	35.89	30.06
	Women	28.50	24.63	29.20	60.07	59.80	46.30
West Bengal	Men	42.87	40.84	30.05	31.79	30.00	27.10
	Women	18.09	20.22	14.30	48.44	45.47	30.00
India	Men	55.03	51.61	45.20	24.19	24.19	23.10
	Women	36.94	38.58	41.50	50.36	48.43	35.60

[Source: Census of India, 1991, Series:8. Paper 1 of 1991, Supplement; Census of India 2001, Series 1, Primary Census Abstract, Total Population.]

According to the 1991 census, 80% of rural workers are engaged in agriculture, which accounts for about half of the national income. There was no significant change in 2001 either. And most of the women workers are associated with this agriculture. But the surprising thing is that the actual evaluation of the contribution of women in the agricultural economy has not been done even today.[4] Table-3 shows that in 1991, 87.01% of female workers in rural areas were involved in agricultural

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production, while 78.09% of male workers were involved in agriculture.In other words, the employment rate of female workers is much higher than the employment rate of male workers in agriculture in rural areas. But 38.58 % of the women workers engaged in agriculture are farmers and 48.43 % are agricultural workers. Among the male workers, 51.61 % are farmers and only 26.48 % are workers. In other words, the percentage of female workers in agriculture is almost double that of 48.43 % of male workers (26.48). In 2001, the percentage of males (45.) was less than that of females (41.5). The percentage of female agricultural workers (35.6) is much higher than the percentage of male workers (23.1).

It is to be noted here that even if a person is a landless shareholder or supervises the cultivation without any cultivation, he is considered as a farmer in the census report. He has been caught as an agricultural laborer if many people work on the land only for exchange of wages.[5] Many times when men in rural areas are engaged in various alternative jobs in urban areas, women are the ones who supervise the cultivation with the help of laborers and grow crops on the family land. According to the definition, these women also fall into the category of wage farmers. However, according to Table-3, in the three decades of 1981, 1991 and 2001, the main position of women in agriculture was as laborers, not as farmers.

There are, of course, many differences in the rates of agricultural labor in different states, such as in the employment of different castes and classes. In rural areas of Andhra Pradesh, Bihar, Orissa and Tamil Nadu, in 1981 and 1991, more than 55% of women workers were laborers. In 2001, more than 50 per cent women workers were employed in Andhra Pradesh.The percentage of women workers in Bihar was the highest (62.7 %). In fact, the percentage of women workers largely depends on the economic status of different states, class differences and the rate of female education.

The percentage of women workers in West Bengal in 1981 and 1991 was 48.44% and 45.47% respectively. In 2001, West Bengal had 14.3 % female farmers and 30 % laborers. Compared to other states, the percentage of women farmers and laborers is moderate.However, many of these women workers are marginal workers who have the opportunity to work 183 days a year or less for six months. Most of the female workers work only during the growing season, usually from April to July. Other

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times they have to look for alternative jobs. And for this purpose, women often have to move to urban areas.

Usually men plow the land, level the land, irrigate, apply chemical fertilizers, and sometimes sow the seeds. The cleaning of weeds, re-planting of seedlings, re-planting of green manure, dung manure, harvesting of crops, taking of crops home by head, sifting of crops, sorting are usually done by women.[6] The work of clearing weeds and planting seedlings elsewhere is generally considered to be the work of women.These two things are not usually done by men. However, sometimes men also do other work specific to women.

However, one thing to note is that according to the definition of the census report, women engaged in domestic work fall into the category of 'non-workers'. As a result, many women involved in agricultural production have been left out of the 'workers'. But a lot of women's agricultural work falls into housework and general household chores.[7]The percentage of women workers is bound to be much higher than the rate shown in the census report if women are involved in these activities related to home based agriculture. Thus it can be said that the census has devalued the work of women as agricultural laborers.

Many of the women's work in agriculture are housework. For example, women usually do housework, drying, warehousing, drying hay, as well as cooking for wage laborers in a farming family.In other words, in a farming family, a lot of work related to farming belongs to women's household. But these household chores directly involved in agriculture are not considered productive work in the census and these workers are called 'non-workers'. But there is no denying that these 'unemployed' or unpaid women have a special role to play in increasing agricultural production.

It has been seen that the exchange value of different work based on home is a lot.If the work related to farming is done standing in the field, it will be 'employed', and if the work related to production is done within the family, it will be housework and 'unemployed'. Needless to say, it is not reasonable to accept such an argument. But through this the contribution of women in agricultural production is being underestimated. There is no denying that the less time men have to work in the field and the less fruit they produce as a result of not doing these things in the

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family, the greater the contribution of these women to agricultural production.

Besides, women have to cook for the whole family at home, gather wood, leaves or fuel for cooking, deliver food to the field for men, etc. There are also many other household chores such as caring for cows and calves, feeding, etc.[8] The labor and time spent by women in these activities to keep the agricultural economy alive is no less valuable. If men did these things instead of women, both agricultural production and family income would be less.However, the position of these women in the agricultural economy is 'non-workers' and their identity as unpaid workers.

Table-4
State-wise percentage of Women & Men Workers, 2001

State	Farmer		Agricultural workers	
	Men	Women	Men	Women
Andhrapradesh	11.4	7.1	59.1	79.2
Assam	32.7	36.8	11.0	18.0
Bihar	08.7	06.6	74.0	84.0
Gujrata	10.9	09.9	31.0	53.9
Hariyana	07.4	09.2	36.7	53.2
Kerala	01.8	01.4	30.9	39.0
Madhyapradesh	28.7	24.0	35.3	53.6
Maharastra	12.6	13.4	35.2	61.7
Punjab	04.0	3.4	39.1	36.4
Orrisa	21.9	10.7	39.7	57.9
Tamilnadu	11.1	09.1	50.6	69.4
West Bengal	20.9	12.9	35.0	45.7
India	21.0	18.1	39.2	57.4

[Source: Census of India, 2001, Primary Census Abstract, Total Population SC/ST.]

It is also worth mentioning that the role of Scheduled Caste women in agricultural production is evident in Table-4. According to Table-4, the percentage of scheduled men and women involved in 2001 work in India is 60.2 % and 75.7 % respectively. But it should be noted that only 18.1 % and more than 57 % of the scheduled women are agricultural laborers. Among the states, except Assam and Rajasthan, the rate of female farmers is much lower than the rate of scheduled male farmers and the rate of

ISBN: 978-91-987581-0-8

female workers is much higher than that of male workers. In other words, even among the Scheduled Castes, the predominance of women workers is more than that of men.

Most of the Scheduled Caste/Scheduled Tribe women are not allowed to work on their own family lands and are forced to work in other lands for wages. Lack of own family land, extreme poverty and lack of alternative employment are responsible for this. And this is why Scheduled Caste/Scheduled Tribe people, especially women, are arbitrarily exploited and oppressed by landowners. In the plain states, there is a shortage of female farmers compared to males and a large number of female laborers, but in the hilly areas inhabited by the tribals, another picture is observed. Here men and women are almost equally involved in farming. Among the inhabitants of the hill country there is still a custom of clearing the forest and making land in some places. Although these tasks are usually performed by men, in some cases women and children are also involved. In addition, women do the work of clearing weeds and sowing seeds, harvesting crops, sweeping crops, uprooting tree trunks and carrying loads of burnt wood elsewhere. There is also work to be done until the crop is stored in a specific room made of leaves.[9] When women are engaged in these activities, men are again engaged in burning trees in new lands or clearing the land for cultivation. So it can be said that women are involved in work on par with men. Even women are seen plowing the land.

❖ CONCLUSION:

Therefore, in the context of this discussion, it can be said that slave laborers belonging to Scheduled Castes/Scheduled Tribes are the most miserable among the workers in the agrarian economy. Moreover, despite the abolition of the slave labor law in 1976, in practice, the status of slaves and workers is less in states other than Kerala and West Bengal.The money and resources provided for the rehabilitation and technology of slave labor are so scarce that the workers who have been legally released from slavery have to return to the old landlords and lenders because of their poverty. And not only the returning male workers, but also the female workers have to work with the male workers as slave workers.[10]

ISBN: 978-91-987581-0-8

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.002

EDUCATIONALLY BACKWARD: SIGN OF POVERTY

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❖ ABSTRACT

Education is a tool for empowerment. Access to quality primary education is a major concern in India. Education is an imperative area that is essential for the progress and development of individuals, society, and nations. Individuals, who are residing in the conditions of poverty often encounter various impediments within the course of the acquisition of education and development of literacy skills. The impact of poverty on education is mainly considered unfavorable, but measures are required to get implemented to alleviate the barriers that arise due to poverty within the course of the acquisition of education.

'Poverty is man-made, not God-given' is a famous saying in the world. . Even after 73 years of independence the people of India particularly weaker sections, vulnerable and poor experience every day the basic amenities of life. Tendulkar Committee and Ranga Rajan Committee reports reveal that more than 70% of the people in India are still impoverished. Noble economist Amartya Sen transformed the development agenda by re-conceptualizing poverty as a matter of capabilities such as literacy and access to health care rather than a lack of income.

Education provides a foundation for eradicating poverty and fostering economic development. It is the groundwork on which much of the economic and social well-being of the citizens is built. Education is the key to increasing economic efficiency and social consistency, by increasing the value and efficiency of the labor force and consequently raising the poor from poverty. This paper is aimed at contextualizing the role of education in advancing economic development and thereby alleviating poverty.

Keywords: *Backward classes, Impoverished, Illiteracy. Poverty, Unemployment.*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

Children belonging to poverty-stricken families, who lack the basic resources and necessities live in an unsafe and polluted neighborhood, they are deprived of environments that are supportive of learning. Poverty has adverse effects on the cognitive development of individuals. The increasing standardization, de-skilling, and control of the teacher's work are viewed to have unfavorable effects upon the education of the students, who have undergone multiple deprivations because of poverty and social disadvantage. The children, who reside in the conditions of poverty have slower cognitive and social development and are deprived of physical or mental health. For the poverty-stricken and most socially excluded children, like those from the traveling community, the lack of culturally appropriate education can make these difficulties even larger. So, it is inevitable that children belonging to the families that are living in poverty will experience different challenges at school to those faced by those children coming from families that are not living in poverty or are well off." "The families, who belong to deprived, marginalized and socio-economically backward sections of the society, usually experience problems in getting their children enrolled in schools, instead, they compel them to work and contribute in the sustenance of living conditions. These individuals have recognized the significance of education, but their major problem that proves to impede within the course of the acquisition of education is lack of resources. Poverty is regarded as an impediment within the course of social, cultural, economic, political, and educational development. In the present world, education is regarded as important in the elimination of the conditions of poverty.

Other Backward Class (OBC) "is a collective term used by the Government of India to classify castes that are educationally or socially disadvantaged. It is one of several official classifications of the population of India, along with General Class, Scheduled Castes, and Scheduled Tribes (SCs and STs). "The indirect effect of education on poverty is important concerning human poverty, the reason being, as education improves the income, the fulfillment of necessities becomes manageable and increases the living standards which means, decline in human poverty. The education indirectly helps in the accomplishment of basic needs like water and sanitation, utilization of health facilities, shelter, and it also affects the women's behavior in reproductive decision making and family planning."

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❖ FACTORS OF POVERTY:

The causes of poverty are many and complex. Various factors contribute the poverty i.e. economic factors, social factors, and geographic factors. The financial backwardness, low productivity, low income, poor infrastructure facilities, lack of institutional credit, inequalities in income, and indebtedness et., constitute economic problems causing poverty. Apart from economic factors, illiteracy, high population growth, immobility of people, unemployment, discrimination, social exclusion, traditions, and custom are considered as social factors. Geographical factors like natural calamities, droughts, unfavorable climatic conditions, the absence of natural resources, etc. play a crucial part in making communities relatively poor.

❖ SIGNIFICANCE OF EDUCATION:

Education assists in the development of knowledge and skills amongst individuals. With the acquisition of knowledge and development of skills, they can acquire various types of employment opportunities. The individuals, who are educated and possess adequate knowledge will be able to enhance their wages and hence lead to the elimination of poverty, therefore, the higher the level of education, the lesser will be the number of poverty-stricken persons. The direct impact of education on reducing poverty is through the increase in wages.

Fulfillment of Basic Necessities – The fulfillment of necessities is essential for individuals, belonging to all categories and backgrounds. An educated person can fulfill the basic requirements of housing, food and nutrition, civic amenities, health, cleanliness, education, and other requirements. They generate awareness amongst themselves to create means to meet their basic needs and requirements."

❖ CONSTITUTIONAL OBLIGATIONS OF THE STATE:

Poverty should be addressed by the state because it is painful not only for the poor but for the larger society of which they are part. When Sen viewed the concept of impoverishment in capabilities approach, in comparison to Sen, the other major exponent of the capabilities approach Martha Nussbaum has devised a list of capabilities, which she believes in integral to a free and just society. She seeks to make education compulsory on the basis that is a function rather than a capacity

In the preamble, Justice is not seen as un-dimensional, viewed as having implications across political, economic, and social spheres. Economic justice implies the ultimate eradication of poverty, equal

opportunities, and fair wages. Improvement in impoverished status in society can be done only by educating them, providing work, and inculcating awareness about themselves.

Article 38 of the Indian Constitution enjoins upon the State to strive to promote the welfare of the people by securing a social order in which justice, social, economic, and political shall inform all the institutions of national life and to minimize inequalities in income, status, facilities, and opportunities not only amongst individuals but also amongst groups of people.

Article 39 directs the State inter-alia to secure to the citizens the right to adequate means of livelihood; that the ownership and control of material resources of the community are so distributed as best to subserve the common good; that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment; that the children are given the opportunities and facilities to develop in a healthy manner and conditions of freedom and dignity and that childhood and youth are protected against exploitation and moral and material abandonment.

Article 43 of our Constitution has also adopted as one of the Directive Principles of State Policy that: "The State shall endeavor to secure, by suitable legislation or economic organization or in any other way, to all workers, agricultural, industrial or otherwise, work, a living wage, conditions of work ensuring a decent standard of life and full enjoyment of leisure and social and cultural opportunities. ". This is the ideal to which our social welfare State has to approximate in an attempt to ameliorate the living conditions of the workers

Under Article 340 of the Indian Constitution, the government must promote the welfare of the OBCs. “The president may by order appoint a commission consisting of such persons as he thinks fit to investigate the conditions of socially and educationally backward classes within the territory of India and the difficulties under which they labor and to make recommendations as to the steps that should be taken by the union or any state to remove such difficulties and as to improve their condition and as to the grants that should be made, and the order appointing such commission shall define the procedure to be followed by the commission. A commission so appointed shall investigate the matters referred to them and present to the president a report setting out the facts as found by them and making such recommendation as they think proper.”

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❖ NATIONAL COMMISSION FOR BACKWARD CLASSES:

"India's National Commission for Backward Classes is a constitutional body (123rd constitutional amendment bill 2017 and 102nd amendment 2018 in the constitution to make it constitutional body) (Article 338B of the Indian Constitution) under India's Ministry of Social Justice and Empowerment established on 14 August 1993. It was constituted according to the provisions of the" National Commission for Backward Classes Act, 1993

❖ RESERVATION POLICY:

"The Mandal Commission adopted various methods and techniques to collect the necessary data and evidence. To identify who qualified as an "other backward class," the commission adopted eleven criteria which could be grouped under three major headings: social, educational, and economic.

Social:

- Castes/classes considered as socially backward by others
- Castes/classes which mainly depend on manual labor for their livelihood
- Castes/classes where at least 25 percent females and 10 percent males above the state average get married at an age below 17 years in rural areas and at least 10 percent females and 5 percent males do so in urban areas.
- Castes/classes where participation of females in work is at least 25 percent below the state average.

Educational:

- Castes/classes where the number of children in the age group of 5–15 years who never attended school is at least 25 percent above the state average.
- Castes/classes when the rate of student drop-out in the age group of 5–15 years is at least 25 percent above the state average
- Castes/classes amongst whom the proportion of matriculates is at least 25 percent below the state average

ISBN: 978-91-987581-0-8

Economic:

- Castes/classes where the average value of family assets is at least 25 percent below the state average
- Castes/classes where the number of families living in kutcha houses is at least 25 percent above the state average
- Castes/classes where the source of drinking water is beyond half a kilometer for more than 50 percent of the households
- Castes/classes where the number of households having taken consumption loans is at least 25 percent above the state average.

The Right of Children to Free and Compulsory Education Act,2009(RTE) was enacted in 2009 to provide free and compulsory education to all children between 6 and 14 years of age. It was subsequently amended in 2014, 2015, and 2017. The legislation follows from the 88th Constitutional Amendment of 2002 that recognized the right to education as a fundamental right. It directs the central and state governments as well as the local authorities to work together to ensure that all children (aged 6-14) have access to quality elementary education free. It holds the relevant governments responsible for the availability of funds, infrastructure, teachers, syllabi, and so on. Interestingly, the Act requires all private schools to reserve 25 percent of their seats for students who live in the vicinity and are from the weaker sections of society. It prohibits unrecognized schools from practice, bars charging capitation fees or donations for admission, and forbids children from being expelled, held back, or required to pass a board exam till the completion of elementary education.

❖ CONCLUSION:

India has long struggled with its past. The same goes for a large part of the population of India, those that have historically been less well-off and have yet to be able to take full advantage of the modern systems in place across the country. Deep-rooted prejudices and practices have been difficult to weed out, even with the intensive studies and judgments in place. With progress being made in one direction, a small portion of those that are being catered to can be observed hoarding the resources and creating a further layered entrenchment of the haves and have-nots. Systemic implementation of the vast number of recommendations made by the intensive studies done across the last half-century is yet to reach its peak, signaling administrative lethargy even today. India should enact

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single-window comprehensive legislation dealing with all issues related to economic policies to overcome the pathetic situations by the impoverished. Progress of the Nation will not alone accomplish much unless it is combined with measures designed to promote the participation of the poor community initiative in the implementation of education policies backed with a strong coalition of the poor could make a significant difference. Therefore, to successfully attain the goal of reduction of impoverishment set by the 2030 agenda for millennium sustainable development, it is required to make innovative ideas, systems, and action plans from the perspective of integrating poverty reduction, human rights, and development.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.003

ACHIEVING SUSTAINABLE DEVELOPMENT THROUGH ENVIRONMENTAL MANAGEMENT IN NORTHEAST INDIA WITH SPECIAL REFERENCE TO ASSAM

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❖ ABSTRACT:

From the 2nd half of the 20th century, the issue of sustainable development became a matter of international concern. The environmentalists, statesmen, policy makers, and organizations for environmental protection, have much concern to the matter of achieving sustainable development as it is related to the survival of humans as well as all other living beings. In the modern age of science and technology, industrialization has assumed a key position in the development of a country. Just for the sake of environmental protection, no nation can stop industrialization at the cost of progress and development. For speedy development, industrialization has to be expanded. In this juncture, it is believed that sustainable development can be achieved through environmental management, i.e., mobilization and holistic and efficient use of natural resources. Proper planning, management and use of resources can be helpful in removing a country's poverty to a greater extent and will be helpful in maintaining ecological balance.

India's northeastern region is endowed with vast natural resources supplemented by topical, subtropical and temperate climate. It is expected that by holistic utilization of these resources sustainable development can be accelerated in this region.

This paper attempts at studying the issue of sustainable development and environmental management in the context of North East India with special reference to Assam.

Keywords: *Environmental management, sustainable development, resources, Northeast.*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

One of the biggest challenges facing the world is environmental degradation supplemented by numerous factors. India is also no exception. From the 2nd half of the 20th century at various levels such as policy making, environmental agencies and voluntary societies, the issue of sustainable development has gained much importance. In simple term, sustainable development stands for the providing materials, goods and services and use of natural resources to the present generation without compromising the needs of the future generations.

In the modern age of science & technology industrialization has assumed key position in the development of a country. To provide food, clothes and shelter to the masses every country is heavily dependent on industrialization. The state of industrialization has categorized the world countries as developed, developing and underdeveloped. In agriculture, contribution of industrialization in bringing out "Green Revolution" in real sense is immense by providing utensils, fertilizers, pesticides, cold storages, transportation and irrigation facilities to increase food production, sugar, milk, medicines, a variety of luxury items, jute, leather, chemicals, cement etc. have lifted living standards of human being to a significant level. However, industrialization has played havoc into our environment and existing natural resources. On the other hand, air, water and soil pollution are gifts of industrialization. Natural forests are dwindling causing drought, flood, siltation of rivers, dams, reservoirs. In this juncture a quarry arises- should the industries be banned? But it is true that no nation can stop industrialization at the cost of its progress and development. What we need to do is the planning for the management of environment and conservation of natural resources for a secured future and sustainable development.

❖ OBJECTIVES OF THE STUDY:

The present study endeavors at addressing the following objectives-

(i) to study the idea of management of the environment,
(ii) prospects of environmental management for sustainable development in Assam as well as Northeast India,
(iii) to make some recommendations for environmental management to ensure sustainable development.

ISBN: 978-91-987581-0-8

❖ METHODOLOGY:

The present study is analytical in nature based on secondary sources. Various reference books, journals, articles and websites have been consulted pertaining to the study. All possible efforts have been made to make the study objective and meaningful. Personal observation of the author is also taken into account.

Keeping in mind the objectives, the present study is divided into three parts- Theoretical framework, environmental management in northeast India, and conclusion and suggestion.

❖ THEORETICAL FRAMEWORK:

Environmental planning and management can be defined as the initiation and operation of activities to direct and control the acquisition, transformation, distribution and disposal of resources in a manner capable of sustaining human activities, with a minimum disruption of physical, ecological and social processes. It also implies successful utilizations of the environmental resources and solution of the environmental problems. Followings are the goals and objectives of environmental planning and management-

i. Decrease the entropic effects of economic activities throughout our economic system.
ii. Protect public health and safety and the natural ecosystem from improper handling of resources and residuals.
iii. Stabilize and perpetuate the socio- economic system.
iv. Provide this protection at minimum economic cost (so that management resources are not wasted).
v. Provide these services in as just and equitable a manner as possible.

The nations across the globe are in competition for achieving of their own economic growth and for establishing its hegemony in the international arena. For the fulfillment of the aspirations, all the nations have been paying attention towards the process of industralisation by using available resources without any judicious consideration. During the past few decades, the rapid growth of population and industralisation all over the world have created excessive pressure on the natural resources and thereby total environment of the globe. Human –centric self-centered and aggressive approach of development has damaged the balance of nature at a large extent. This tendency of modern men has caught the attention of the environmentalists, scientists, academicians, social

ISBN: 978-91-987581-0-8

workers, policy makers and planners to make the issue of environmental degradation and sustainable development.

The vital importance of the proper management of India's land resources was realised when an exhaustive paper entitled "A charter for the land" was published in "The Economic and Political Weekly" of March 31, 1973. But even after the initiative taken by the then Prime Minister Mrs. Indira Gandhi, little emerged except a directive to State Governments that they should set up State land use Boards under the chairmanship of Chief Ministers. Even recommendations of N.D. Tiwari Committee on the Environment (1980) to set up a Central Land Commission to serve as a policy planning coordinating and monitoring agency "for all issues concerning the health and scientific management of our land resources" failed to find acceptance. The 6th Plan document and the 7th Plan had nothing more to do with the problem.

However, the serious ecological and socio-economic crisis was soon realised and the Central Government constituted three new bodies – (1) the National Wastelands' Development Board(1985) charged with the responsibility of the mounting a massive afforestation programme with the help of the people, (2) the National Land Use and Conservation Board(1986), which was expected to formulate a national policy and a perspective planed for the conservation, development and management of the land resources of the country, and (3) as apex body called the National Wasteland and Land Use Council(1983) which has all Chief Ministers as its members and over which Prime Minister presides.

The National Youth Policy of 2014 has very sincerely considered the participation of the youth in all vital areas for the transformation of social life and protecting the environment. It has emphasized on the promotion of social values for the protection of future of Indian society in specific and global society in general. It has emphasized on sensitizing the youth about the protection and improvement of the environment and developing compassion for the living creatures.

❖ ENVIRONMENTAL MANAGEMENT IN NORTHEAST INDIA:

Northeast India has an image of dense, evergreen, and inexhaustible forests of precious timber, exotic wildlife, home to numerous tribal communities and hides-out of armed insurgents. It is also

ISBN: 978-91-987581-0-8

known for its mountains and hills, turbulent rivers, flooded plains, proud and brave hill communities and colourful craftsmen of the river valleys. The region holds the world's record of highest rainfall at a place and also has the wettest zone (Cherrapunji & Mawsynram is in Meghalaya) in the world. It exports its famous Assam tea all over the world. Among its exotic wild species of mammals, one –horn rhino is also a unique creature of its own type. The region is known for quick growth of vegetation because of heavy and recurrent precipitation. Though covered with forests all over the hills and plains, the 'states' as such have limited forests under their direct control and bulk of the forests is under the customary authority of the communities, especially in the hill areas, a right guaranteed by the Indian constitution.

When one glances at the topography of NER, it is indeed a panoramic view and an awe- inspiring landscape, each unit having distinct features of its own. With the fascinating and fabulous environment of this region, it is said that rich potential wealth of mineral resources is lying untapped, ready to be exploited for the people's benefit. Accordingly, the Geological Survey of India (GSI), a Government of India establishment, has taken up the challenge of conducting survey in the scattered area of the region. The findings are quite encouraging. Parts of *Mokokchung, Longleng and Tuensanj* districts of Nagaland have rich deposits of petroleum oil. In the Barail range of Assam, there is thick and well-bedded sandstone (80%) and a thin band of shale (20%) with coal seam (1-2 meter thick) (www.meghelayatimes.into/index.php.cfm). All along the foothills of Assam- Arunachal, scientists have found evidences of rich mineral deposits. These are concentrated in the Sonitpur district of Assam and West kameng districts of Arunachal Pradesh. Sedimentary rocks found in *Ngopa, Khazawl, Champhai and Serchhip* districts Mizoram. The areas which have substantive resources are. Rich deposit of coal and limestone are found in the Upper Assam and the states of Meghalaya. Coal reserves in Meghalaya are estimated to be 63,880 million tones.

Industralisation in the region has not developed successfully and even small-scale industries have not been feasible due to lack of adequate economic infrastructure like transportation, communication and market accessibility. The region's economy remains primarily agricultural. Primitive farm practices of slash and burn cultivation is still practiced in many hill areas, while traditional single farming in the plains continues.

ISBN: 978-91-987581-0-8

The Northeastern region has the vast potentiality to produce conventional energy. A major problem with thermal power generation is that of air pollution by stack exhausts. Electrical energy generation by hydro-electric power is non-polluting and uses a renewable source of energy. However, there are several problems associated with the construction of dams on natural waterways. The construction of such dams alters the downstreams ecology as well as that in the lake area behind the dam. Huge areas get submerged. Flora, fauna or any agricultural produce of this land get affected. People and towns in this area have to be removed and reallocated, causing disturbances and sometimes hardships. For example, in their study on Lower Subansiri Hydel dam, Vagholikar and Ahmed found the 'dam submergence zone' falls in the eastern Himalayas. This is an important part of Indo-Myanmar biodiversity hotspot, one of the 25 hotspots in the world, and houses Endemic Bird Areas (EBA) identified by Birdlife International. The 3436 ha of forests to be submerged comprise crucial wildlife habitats and project also envisages building of over 70 km of roads in the region. The submergence area includes four reserve forests in Arunachal Pradesh and one in Assam (Tale Valley Sanctuary, Tale Valley RF, Panir RF, Kamala RF, and Jiadhol in Arunachal Pradesh and Subansiri Reserved Forests in Assam). These are all primary forests with rich wildlife. The submergence area is in the midst of a rich biodiversity zone and part of contiguous forests. The area is also part of an important elephant corridor (Vagholikar and Ahmed, 2003: 26)

Forests play a vital role in influencing our environment and the atmosphere. In the states of N.E. India, the area under forests is much higher than the national average. It is 82.21 percent in Arunachal Pradesh, 30.20 percent in Assam, 77.87 in Manipur, in Meghalaya it is 69.70 percent, Mizoram 86.99 percent, Nagaland 85.83 percent and in Tripura it is 54.79 (Basic Statistics of NER, 2012). Initially forests take carbon dioxide from the atmosphere in the process of photosynthesis and provide us oxygen. A number of forest products become precious assets to our day-to-day life. To fulfill the requirements of industrialization and increasing population forests have paid heavily. Due to indiscriminate deforestation, soil erosion, landslides, siltation of rivers, dams and reservoirs, flood and drought have become common problems of the region.

In the year 2011, the Government of India through the Ministry for the Development of North-Eastern Region (DoNER), Environmental

Management Framework was made for the states of Mizoram, Nagaland, Sikkim and Tripura by initiating "North East Rural Livelihood Project". It focuses on supporting various livelihood activities to increase and sustain income of the poor, especially women in these states. The aim of this programme is to provide alternative livelihood to shifting cultivation as shifting cultivation mainstay of the people in Mizoram and Nagaland and tribal dominated hilly areas of Tripura. On the other hand, subtropical climate of Sikkim not favourable for sustain means of livelihood.

❖ CONCLUSION AND SUGGESTIONS:

For achieving sustainable development, it is felt that environmental management could play a big role. As the region is endowed with vast resources proper utilisation of such resources can bring desired development without compromising the needs of the future generations. In this direction, following suggestions can be made for sustainable development.

1) Environmental planning, management and awareness needs to be created through formal and informal education among all sections of the society. In this venture along with the government, NGOs could play a big role in educating the people in creating awareness and holistic use of natural resources.
2) Massive programmes aimed at the natural regeneration of non-agricultural lands by protecting them against unrestricted grazing should be adopted so as to save the country from recurring and increasing severe floods, drought, growing depletion of the productive capacity of its land resources and stupendous soil run off losses it suffers. Soil conservation works must also be undertaken on all eroding lands irrespective of whether these are under agricultural or other uses. The amelioration of waterlogged and saline lands, the protection of good agricultural lands against diversion to urban uses, the maintenance of the fertility of overworked agricultural soils and the vigorous conservation of whatever, natural forests are still left to us must also figure prominently in a comprehensive programme of land management.
3) Proper emphasis should be given on conservation and plantation of medicinal plants. The subtropical state of Northeast India is the home of a variety of medicinal plants. The states are losing its economic benefit due to lack of awareness and research in this

ISBN: 978-91-987581-0-8

direction. So, there is an urgent need for conservation and development of agro-technology for the medicinal plants.

4) Agro based industry can be set up in the region for sustainable industry which has economic viability as well as environment friendly. For example, it may be mentioned that Meghalaya is the second ginger producing state next to Kerala in India. Hence ginger processing units can be set up which is an aspect of agro based industry. Soft beverage producing factory could be set up as the state produces an adequate number of bananas throughout the year.
5) Horticultural corps may be a boost for economic potential as being environmentally friendly.

For that micro irrigation programme should be undertaken by the government.

6) Instead of big Hydel project, more small size hydro projects are called mini hydel or micro-hydel, which can be built on small streams and even on canals in the region especially Assam which has a good number of rivers and receives adequate rainfall. It is feared that construction of a big dam will compromise the future of the region as the region is situated in the high Semitic zone.
7) All kinds of waste whether generated during extraction of raw materials, the processing of raw materials, residential, institutional or commercial should transform to productive one. For that desired plan, policy and scientific approach is necessary. The International Conference on Waste Management (1-2 April,2016), namely RECYCLE,2016, conducted by the Indian Institute of Techonology Guwahati addressed the issue of major environmental problems caused by Solid and Liquid waste management. It aimed at making proper strategies and necessary infrastructure for organized waste management.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.004

POPULATION OF INDIA AND PROBLEMS OF OVER POPULATION

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❖ ABSTRACT:

In the world India is one of the densely populated countries. It has about 15% of support to the world population and India's land area is 2.4% of the world land area. In 1950-51 India's population was 361 million. According to 2001 census it was 1,027 million. In the world, India is the second most populated country. It was nearly a fifth of the world's population. The Indian census carried out in 2011 the population of India was exactly 1,210,193,422, which means India has crossed the 1-billion mark. According to the revision of the World Population Prospects In 2019 the population stood at 1,352,642,280. According to UN data In 2020 India population is estimated at 1,380,004,385 people at midyear.

On Monday, December 6,2021The current population of India is 1,399,346,585. In the total world population, India population is equivalent to 17.7%. India ranks number 2 in the list of countries by population. In India the population density is 464 per Km^2. The urban population is 335% it is equal to 483,098,640 people in 2020. Assamese, Bengali, Gujarati, Hindi, Kannada, Maithili, Marathi, Malayalam, Odia, Punjabi, Telugu, Tamil and Urdu are official spoken language in India.

The world's population is increasing mainly due to increases in agricultural productivity and medical advancements. Brazil, China and India add more to their woes by neglecting substantial increases in their populations. Many people are already aware of overpopulation due to social and environmental problems, but only a few are aware of its adverse effects on health. It's not just India's struggle, China and Brazil are also coping with the ramifications of overpopulation.

Keywords*: India Population distributed by States and Union territories, highest population Countries, highest and lowest growth rate in 2021, Problem and steps to control the overpopulation in India.*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

India is a large country and most people are ignorant and illiterate who live in backward areas. India has more than 50% of its population below the age of 25 in 2020 and more than 65% below the age of 35. The average age of an Indian is 29 years compared to 37 for China and 48 for Japan.

India has more than two thousand ethnic groups, and every major religion is represented, as are four major families of languages are Indo-European, Dravidian, Austro-Asiatic and Sino-Tibetan languages as well as two language isolates the Nihali language spoken in parts of Maharashtra, and in parts of Jammu and Kashmir people spoken the Burushaski language. 1,000,000 people in India are Anglo-Indians and 700,000 United States citizens are living in India.

The population growth rate depends on the difference between the birth rate and the death rate. In India can largely be explained by variations in birth and death rates. The death rate continued to fall over the entire plan period. But the birth rate continues to remain high by current standards. As a result there has been a net addition to the size of the population. India's demographic trends during the last five decades reveals that the death rate has fallen much faster than the birth rate.

In India, the sex ratio has been estimated a number of methods and data set including the National Family Health Surveys (NFHS), the Decennial Censuses (DC), the Sample Registration System (SRS), the Civil Registration System (CRS), and the Health Management Information System (HMIS).

The sex ratio was 940 females for 1000 males in 2011 and 944 females for 1000 males in 2016. In the last century this ratio has been showing an upwards trend for the last two decades after a continuous decline. In 2011–2013 the Sample Registration System was revealed through a population census with that the sex ratio of India was 909 females per 1000 of males. It has skewed downwards from then, in 2013–2015 recording 900 females and 896 females in 2015-17 per1000 of males. Furthermore, that survey conducted with the SRS also showed Chhattisgarh as the highest sex ratio at 961, Haryana was recorded the lowest at 831. However, sex ratio has moved into a positive direction. According to the latest round of National Family Health Survey 2019-21 India has 1,020 females per 1,000 males.

ISBN: 978-91-987581-0-8

INDIA POPULATION PYRAMID IN 2020

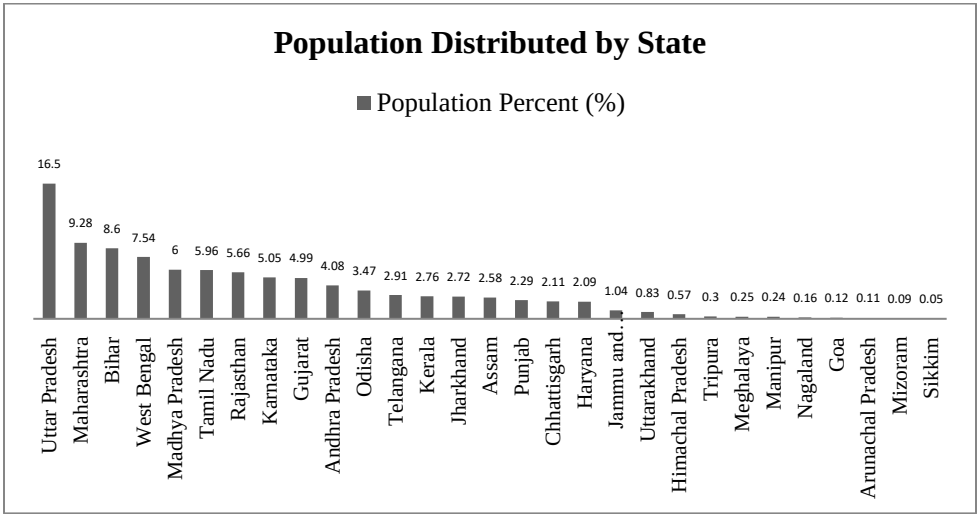
Population	1,392,700,250 (April, 2021)
Growth rate	1.1% (2020)
Birth rate	18.2 births/1,000 population (2020)
Death rate	7.3 deaths/1,000 population (2020)
Life expectancy	70.03 years (2020)
• male	68.71 years (2020)
• female	71.49 years (2020)

POPULATION DISTRIBUTED BY STATES

Rank	State	Population	Percent (%)
1	Uttar Pradesh	199,812,341	16.50
2	Maharashtra	112,374,333	9.28
3	Bihar	104,099,452	8.60
4	West Bengal	91,276,115	7.54
5	Madhya Pradesh	72,626,809	6.00
6	Tamil Nadu	72,147,030	5.96
7	Rajasthan	68,548,437	5.66
8	Karnataka	61,095,297	5.05
9	Gujarat	60,439,692	4.99
10	Andhra Pradesh	49,386,799	4.08
11	Odisha	41,974,218	3.47
12	Telangana	35,193,978	2.91
13	Kerala	33,406,061	2.76
14	Jharkhand	32,988,134	2.72
15	Assam	31,205,576	2.58
16	Punjab	27,743,338	2.29
17	Chhattisgarh	25,545,198	2.11
18	Haryana	25,351,462	2.09
19	Jammu and Kashmir	12,541,302	1.04
20	Uttarakhand	10,086,292	0.83
21	Himachal Pradesh	6,864,602	0.57
22	Tripura	3,673,917	0.30
23	Meghalaya	2,966,889	0.25
24	Manipur	2,855,794	0.24
25	Nagaland	1,978,502	0.16
26	Goa	1,458,545	0.12
27	Arunachal Pradesh	1,383,727	0.11
28	Mizoram	1,097,206	0.09
29	Sikkim	610,577	0.05
	Total (India)	1,210,854,977	100

Source: Census 2011 & UIAI for 2021 Estimates

ISBN: 978-91-987581-0-8



India is a federal union comprising 29 states and 7 union territories. Uttar Pradesh is the largest state by population & Goa is least populated state in India. Let's have a look at the population of States & Union Territories. As per the Unique Identification Authority of India, India's population is 1,371,360,350 approx in 2020. India's 2020 population is estimated at 1,380,004,385 people at mid-year according to UN data.

In India the most populated state is Uttar Pradesh. Uttar Pradesh, Maharashtra, Bihar, West Bengal, and Madhya Pradesh are top 5 populated states in India. In 2011 Maharashtra is at 2nd Spot, but Bihar with a higher growth rate approx 20% is very close to Maharashtra by 2023-24 it will be at the second spot. **India's Population is estimated in 13, 75,586,000 or 1.38 Billion** according to the Census Population Projection Report in 2022.

Almost half of the country's population lives in these five (Uttar Pradesh, Maharashtra, Bihar, West Bengal, and Madhya Pradesh) highest populous states and the 10 most populated states of India contribute 74% of India's population. During this decade Bihar has the highest population growth rate.

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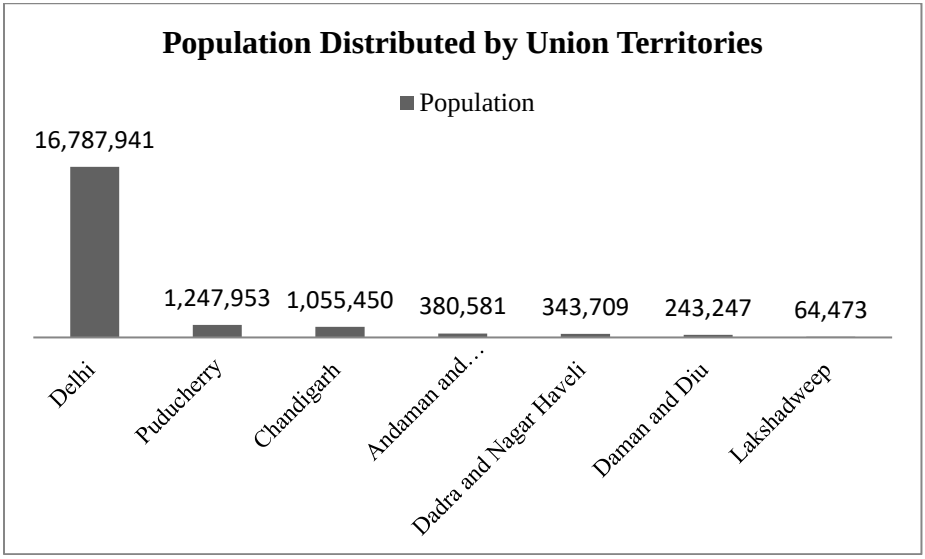
POPULATION DISTRIBUTED BY UNION TERRITORIES

Rank	Union territories	Population	Percent (%)
1	Delhi	16,787,941	1.39
2	Puducherry	1,247,953	0.10
3	Chandigarh	1,055,450	0.09
4	Andaman and Nicobar Islands	380,581	0.03
5	Dadra and Nagar Haveli	343,709	0.03
6	Daman and Diu	243,247	0.02
7	Lakshadweep	64,473	0.01

Source*: Census 2011, UIAI & Census Population Projection report*

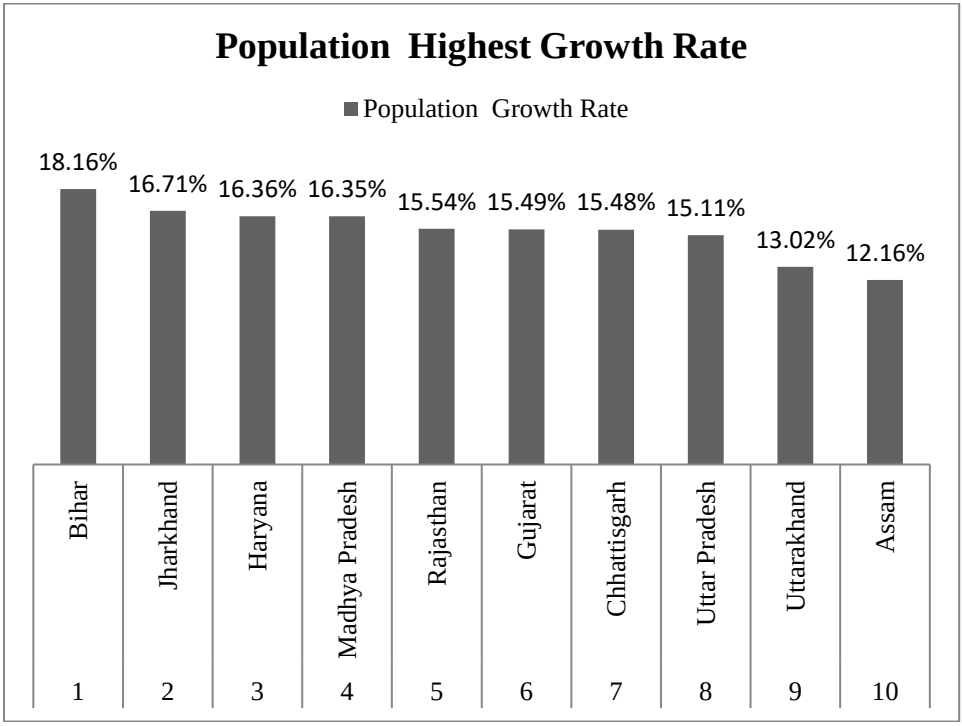


STATES WITH HIGHEST GROWTH RATE 2021

Rank	States	Growth Rate
1	Bihar	18.16%
2	Jharkhand	16.71%
3	Haryana	16.36%
4	Madhya Pradesh	16.35%
5	Rajasthan	15.54%
6	Gujarat	15.49%
7	Chhattisgarh	15.48%
8	Uttar Pradesh	15.11%
9	Uttarakhand	13.02%
10	Assam	12.16%

Source: Census 2011 & UIAI for 2021 Estimates

ISBN: 978-91-987581-0-8



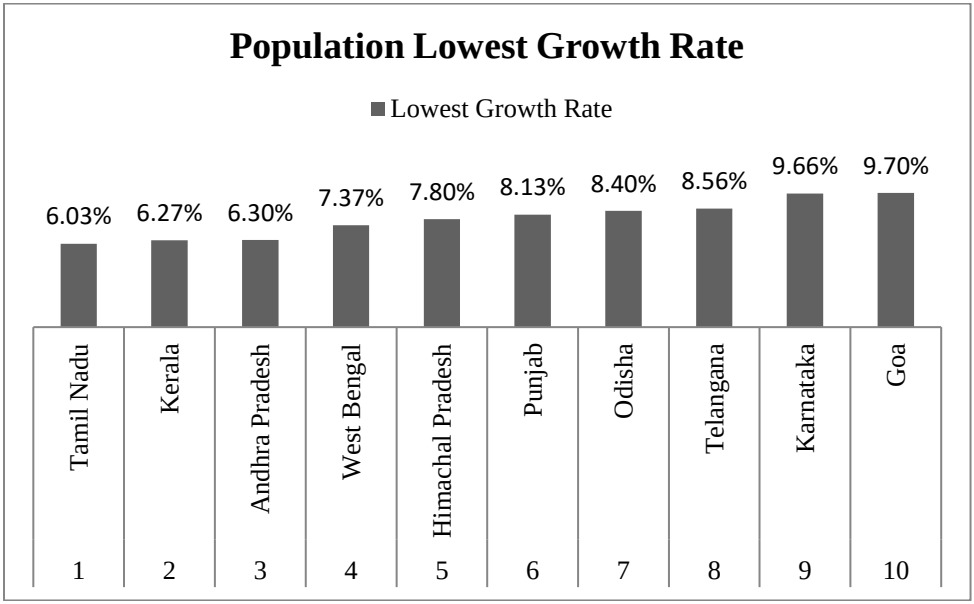
As per estimates in 2011-2021India's growth rate is approx 12.56%. Bihar has the highest population growth rate 18.16% during 2011-2021 followed by 16.71% Jharkhand and 16.36% Haryana.

INDIAN STATES WITH LOWEST GROWTH RATE 2021

Rank	States	Growth Rate
1	Tamil Nadu	6.03%
2	Kerala	6.27%
3	Andhra Pradesh	6.30%
4	West Bengal	7.37%
5	Himachal Pradesh	7.80%
6	Punjab	8.13%
7	Odisha	8.40%
8	Telangana	8.56%
9	Karnataka	9.66%
10	Goa	9.70%

Source: Census 2011 & UIAI for 2021 Estimates

ISBN: 978-91-987581-0-8



As per estimates, in 2011-2021 India's growth rate is approx 12.56%. Ten States have grown at a rate below 10%. In the 2011 census, most of the South & Western Indian States have a growth rate below the national average and in 2021 also they have a low growth rate. Tamilnadu (6.03%) is a state with the least growth rate followed by Kerala (6.27) and Andhra Pradesh (6.30).

❖ COMMON CAUSES LEADING TO OVER POPULATION IN INDIA ARE:

- Still the birth rate is higher than the death rate. We have been successful in declining the death rates but the same cannot be said for birth rates.
- Due to the population policies the fertility rate and other measures has been falling but even then compared to other countries it is much higher.

Our countries which are leading to over population in the above causes are interrelated to the various social issues.

❖ IMPACTS OF HIGH POPULATION:

Due to overpopulation our country scenario is not good, even after 67 years of independence.

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- **Unemployment**

It is very difficult to generating employment for a huge population in India. Every year the number of illiterate persons increases. The unemployment rate is thus showing an increasing trend.

- **Utilization of Manpower**

The number of jobless people is on the rise in India due to economic depression and slow business development and expansion activities.

- **Infrastructure Facilities**

Unfortunately development of infrastructural facilities is not keeping pace with the growth of population. The result is lack of communication, education, housing, healthcare, transportation etc. There has been an increase in the number of overcrowded houses, traffic congestion, slums etc.

- **Utilization of Resource**

Forests, land areas, water resources are over exploited. There is also a scarcity of resources.

Then it causes production decreased and costs increased. Food production and distribution have not been able to catch up with the increasing population and hence the costs of production have increased. The major consequence of over population is Inflation.

- **Distribution of Income**

In the face of an increasing population, there is an unequal distribution of income and inequalities within the country widen.

❖ PROBLEMS ON OVER POPULATION:

- **Universal Marriage System and Early Marriage**

Even though the marriageable age of a girl is legally 18 years, the concept of early marriage still prevails and getting married at a young age prolongs the childbearing age. In India also marriage is a universal practice and a sacred obligation , where almost every woman is married at the reproductive age.

- **Illiteracy and Poverty**

Poverty is the factor for the rapid growth of population. Impoverished families have this notion that more the number of members in the family, more will be the numbers to earn income. Some feel that more children are needed to look after them in their old age. Also, hunger can be a cause of death of their children and hence the need for more children. Strange but true, Indian still lags behind the use of contraceptives and birth control

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methods. Many of them are not willing to discuss or are totally unaware of them. Illiteracy is the another cause of over population

- **Age-old cultural norm**

Sons are the bread earners of the families in India. This age-old thought puts considerable pressure on the parents to produce children until a male child is born.

- **Illegal migration**

Last but not the least we cannot ignore the fact that illegal migration is continuously taking place from Bangladesh, Nepal leading to increased population density.

❖ STEPS TO CONTROL POPULATION IN INDIA:

- Increasing the welfare and status of women and girls.
- Spread of education and sex education
- Increasing awareness for the use of contraceptives and family planning methods.
- Encouraging male sterilization and spacing birth.
- Free distribution of contraceptives and condoms among the poor
- Encouraging female empowerment.
- More health care centre for the poor
- Major steps which have been already implemented but still need to be emphasized more control population.
- A bold population policy should initiate Government of India, politicians and policy-makers so that the economic growth of the country can keep pace with the demands of a growing population.
- Experts are hopeful that by increasing public awareness and enlisting strict population control norms by the Government will definitely lead the way for the country's economic prosperity and control of the population.
- In the global world India's strengths in various fields cannot be ignored, whether it is in science & technology, medicine and health care, business and industry, military, communication, entertainment, literature and many more.

The above steps can play a major role in controlling the population.

❖ CONCLUSION:

Really India is not over-populated because it is a vast country with plenty of natural resources. These resources have not been fully used as yet. The most serious obstacle to the economic development is India's

rapidly growing population. It is not possible to reduce the existing size of population. But it is possible to slowdown the rate at which population is increasing. In spite of the fact that the population policies, family planning and welfare programmes undertaken by the Government of India have led to a continuous decrease in the fertility rate. The overall development of the country and rise in per capita income can go a long way in reducing the rate of increase in population. Already the death rate has fallen to a very low level. There is no scope for reducing it further. But the birth rate continues to be high by current standards. Therefore, in future India's population will be a function of birth rate alone. Excess population is itself a symptom of over-population. This problem is becoming more and more acute day by day due to rapidly increasing population by about 22 million persons a year. So, India is over-populated. It's time for all global forums to provide effective solutions in order to resolve this problem.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.005

IMPACT OF GLOBALIZATION ON POVERTY AND INEQUALITY IN INDIA

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❖ ABSTRACT

There are conflicting views about whether globalization has increased or reduced poverty. Proponents of globalization state that economic progress has been rapid in those countries where globalization has been given priority. Due to the increasing economic cooperation among the countries, progress has been made everywhere, which has benefited all the citizens. This has reduced poverty all around. The opposition side says that there can be no bigger lie than this. They say that the World Bank is the only institution providing statistics on poverty. Its president, says that in the last 20 years (from 1980 to 2000), the number of poor has decreased by 200 million. But on the other hand, the first sentence of the World Development Indicator 2001 is that "1.2 billion out of the world's 6 billion people live on less than a dollar a day". This number was the same in 1987 and it was the same in 1998 as well. The paper tries to produce an analysis on impact of globalization on poverty and inequality in India.

Keywords*: Globalization; Poverty; Inequality; Malnutrition.*

❖ INTRODUCTION

In fact the figures given by the World Bank are misleading. In the nineties, the World Bank has made changes in the basis of the assessment of poverty itself. The poverty criterion has been changed from $1.08 per day to $1.08 per day. Earlier, the assessment was done on the basis of PPP computed in 1985 whereas now the computation has been done on the basis of PPP of 1993. For this reason the two rates cannot be compared and the propaganda of poverty reduction is misleading. The new $1.08

ISBN: 978-91-987581-0-8

condition has reduced poverty in 71 of the 94 countries. In China it is 14 percent and in India it is 9 percent.[1] They say that if we compare poverty in both the old and new rates, then the situation becomes as follows –

BASIS	POVERTY RATE ON OLD BASIS	POVERTY RATE ON NEW BASIS
Sahara South African Region	39.1	49.3
South America Continent	23.5	15.3
West Asia/North Africa	4.1	1.9

The World Bank has also changed the base in such a way that the reporting period of some items has been increased from seven days to 30 days. Along with this, the estimate is high in the computation of PPP and there is a difference between the actual survey. In China, it has been estimated on the basis of estimates only in some cities because there the government refused to conduct a comprehensive survey. India had also refused to participate in the 1993 survey, due to which the calculation has been done on the basis of the 1985 survey itself. The number of people below the poverty line in these two countries is so much that they can have an opposite effect on the world indicator.[2]

Different criteria have also been suggested by the World Bank and by other agencies, depending on which lack of things they would consider as poverty. One premise is that those under $1.25 should be considered poor. Some consider the other two dollars to be necessary to meet the minimum requirement. If 2 dollars is considered, then in 1991 the number of poor will be 2.2 billion. It is necessary that the criterion of poverty should be such which is acceptable to all and it should not be changed for a long time in this or on the basis of survey, so that comparative study can be done.[3]

In this sequence, another parameter is also considered. This is a state of malnutrition. Many studies have been done in this. Malnutrition can be considered as another form of poverty because today there is no ignorance about what are the nutritional elements, which are necessary to be consumed, but to get them economic condition comes in the way. The study is conducted by the Food and Agriculture Organization in relation to

ISBN: 978-91-987581-0-8

malnutrition. The updated report pertains to the period 2012-14. According to this, 800 million people in the world are suffering from malnutrition. The number of these in India is 164 million. In the report of the period 1990-92, the number of malnourished was stated to be 84 crore. This shows that the number has not decreased significantly.[4]

Contrasting opinions are also seen on the condition in which the distribution of income is going on within the countries. There are many types of basis for its assessment such as a). Gross National Product - converted into dollars on a PPP basis; b). Computation by assigning weights to each country on the basis of population; c). the top ten percent of the population compared to the lower ten percent of the population; or d). On the basis of National Income Account. The results will be different in all of these. Then it should also be noted that the value of the dollar has increased in the last decades, as in India in the 1970s, the dollar was equal to eight or nine rupees, whereas today it is around 60. It has to export more goods to pay back the debt. These loans are not repaid on PPP basis but at market rate only.[5]

There is also no consensus among economists about the computation of inequality. There are three methods of computing this –

1) Comparison of the highest and lowest tithe with the middle, also known as the Gini ratio, on the basis of which the disparity among countries has increased (i.e. rich countries have become richer, poor countries more poor).
2) If the entire national income is taken together and each country is treated as equal (India=Uganda), the disparity has increased.
3) Poverty has not increased or decreased if the comparison is made on the basis of population weight.

Some people point out that even though the percentage increase is the same, the actual distance increases, e.g. a one percent increase on $30,000 becomes $300, but a five percent increase on $4000 will also mean $120, which means that the actual difference from the previous $ 26000 increases to $ 26180.

While the average output in the bottom twenty countries during 1960-62 was $212, in the richest countries it was $11,417. (Both figures are based on 1995 dollar price); at the same time, in the period 2000-02,

these figures have increased to 267 and 32,339 dollars respectively. The percentage increase is 26 and 83 percent respectively.[6]

On the other hand it is also argued that there is no importance of comparison of countries among themselves. There is no point in computing the inequality. It should be seen that income is increasing in all countries. The basic question in his view is what the state of inequality within the country is. In this regard, in the 2012-13 study of ESCAPE (Economic and Social Commission for Asia Pacific) of 40 countries of Asia, it has been said that the birth ratio of income inequality in India has increased from 30.8 to 33.9 between 1990 and 2019. . In China these figures are 32.4 and 42.1 and in Indonesia 29.2 and 38.1. Inequality in India has increased but not reduced, it is clear. It is to be seen that India has come a little later in the race of globalization. It can be said that income inequality has increased or at least not decreased due to globalization.[7]

It is generally seen that the rich people of developing countries want to imitate the developed countries in everything. Even their laundry soap should be the same as that used in developed countries. Corruption is used to reach this position. Due to this the whole system of the developing country gets affected. Another effect of this is the migration of people with higher education from developing countries to developed countries. This drain of talent has the opposite effect on the progress of developing countries. It is a profitable deal for developed countries because they get talented people cheaply. We have seen in the past about the claim that globalization is the best way to reduce poverty and inequality, but it can be said that at least this makes the difference clear.

One of the arguments in favour of globalization is that the mutual trade of countries is increasing. The World Bank has conducted a study in which all the countries have been ranked in terms of globalization. The top one-third of countries with more globalization were found to be making more rapid economic progress than the rest. This study is about the difference between 1977 and 1997. One drawback of this study is that countries that showed rapid progress had very low GDP in the base year. Therefore the percentage increase appears to be very high. In macro economies such as China and India, the percentage growth will be less. Globalization in both these countries has also happened at its own slow pace and still there are protective restrictions in them. There are also such

ISBN: 978-91-987581-0-8

countries as Japan, South Korea and Taiwan, which have increased trade only by keeping their economy limited. When he became rich, he took steps to be liberal as is happening in China now.

It is necessary to reflect on what are the reasons behind not being able to remove poverty and inequality. The construction industry is growing in developing countries, but it is seen that as the production in the construction industry increases, its contribution to the gross output decreases. The reason for this is the rapid growth in the service sector. For this reason, the World Bank has also given up talking about the contribution of the construction industry and the emphasis is being laid on the matter of human needs. If the role of the construction industry is limited, what could be another reason? The value of exported goods is decreasing in comparison to the value of imported goods. Due to this, the amount being received by the import-export difference to the developing countries is getting reduced, due to which inequality or poverty is being affected. Many African countries which have an open economy but are largely dependent on exports have to face the adverse situation due to this policy.

It has been observed that most of the sales of the world's largest 500 multinational companies, which are called global, are being done in their home region - North America, Europe or East Asia. These companies are becoming area wide, not worldwide. High-income industries are flourishing only in developed countries. The cost of a skilled worker is 15 percent higher in Germany but it is still a leader in the construction industry. One reason for this is that the contribution of labour is now comparatively less. The relation of second production has become more than the technical knowledge available in the firm, so it is unprofitable to keep more salary people also. Contact with other advanced industries of its level in the developed area also becomes easy. In this way production with less technical knowledge is done in low cost countries and high cost, in which dividend is high, is done in developed areas. Due to this, there is no equality in the mutual inequality among countries due to globalization.[8]

Due to the above reasons and due to migration, developing countries are able to come forward only in less technical areas and globalization cannot be helpful in eliminating inequality. On the other hand, the prices of goods with advanced technology can be kept high, which has to be paid by the developing countries only. Because of this,

ISBN: 978-91-987581-0-8

only developed countries are getting the benefit of globalization. One aspect of this can also be traced to research going on in technology. Except Japan, this is happening only in western developed countries. Countries like China and India still have to depend on foreign investment. In China, only Taiwan and other foreign technology is being used in production.

There are some other things also worth considering. Information technology is expanding as an alternative to the construction industry. In this, education and technical knowledge are more important. With this, financial services are also expanding. This situation increases the risk of financial flight overnight. A few years back in East Asia, due to this a serious situation had arisen. For this reason, continuous monitoring becomes necessary. It is true that development is necessary to improve the economic condition of the people. In this, the developing countries where cheap land and cheap labour are available, will have their contribution. The time of self-contained economy has passed. But at the same time it is necessary to try to reduce the inequality within the country and among the countries, which is not happening right now. For this, first of all, the methods of computation have to be changed so that only the work of entertainment is not done, but the real progress can be known. Lest the economy be going in the opposite direction like climate change. For this, instead of importing, it will be necessary to give importance to the expansion of indigenous industry. In this the state will have to make a policy of proper national interest. The World Trade Organization will also have to work in such a way that instead of mutual exchange, more facilities are provided to the developing countries.

Globalization is characterized as the seamless cross-border exchange of goods, services, capital, technology, ideas, information, legal systems and individuals. With the increase in globalization it was expected that the benefits of development would reach every section of the society, but at least from the examples of developing countries there is enough evidence that globalization has not resulted inequitable growth.

- **Globalization and increasing inequality**

Globalization has promoted inequality based on gender, class, caste, region, religion and ethnicity in India.[9]

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For example:

- **Metropolis-Satellite Linkage:** Resources from extremely backward and tribal areas are being increasingly exploited for the development of more developed areas. For example the case of mining in Niyamgiri hills by Vedanta group.
- **Income inequality:** According to Thomas Piketty, income inequality in India has reached its highest level since the year 1922.
- **Inequality in national wealth:** Over the past two decades, foreign development aid from rich countries to poor countries is $50-80 billion a year. Over the same period, about $500-800 billion of illicit funds are transferred from poor countries to rich countries each year.
- **Labour Inequality:** Globalization has created a high demand for cheap labour to increase profits. More than 90 percent of Indian workers are employed in the unregulated unorganized sector.
- **Caste and religion based inequalities:** Globalization and consequently better access to resources of creamy layer or rich people in particular caste category have increased inequalities within caste sub-groups.
- **Impact on Agriculture:** With measures like Green Revolution in agriculture, the rich farmers became richer while the poor farmers failed to get its benefits. Small and marginal farmers account for 85% of India's population and more than 2,00,000 farmers have committed suicide since 1997.
- **Environmental inequalities:** Large scale transportation, use of technology, water bodies polluted by industrialization, expansion in non-sustainable practices etc. are some of the common consequences of globalization, which is worsening the ecological situation by making poor areas more vulnerable.

❖ CONCLUSION:

Globalization has also intensified human trafficking. Thus, it has transformed human beings into commodities which are being bought and sold in international markets. It should be noted that globalization increased various benefits such as better standards of living and better medical facilities, but globalization induced poverty and inequalities have also created unsafe conditions for millions of people.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.006

CAUSES OF POVERTY AND GOVERNMENT SUPPORT TO THE POVERTY IN INDIA

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❖ ABSTRACT:

India is said to be the second largest populate country in the world (1,407,547007- current population- taken at 3:11pm, 21st December 2021), next to China (1,446,238,767- current population- taken at 3:13pm, 21st December 2021). The population is increasing in India, every second and also the birth rate is higher than the death rate. The death rate is considerably reduced in India, but the same cannot be taken for the birth rate. The population is increasing in India because of the early marriage and the girls are married at the reproductive age, as compared to other countries. It is said that poverty also leads to the growth of population as the people think that they need more people to fetch income for the family, and also of the fear that children would die because of hunger. Illiteracy is another factor for the raise in the population as people are not aware of the use of condoms and other preventive measures which are introduced by the government. Objectives of the chapter are (i) to present the Indian population and reasons for poverty, (ii) to present the causes of poverty and (iii) to present steps taken by the government to eradicate poverty in India. This chapter concluded that the poor people are unaware of government schemes and

ISBN: 978-91-987581-0-8

benefits, because the aim of the plan may reach if the beneficiary are aware and utilize in an effective manner.

❖ INTRODUCTION:

India is said to be the second largest populate country in the world (1,407,547007- current population- taken at 3:11pm, 21st December 2021), next to China (1,446,238,767- current population- taken at 3:13pm, 21st December 2021) . The population is increasing in India, every second and also the birth rate is higher than the death rate. The death rate is considerably reduced in India, but the same cannot be taken for the birth rate. The population is increasing in India because of the early marriage and the girls are married at the reproductive age, as compared to other countries. It is said that poverty also leads to the growth of population as the people think that they need more people to fetch income for the family, and also of the fear that children would die because of hunger. Illiteracy is another factor for the raise in the population as people are not aware of the use of condoms and other preventive measures which are introduced by the government. It is said that the women are forced to give birth to children until a male baby is born in their family. The illegal migration is entering into India from Bangladesh, Nepal and from Sri Lanka. The increase in population leads to unemployment, increase in the cost of products, decreased production, unequal income distribution. All these factors lead to the increase in poverty among the people of India. Though the government of India has taken many steps to reduce the population of India by increasing the marriage age of woman to 21, the status of women and girls, empowerment, sex education, family planning, free distribution of condoms among the poor, male sterilization, births spacing, health centers etc for the reduction of population. The main reason of poverty in India may be concluded with the reason of great increase in population. Let us discuss the causes of poverty in India, which is considered to be the main reason for India to be a backward economy. The government has made lots of steps to reduce the poverty of India right from the independence, but hasn't shown a success for the eradication of the same.

❖ OBJECTIVES:

1) To present the Indian population and reasons for poverty.
2) To present the causes of poverty.
3) To present steps taken by the government to eradicate poverty in India.

ISBN: 978-91-987581-0-8

❖ CAUSES OF POVERTY:

It is said that India is rich country inhabited with poor people. The saying emerged as the Indian **resources are under-utilized** such as the water resources are not properly channelized for irrigation, in turn affects the agriculture and the production of the country. As **agriculture** depends hugely on the rainfall which always fails in the seasons, if the water resources are properly taken for agricultural purposes would help India to grown in agriculture. The next is the export of iron ore to other countries like Japan which is not up to the economies, instead that should be done as finished iron products would help the economic development of our nation. As India has got more than 20% of forest resources, the minerals if taken out of it would make the nation grow for the eradication of poverty. We are quite rich in our resources but the problem here is, that it is not utilized properly in the right channel.

The next reason for the poverty of India is that the one fifty of total income of the nation is held by 1% of the Indian population in the year 2021, while its just 13% of the income is held by the last 50% of the Nation's income. Since the **national money is in the hands of a very few people**, the rest of the population is going without any money. Here is a saying that rich becomes richer and the poor becomes poorer. In daily life, messages in newspapers, televisions, journals, articles stating the poverty in India and steps to eradicate the same, but we always lack in taking the first step of wiping of the hunger of the people who are living below the poverty line. The 70% of the population is living in the village, where people depend much on agriculture. Moreover, the flood, famine, cyclone and earthquake also affect the agriculture in our country. Most of the people are illiterate and more than 45% of the Indian population is labour force. The scholars who graduate every year expecting a job is also left without a decent job and also the unemployment is rising in a huge rate. An UN report says that the India of huge population, more than 300 million people living in poverty with no healthy food, hygiene drinking water, sewage, electricity and education. The country is having huge industrial groups and the consumer markets are regulated by few monopolies in the country.

The money that is locked in the Swiss Bank, by the depositors of Indian also made the country poor. Since it is not evenly distributed among the people of India, some are left empty handed in our nation. Though government is taking lots of steps to bring out the money from the bank goes in vain. **The black money**, for which the tax is not paid affects the financial system in the country. Black money is the money which is

earned by means of illegal activities or the money for which the tax is not paid. This money which is got in the form of cash, not taxed, cannot be spent for the development of the economy, instead could be used for underground businesses, that naturally affects the money rotation in the nation, inturn leads the poverty of the people. The Indian government is spending on rural welfare scheme, helps in reducing the national poverty. It is targeted that by the government in eradicating the poverty for all people who live in extreme poverty by the year 2030.

The use of new technology in agriculture is very less in many states of the country unlike in the states of Punjab and Haryana. This will provide more employment opportunities for the poor and the increase in the production of food grains. But since the people depending on agriculture are not rich enough to take loans and to repay the same. Since the usage of technology is not been adopted in the states of Assam, Orissa, Bihar, Madya Pradesh and East Uttar Pradesh, the poverty is also in the increasing phase in India. As a result, the poverty triumphs to a larger extent. Moreover, the Indian government has neglected the public sector investment in agricultural sector, the irrigation system fails to fulfil the need of the agricultural lands, if were adopted would have raised productivity, employment and income for the people who depend on agriculture. So, agriculture has to depend heavily on rainfall which is insufficient for the productivity and the reduction of poverty.

Another important and the leading cause of poverty is the rapid increase in population in our country. Population in India is increasing since 1951 with 36 crores to 140 crores by the end of November 2021, that is more than 80 crore people have been added to the Indian population in the past 70 years since independence. Due to this reason, the available land for per person is decreasing, and the people don't have sufficient land to produce output and fetch income out of it. In this case, the person who is earning in the family is much burdened because he has to carry the whole responsibility of the family members. This leads to lower per capita consumption expenditure which is not enough for meeting the basic needs of a human being, resulting in lower standard of living of the people, lowers savings and investment, lesser employment opportunities, resulting in unemployment. All the above affected the national income and resulted in poverty. In a country, which increases the savings and investment for the capital formation for the development of the nation is reducing, the steps taken for the reduction of poverty is also in a declining phase.

The problem of under and unemployment in the Indian economy is another important reason for the prevalence of poverty in our nation.

ISBN: 978-91-987581-0-8

When the educated graduates are paid less for the qualification, underutilisation of their skills, job and part time. The increase in the unemployment and the poverty are growing together. The unemployment, growing population, excess labour force, low income, low capital formation, low productivity and poverty. In India, a poor cannot sustain with hunger for a longer period, so he takes up a job whichever is available, even getting a low remuneration. The poor, though work very hard for longer period of time, still unable to earn enough money to meet the basic needs.

❖ STEPS TAKEN BY THE GOVERNMENT TO ERADICATE POVERTY IN INDIA:

Government has introduced minimum payment every month for the people living under the poverty line. The minimum requirement is provided by the government by way of ration shops, ensuring the minimum needs of the poor there by solving the poverty problem atleat in a minimum rate.

1) Integrated Rural Development Programme

The integrated rural development programme was introduced in the year 1978–79 and universalized from 2nd October, 1980. Aim of this programme is to provide support to the rural poor in the form of subsidy and bank credit for productive work opportunities through successive plan periods.

2) Jawahar Rozgar Yojana /Jawahar Gram Samriddhi Yojana (JGSY)

The above two schemes National Rural Employment Programme (NREP) and Rural Landless Employment Guarantee Programme (RLEGP) were merged in the year1989, under Jawahar Rozgar Yojana (JRY). The purpose was to generate good work prospects for the unemployed in rural areas by creating economic infrastructure, community and social assets. The old scheme started again with a new name as Jawahar Gram Samriddhi Yojana (JGSY), mainly for rural economic infrastructure programme with the purpose of employment generation.

3) Employment Assurance Scheme

This scheme was launched in the year 1993. It mainly covers drought-prone, desert, tribal and hill area blocks. In the year1997-98, it extended to several other blocks. Employment assurance scheme was planned for creating employment opportunity in the form of manual work when there is no agricultural season. It was expected to lead to the creation of robust economic and social infrastructure and address the needs of people.

4) Food for Work Programme

In the year 2000, the Food for Work Programme was started as a component of EAS. It was started with some major drought-affected states, namely Maharashtra, Rajasthan, Orrisa, Gujarat, Himachal Pradesh, Madhya Pradesh, Uttaranchal and Chhattisgarh. The main aim is to enhance food security through wage employment.

5) Sampoorna Gramin Rozgar Yojana:

The new Sampoorna Gramin Rozgar Yojana (SGRY) Scheme was started in 2001 was the mix of old JGSY, EAS and Food for Work Programme. The primary aim of the scheme was the generation of wage employment, creation of good economic infrastructure in rural areas as well as food provision and nutrition security for the underdeveloped.

6) Rural Housing – Pradhan Mantri Gramin Awaas Yojana (PMGAY)

PMGAY is a government flagship programme, created for providing housing for the Indian rural poor. A similar scheme for urban poor was launched in 2015 as Housing for All. For BPL population, similar program was launched by late PM Rajiv Gandhi, known as Indira Awaas Yojana which was one of the major flagship programs.

7) National Old Age Pension Scheme (NOAPS)

NOAPS came into effect from the year 1995, providing pension to old people above 60, who does not have any means of subsistence is the main aim of this project. It is provided by the central government. The implementation of this scheme in places is given to panchayats and municipalities.

8) National Family Benefit Scheme (NFBS)

NFBS was started in the year 1995 and is sponsored state governments, under community and rural department. They provide certain amount to a member of family who becomes the head of the family after the death of its primary breadwinner.

9) National Maternity Benefit Scheme

NMBS provides certain amount grant mother in three instalments. The women must be older than 19 years. It is normally provided eighth to twelfth weeks before the birth of child. And in case of the death of the child, the women can still avail it.

10) To accelerate economic growth

The government tried to impart various methods for accelerating economic growth. They really expected that the poor will be raised above the poverty line with the various growth measures. While efforts were made to accelerate economic growth but they fail as they applied capital-

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intensive technologies of the Western Countries. Our nation is more on the road to the labour-intensive path of economic growth. Hence, fiscal and monetary were adopted that provide incentives for using labour-intensive techniques.

11) By agricultural growth and poverty alleviation

One of the most important factors is agricultural growth that can help reduce poverty. As per reports of Montek Ahluwalia commission (former member of Planning Commission), it brought clearly that agricultural growth and poverty are inversely related. As higher the agricultural growth is, it leads to lower poverty ratio.

12) By speedy development of infrastructure

The speedy development of infrastructure, an important measure is to generate employment opportunity and raising their productivity. Infrastructure development involves construction of buildings, roads, highways, ports, telecommunication, power and irrigation. It encompasses mainly construction work which is again labour-intensive thing.

13) By accelerating human resource development

In addition to infrastructure development, poverty can also be reduced through human resources development. HRD requires better investment in areas of educational facilities such as schools to promote literacy, vocational colleges and technical training institutes to impart skills to the people.

14) By accelerating the growth of non-farm employment

Rural areas are of special importance for the reduction of poverty and growth of non-farm employment opportunities. This type of employment can be created in sales, marketing, transportation, handicrafts, dairy farming, forestry, food processing and other agricultural products, repair workshops, etc.

15) By giving access to assets

After independence, faster rate of population increase has led to greater sub- division and fragmentation of agricultural holdings. Lack of employment opportunities in factories, industries and non-farm sectors has deteriorated the conditions of agricultural labour and self-employed small farmers.

16) By giving access to credit

Credit availability for the poor and underprivileged on easy terms can create better living conditions. Small farmers can gain access to dynamic resources such as better seeds, good fertilizers, etc. Construction of minor irrigation channels such as wells and tube wells can be accelerated.

ISBN: 978-91-987581-0-8

17) By proper public distribution system (PDS):

From the studies, it came out that households spend nearly 80 per cent of their income on food. Hence, an effective way of raising rural incomes and to ensure food security to the poor households, the government should work on an assured supply of adequate quantity of food-grains.

18) By direct attack on poverty

The government realised in the early 70's that it is going to take a long time for economic growth to generate enough employment opportunities for the needy people in our country.

❖ CONCLUSION:

Government should provide all the facilities to all, people need comfortable, safe and secure life. But based on the people income and financial background rich people are getting better commodities and good life. Poor people working to earn money to push a day, very next day again they have to earn to live. Government is working on to provide basic facilities, shelter and medical facilities to all people, especially for poor people. In this chapter, the authors have given some steps taken by the government to eradicate poverty in India. Poor people are unaware of government schemes and benefits, so the aim of the plan may reach if the beneficiaries are aware and utilize the schemes in an effective manner.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.007

ISSUES AND CHALLENGES OF POVERTY, MICROFINANCE AND WOMEN EMPOWERMENT: REALITY CHECK FROM IMPHAL EAST DISTRICT, MANIPUR

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❖ ABSTRACT:

The problem of poverty and inequality seem to have taken precedence over the problem of growth, and over the years the community involvement and the concept of self-help were felt most required for the success of these efforts. Poverty is comparable to the disease of cancer that one who has infected with has to sustain discomfort until his death. Solutions to the alleviation of poverty lie in generation of self-employment opportunities. Such opportunities can be created by bringing at least one member of every BPL family into the fold of SHG. In such context of growing importance of SHGs. Hence, search for newer approaches and instrument of poverty alleviation continues. In this context, self help Groups (SHGs) and microfinance have emerged as an innovative and potential instruments for poverty alleviation. Hence, Self-Help Groups are realized to be a proven model/methodology to address the issues of poverty alleviation

Keywords: *Poverty Alleviation, Microfinance, NGOs, SHG-Bank Linkage*

❖ ISSUE OF POVERTY:

Poverty is a serious social phenomenon due to unproportionate ratio between total population and resources currently available in the economy.The proposition is so serious that it deprives their fundamental freedoms of choice and action, face extreme vulnerability to ill health and exposed to ill treatment by the institution of the state and society and are powerless to influence key decision affecting their live. Poverty is

ISBN: 978-91-987581-0-8

comparable to the disease of cancer that one who has infected with has to sustain discomfort until his death. To quote the reference of Amartya Sen, "People must not be allowed to become so poor that they offend or are hurtful to the society. It is not so much the misery and plight of the poor but the discomfort and cost of the commodity which is crucial to this view of poverty. We have a problem of poverty to the extent that low income creates problems for those who are not poor. The solution to the problem of poverty in general of any economy is considered achievable by consistently rising levels of economic growth and development. In the words of W.C. Peterson, 'Economic growth involves an increase over time in the actual output of goods and services as well as an increase in the economy's capability to produce goods and services'. It has been recognized that successful development requires comprehensive, multifaceted, and properly integrated mandate. In addition, another problem of an economy is poverty amid plenty and it becomes the world's greatest challenge. Efforts are on persistently mainly in underdeveloped and developing countries to contain the prevailing phenomenon in the world. Hence, all over the world, in many different ways, countries have tried to rolled back poverty and improved in the recent past, may be in terms of global wealth, global connection and technological capabilities. However, due to uneven distribution of these gains makes the gap between countries, regions and peoples widen causes difficult to build the conditions for sustained, equitable growth in the world.

Of the World's 6 billion people, 2.8billions- almost half- live on less than$2 a day, and 1.2 billion-a fifth-live on less than $1 a day, with 44 percent living in south Asia .In rich countries fewer than 1 child in 100 does not reach its fifth birthday, while in the poorest countries as many as a fifth of children do not .And while in rich countries fewer than 5 percent of all children under five are malnourished, in poor countries as many as 50 percent are.

The average income of in the riches 20 countries is 37 times the average in the poorest 20 countries ─ a gap that has doubled in the past 40 years. And experience in the different parts of the world has been very diverse.[3]. How can we find out about the implementation factors that triggered success and foster those approaches on a global scale to shrink poverty in many parts of the world where it remains widespread?

It is indeed necessary to build a strategy to meet the challenge of reducing poverty through the force of global integration and technological advancement to serve the interest of poor people.

ISBN: 978-91-987581-0-8

Poverty is commonly understood as the condition of having little money and few material possessions. Not all agree on the undesirability of poverty, with a number of spiritual traditions emphasizing the virtue of voluntary renunciation of material goods, and disavowing the logic of accumulation. In international and community development literature however, poverty has the additional meaning of deprivation of basic needs. While some seek to define poverty in economic terms, others consider social and political arrangements to be intrinsic to poverty. Debate on the causes, effects and measurement of poverty directly influences the design and implementation of poverty reduction programs and is thus important to the fields of international development and public administration.

Economic aspects of poverty may include material need, typically including the necessities of daily living (food, clothing, shelter, and health care). Poverty in this sense may be understood as a condition in which a person or community is deprived of, and or lacks the essentials for a minimum standard of well-being and life. These essentials may be material resources such as food, safe drinking water, and shelter. Poverty also describes a (persistent) lack of wealth and income, or wealth and income disparities.

Social aspects of poverty link conditions of scarcity to aspects of the distribution of resources and power in a society. These aspects of poverty may include access to information, education, health care, social status, political power, and the opportunity to develop meaningful connections with other people in society. Poverty may also be understood by those who experience it as an aspect of social relationships and need, including social exclusion , dependency , and diminished capacity to participate in society, including as a result of being deprived of access to education and information.

The World Bank's "Voices of the Poor," based on research with over 60,000 poor people in 60 countries, identifies a range of factors which poor people identify as part of poverty'[4]. These include

- precarious livelihoods
- excluded locations
- physical limitations
- gender relationships
- problems in social relationships
- lack of security
- abuse by those in power

ISBN: 978-91-987581-0-8

- disempowering institutions
- limited capabilities, and
- weak community organizations.

Critics argue that some measures reflect pejorative and sometimes racialized colonial stereotypes of poor people as powerless victims, and passive recipients of aid programs.

Poverty elevation is still an unfinished agenda of under developed countries/developing countries of the world in general and India in particu

About 260 million people both in rural and urban areas were officially estimated as living below poverty line at the turn of the new millennium.The magnitude of the continuing poverty is reflected in the fact that a significant chunk of our population are deprived of basic developmental need like schooling, housing, water, health, sanitation and electricity . It needs proposes a strategy for attacking poverty in three ways: Promoting opportunity, facilitating empowrment, and enhanching security5.

- Promoting opportunity: Poor people consistently emphisis the centrality of material opportunities.This means jobs ,credit, road, electricity, markets for their produce ,and the schools, water,sanitation, and health services that underpin the health and skills essential for work.
- Facilitating empowerment: The choice and implementation of public actions that are responsive to the needs of poor people depend on the interaction of political,social, and other institutional processes.Access to market opportunities and to public sector services is often strongly influenced by state and social institutions,which much be responsive and accountable to the poor people.
- Enhanching security: Reducing vunerablity to economic shocks, natural disasters, ill health, disability, and personal violence is an intrinsic part of enhancing well-being and encourages investment in human capital and in higher-risk, higher return activities .

There is recognition of the fact that impact on poverty and deprivation must be ended as soon as possible. Many governments all over the world pursue economic planning as a means to way out of the problem of poverty. Increase in GDP or GNP is considered to the measuring rod for the progress of the economy and consiquently for the rolling back from poverty level of the ecomomy.

ISBN: 978-91-987581-0-8

Experience of all over world in the recent years had seen that there has grown disillusionment both in rich and poor countries about the pursuit of growth as a main socio-economic objective.This view has echoed again and again at the United Nations World Summit for Social development held at Copenhagen in March1995 . The problem of poverty and inequality seem to have taken precedence over the problem of growth. In this connection, Mahbubul Haq (former minister of planning , Pakistan) expressed, "We were taught to take care of our GNP as this will take care of poverty.Let us reverse this and take care of poverty as this will take care of the GNP.[6] Search for newer approaches and instrument of poverty alleviation continues. In this context, Self help Groups (SHGs) and microfinance have emerged as an innovative and potential instruments for poverty alleviation and socio-economic empowerment of the poor. Experience of micro credit delivery through SHGs many countries reveals that poor and humble persons make investment wisely and earn returns. However, the flow of financial assistance to them was too marginal to enable them to cross the poverty line.

The essence to create a grassroot organisational base to enable the down trodden people to come together, to analyse their issues and problems themselves, and to fulfil their needs was strongly advocated. In fact, experience shows that some of the successful group-based participatory programmes have made significant improvement in the conditions of living poor women.

The concept of self-help group has gained its significance, especially after 1976 when Prof. Mohammed Yunus of Bangladesh began experimenting with micro-credit and women SHGs. A strategy was made in Bangladesh with a sense of economic eradication in poverty eradication 'by empowering the poor women'. SHGs (small informal associations) were created for the purpose of enabling members to reap economic benefit out of mutual help, solidarity and joint responsibility. The benefits include mobilisation of savings and credit facilities and pursuit of group enterprise activities. The group-based approach not only enables the poor to accumulate capital by way of small savings but also helps them to get access to formal credit facilities. These groups by way of joint liability enable the poor to overcome the problem of collateral security and thus free them from the clutches of moneylenders. The joint liability not only improves group members' accessibility to credit, but also creates mechanisms like peer monitoring leading to better loan recoveries . Besides, some of the basic characteristics of SHGs like small size of membership and homogeneity of composition bring about cohesiveness

and effective participation of members in the functioning of the group. In general, SHGs created on the above lines of functioning have been able to reach the poor effectively, especially women and help them obtain easy access to facilities like savings and credit and empower them. Studies reveal that certain elements become crucial or critical for the successful formation and functioning of the groups. These include voluntary nature of the group, small size and homogeneity of membership, transparent and participative decision-making and effective use of funds for micro-enterprise creation. Regular meeting of the members fosters meaningful relationship among them and issues other than thrift and credit, issues on gender and social problems also get a platform for discussion. Micro finance is a cost effective tool to fight against many dimensions of the poverty challenge. The response of various microfinance initiatives, especially in Indian context, has been broadly on the following two lines[7].

1) Creation of alternative delivery mechanism for the poor: The main aim of microfinance intervention in this regard is to help the poor to reduce the difficulties they face with the bank or money lenders by creating separate institutions which can fully understood and appreciate their needs.The idea is to create pro-poor agencies or institution which can deliver financial service to the poor.
2) Reforming the formal agencies: The reforms include adapting methods and innovations tried out by NGOs and other microfinance agencies. The fast growing SHG-Bank Linkage Programme in India is one such example of the response from the formal agencies in reforming their earlier days.

❖ THE IMPORTANCE OF SELF HELP GROUPS (SHGS) IN POVERTY ALLIVAITION THROUGH ACCESSING MICROFINANCE:

The SHGs-bank linkage programme has emerged as the largest microfinance out reach programme in the world, and is also the most cost effective and fastest growing micro-finance initiative over the world. Micro-finance or a small loan is a helping hand to the poor in the fight against poverty.The High Power Task Force set up by NABARD in November 1998 defines “micro finance as provision of thrift, credit, other financial services and products of very small amounts to the poor in rural ,semi-urban areas for enabling them to raise their income levels and improve living standard”. Empirical evidence has shown that women as a group are consistently better in promptness and reliability of repayment. Targeting women through SHG programme have been a very effective

ISBN: 978-91-987581-0-8

method of ensuring that the benefits of increased income accrue to the general welfare of the family, and particularly of children. At the same time, women themselves benefit and achieve higher status when they are able to get new income.

It would be useful here to discuss the importance of microfinance as a tool for poverty alleviation. There may be various medium of micro finance, however, the most prominent and dominent among them has been through the medium of SHGs. In 1992, National Bank for Agriculture and Rural Development (NABARD) gave a fillup to the movement when it started the SHG-Bank linkage programme. This was the first major attempt to link the financial institutions with the informal groups, thereby, linking them with the market.

The term micro finance and Self Help Group(SHG) is very closely related and is considered as two sides of the same coin.The SHG represents the demand side of the system and microfinancing sector i.e. the banking sector represents the supply side .The ideal situation of the system is the equilibrium position, where the supply match the demand.The evolution of ideas in relation to credit delivery system has some parallel to the evolution of thought on economic growth and development .The idea is that in macro level credit should be delivered adequately to meet the growth process in the economy and in micro level the emphasis shifted to ensure the credit went to all segment of soceity.In order to meet these twin objectives, the expansion of organised banking is encouraged by every admistrative set up in an economy.The reality is, despite of expansion of organised banking system deep into the rural areas,a very large number of the poor continue to remain outside the fold of the formal banking system.The formal banking system with its systems and procedures was found to be inaccessible to the poor. Therefore, it is needed to find a new delivery machanism which would meet the requirments of the poor and down trodden, particularly, the women folk in the soceity. In India, during 1991-92, NABARD launched 92 pilot projects on linking SHGs with Banks, in various parts of the country. In July 1991, RBI advised the banks to participate in the pilot project and to extend finance to SHGs as per the norms and guidelines of NABARD. In February 1992 detailed guidelines were issued to the commercial banks, explaining the modalities of the pilot project. Later the scheme was made applicable to RRBs and Cooperative Banks in May 1993. The NABARD guidelines to banks for implementation of the pilot project allowed ample flexibility to the participating banks to innovative responses and observed variations in the grassroots level situations. It aimed at providing credit to

ISBN: 978-91-987581-0-8

the informal SHGs of rural poor, through the banking system, with minimal documentation and simplified procedures.

This intended to build the trust and confidence between banker and the poor group of people and encourage banking activies in a section of population that formal financial instution usually found reluctance to cover in their fold. For the SHG system developed and promoted by NABARD, they took the initiatives for linkage between SHGs and NGOs on the one hand, and the banks on the other. Several models of SHG-Bank linkage programme were tried out. As a result of these experiments, three most commonly used Models throughout the country came into existence.

❖ MODELS OF BANK LINKAGE

In order to deliver credit to the SHGs, NABARD has introduced three models under SHGs bank linkage programe as given below:

- **Model I,** the SHGs are to be organised and promoted directly by Banks without any assistance from any NGOs. The bank provided credit in bulk directly to the SHG, which might be an informal or formal body. The SHG, in turn, would undertake on-lending to its members, on terms and conditions agreed upon mutually among them. NABARD provided refinance assistance to the lending Bank. In this Model there is no involvement of NGOs
- **Model II**, NGOs act as an organiser and promoter of the SHGs, and then referred those SHGs to the Bank for lending directly either to the SHGs or to individual members. Here, NGOs stand as support to both the Banks and the SHGs, for monitoring and evaluation of the projects, proper functioning of the SHGs, repayment of the loans, training to members of SHGs, etc. NABARD provides refinance to the lending Bank.
- **Model III,** the SHGs are to be facilitated and promoted by NGO and then referred to the Bank for linkage, and the Bank finance directly to the NGO for on-lending to the SHGs. The NGO is fully responsible for making sure repayment of the loan to the Bank, with proper monitoring and evaluation of the projects of the SHG, and training of members of SHGs. NABARD provided cent percent refinance to the lending Bank.

The Self Help Group (SHG) which is defined as a homogenous group of poor people, voluntary formed to save small amounts within their earning and to mutually agree to contribute to a common fund which is on–lent to members for meeting their credit needs, either for consumption or income generating activities, on terms and other conditions mutually

ISBN: 978-91-987581-0-8

agreed upon by the group member. Later on the group approaches the banks for lingkage programme for assisting larger fund for operation of productive purposes. Such an approach of financing operation have benefited both for the borrower and the banks.

Over 90% of the groups have been set up by women which enables amelioration of the socio-economic conditions of their families and also brings enormous social change by empowering them. The thrift habit among the poor has been propagated as never before. The poverty alleviation process has been hastened on account of proper utilization of the saving and loans by the group members. The loan recovery rate of over 95% showed that the SHGs could use the bank credit effectively and in a responsible manner.

Another impact evaluation study by NABARD (2001) had found that 86% of the members of SHGs belong to the weaker sections . On account of the SHGs-Bank Linkage Programme the value of the assets of the group members had increased by 59%.There was a threefold increase in the average annual savings of each member and doubling of borrowings per annum. Besides, the members had improved their communication, learnt handling problem situations and there was a general increase in the level of self –confidence.

Through these three different SHGs bank linkages models banks are encouraged to make loans to the Self Helf Groups in certain multiples of the accumulated savings of the Self Help Group.The bank loans are given without any collateral and at market interst rates.They continue to decide the terms of loans to their own members. Since, the group own accumulated savings are part and parcel of the aggregate loans made by the group to their members, peer pressure insures timely recovery of loan. In most cases, there is a Self Help Promoting Institution/NGO which enables to the Self Help Groups to function effectively.

Self Help Groups brings about benefits both for the members, for banks and Self Help Groups Promoting Institutions or NGOs as indicated below:

For members:

- Discuss and help each other to solve common problems
- Collect and use own savings to make interest bearing small loans to each other
- Learn basics of financial intermediation
- Learn to appreciate others' needs and their own needs

- Start handling resources of a size much beyond their individual capacities.
- Realising that resources are scares and that have cost
- Learn that repayment is not difficult , with regular saving habit
- Use peer press use as and effective substitute for collateral security
- Win the confidence of the formal banking systemthrough mature financial behavior ,leading to futher access to need based funds

Learn to interact with the external environment in a meaningful way, leading to increase self esteem and confidence for Banks:

- Benefit from reduced transaction costs through economies of credit and

Learn to externalize credit supervision and servicing to the groups themselves

- Benefits from mobilization of small savings through groups , gaining access to low-cost funds
- Accept peer pressure within the Self Help Groups as an excellent substitute for the colleteral securities, leading to more than 95% repayments
- Get timely repayments leading to faster recycling of funds
- Recognize self helf groups as the appropriate medium for expansion of business of rural branches for wider coverage of clients
- Recognize the prospects of ripple effect in quality among their clients
- Building good well among the rural client
- Benefit from refinance facilities from NARBARD for better fund management.

For NGOs:

- Find SHGs as complimentary to their core functions
- Use the synergy of social and economic programmes for better impact on the poor
- Deepen and widen the outreach to the poor through creedit plus approach
- Gain recognition as socio-economic change agents
- Use the avenue for performing financial intemediation in underbanked areas
- Act as meaningful agents between banks and the poor

ISBN: 978-91-987581-0-8

- Perform the role of propagators of innovative financial services delivery approaches

❖ CONCLUSION AND OBSERVATIONS:

It is based on the available evidence and experience about the role of microfinance in poverty alleviation and large scale failure of both state and market to meet the savings, credit and insurance needs of the poor. Micro-financing: Shift from the traditional banking system Micro-financing has turned out to be an effective strategy for formal financing agencies. Group lending minimizes transaction cost and at the same time the members of a group can avail small loans through that group. The chance of mis-utilisation is minimal and there is assured repayment because of peer monitoring by the group. The group concept has enabled the rural poor to develop the savings habit and minimise extravagance. For the SHG members, the system has been found beneficial because of minimal procedural formalities, access to institutional credit without collateral offering, full autonomy in the selection of activity, and the availability of thrift for meeting urgent needs. The skill needed for filling the application forms and the absence of procedural formalities have made the programme customer-friendly. Besides, the flexible repayment schedule enables them to repay as and when it is convenient. The group will see to it that prompt repayment is made, as they are likely to get repeat loans. The micro-sized, supplementary income-generating activities pursued by the members defy the conventional standards of unit cost and unit size prescribed by banks and government departments. The smaller unit size allows women to pursue the activities in their spare time and contribute to the family's income. Right from the mid-eighties of the past century micro-finance has become a key strategy for poverty alleviation and empowerment of women in southern State of India. More than 90 percent of the (SHGs) groups in this region are women groups. In some areas, men groups and mixed groups also exist. There has also been an increase in the flow of funds for micro-enterprises through various promotional agencies. Though NGOs were the forerunners in this field, the early nineties marked a new era for micro-finance programmes in the State with the evolution of the Community Development Society (CDS) model women groups in various part of our country. Further the setting up of the poverty eradication programme of the various State Government has given a boost to the SHG strategy. There is a general tendency to consider SHGs as a panacea for all the ills of the rural community. This is evident from the mushroom growth of self-help groups in the country. In many

cases it has been a blind replication of success models without considering the intricacies involved in group formation and sustainability.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.008

CAUSES OF INCREASING POPULATION IN INDIA

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❖ ABSTRACT:

The total number of people living in a particular area in a particular time is known as the population. It is a summation of all the living organisms of the same group or species which live in a particular area. It includes the demographic and social characteristics like reproduction sex, caste etc.

The size of the population is always changing in response to fertility, mortality and migration. The actual size of the population can be explained on the basis of the particular place and in a particular time. The population is one of the important factors which helps to balance the environment, the population should in a balance with the means and resources. If the population will be balanced, then all the needs and demand of the people can be easily fulfilled, which helps to preserve the environment of the country.

Keywords: *Effect of over population, causes, Higher Risk of Disasters and Pandemics, Solutions, Population Policy.*

❖ INTRODUCTION:

Population Studies is broadly defined as the Scientific Study of human Populations. Major areas Studied include broad population dynamics; Fertility and family dynamics, health, aging and mortality and human capital and labor markets. Researchers in population Studies also focus on methodology. population Studies is an interdisciplinary area of study, Scholars from demography. Epidemiology, Sociology, economics, anthropology and Various other disciplines study populations.

ISBN: 978-91-987581-0-8

❖ POPULATION GROWTH:

is the increase in the number of people in a population. Global human population growth amounts to around 83 million annually or 1.1% per year. The Global Population has grown from 1 billion in 1800 to 7.9 billion in 2020. The UN Projected population to keep growing and estimates have put the total population at 8.6 billion by mid-2030. 9.8 billion by mid 2050 and 11.2 billion by 2100. However some academics out side the UN have increasingly developed human population models that account for additional downward pressures on population growth in such a scenario population would peak before 2100. A Popular estimate of sustainable population is 8 billion people. World human population has been growing since the end of the Black Death. Around the year 1350. A Mix of technological advancement that improved agricultural productivity and sanitation and medical advancement that reduced mortality have caused an exponential population growth. In some geographies, this has slowed through the process called the demographic transition. Where many nations with high standards of living have seen a significant slowing of population growth. This is in direct contrast with less developed contexts, where population growth is still happening. However the global human population is projected to peak during the mid 21st Century and decline by 2100.

Population growth alongside over Consumption is a key driver of environmental concerns, such as biodiversity loss and climate change, due to resource intensive human development that exceed planetary boundaries. International policy focused on mitigating the impact of human population growth is concentrated in the sustainable Development Goals which seek to improve the standard of living globally while reducing the impact of society on the environment.

❖ INDIA'S POPULATION:

The current population growth rate is 1 percent, which means India will add over 13 million people this year. In contrast the death rate is 7.21 per thousand. India's current population is estimated at 1.3 Billion. Nearly 17.7 percent of the world's population lives in India. We are catching up with China whose population is 1.4 Billion and has 18.47 percent of the global population. India is expected to surpass China as the world's most populous nation by 2024.

ISBN: 978-91-987581-0-8

❖ IMPLICATIONS OF POPULATION GROWTH:

India is not growing uniformly The latest National Family Health Survey (NFHS).

- The poorest wealth quintile has a TFR of 3.2 Children per woman.
- The second lowest wealth quintile has a TFR of 2.5 Children per woman.
- The richest wealth quintile has a TFR of 1.5 Children per woman.

This shows that population growth is more concentrated in economically weaker sections of society.
Population growth acts as a hurdle in addressing effectively the problem of poverty. Hunger and malnutrition and also in providing the better quality of health and education.

❖ CAUSES OF INCREASING POPULATION:

The two main common causes leading to over population in India

1) The Birth rate is still higher than the death rate.We have been successful in declining the death rates but the same cannot be said for birth rates.
2) The fertility rate due to the population policies and other measures has been falling but even then it is much higher compared to other countries.

The above two causes are interrelated to the various social issues in our Country which are leading to over population.

1) Early marriage and universal marriage system.

Even though the marriageable age of a girl is legally 18 years. The concept of early marriage still prevails. Getting married at a young age prolongs the child bearing age. Also in India marriage is a sacred obligation and a universal practice, where almost every woman is married at the reproductive age.

2) Poverty and Illiteracy

Another factor for the rapid growth of population is poverty impoverished families have this notion that more the number of members in the family, more will be the numbers to earn income. Some fell that more children are needed to look after them in their old age. Also hunger can be cause of death of their children and hence the need for more

ISBN: 978-91-987581-0-8

children. Strange but true, Indian still lags behind the use of contraceptives and birth control methods. Many of them are not willing to discuss or are totally unaware about them illiteracy is thus another cause of over population.

3) Age old Cultural norm

Sons are the bread earners of the families in India. This age old thought puts considerable pressure on the parents to produce children till a male child is born.

4) Illegal Migration

Last but not the least. We cannot ignore the fact that illegal migration is continuously taking place from Bangladesh and Nepal is leading to increased population density

❖ CONTROL OF INCREASING POPULATION:

Social measurs

1. Minimum age of marriage
2. Raising the status of woman
3. Spread of education
4. Adopt orphan children
5. Social security schemes

Economic measures

1. More employment opportunities
2. Providing incentives

Other measures

1. Medical Facilities
2. Spreading awareness

❖ CONCLUSION:

Rapid population growth is detrimental to achieving economic and social progress and to sustainable management of the natural resource base. But there remains a sizeable gap between the private and social interest in fertility reduction and this gap needs to be narrowed policies and programs that influence health, education, the status of women and the economic value of children in turn influence attitudes toward childbearing family planning and people's ability to control family size. Efforts to reduce fertility through explicit population policies, therefore should be integrated with policies to improve health, education and the status of women.

ISBN: 978-91-987581-0-8

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.009

POPULATION EXPLOSION AND ITS IMPACT ON ENVIRONMENT IN INDIAN SCENARIO

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❖ ABSTRACT:

In the past, population growth was to some extent limited due to death of children and short life span. But now a days population explosion, i.e. a rapid increase of human population is putting an incredible strain on the environment. While developed countries continue to pollute the environment and deplete its resources, developing countries are also damaging as well due to compliance of their industrial advancements and economical development. India is facing the problem of population explosion accompanied with environmental degradations such as deforestation, loss of biodiversity, air and water pollution, water crisis, land degradation etc. Unsustainable use of environmental resources by a section of the poor people to meet their livelihood is notably observed. Poverty may be one of the common causes of population explosion and environmental degradation. Proper socioeconomic status of the population must be maintained to restrict the exploitation of environmental resources. So, everyone should aware about the problem of unsustainable population growth associated with the environmental degradation.

Keywords*: Population explosion, environmental degradation, poverty, India*

❖ INTRODUCTION:

A population is defined as a group of individuals of the same species living and interbreeding within a given area. Members of a population often rely on the same resources, are subject to similar environmental constraints, and depend on the availability of other members to persist

ISBN: 978-91-987581-0-8

over time. Demography is the study of the characteristics of populations. It provides a mathematical description of how those characteristics change over time. Demographics can include any statistical factors that influence population growth or decline, but several parameters are particularly important such as population size, density, age structure, fecundity (birth rates), mortality (death rates), and sex ratio (Dodge 2006). Large populations experience their own problems. As they approach the maximum sustainable population size, known as carrying capacity, large populations show characteristic behaviour. Populations nearing their carrying capacity experience greater competition for resources. Between 1959 and 2000, the world's population increased from 2.5 billion to 6.1 billion people. According to United Nations projections, the world population will be between 7.9 billion and 10.9 billion by 2050.

❖ TRENDS OF POPULATION GROWTH IN INDIA:

India, being a vast fertile country, situated in the southern-part of Asia. India is one of the oldest civilizations in the world, with a rich heritage and myriad attractions. The great urban culture of the Indus valley civilization, a society of the Indus River valley that is thought to have been Dravidian speaking, prospered around 2500 BCE. Population growth rate is the average exponential rate of growth of the population over a given period. It is expressed as a percentage. High fertility has been observed in many developing regions, coupled with low fertility in more-developed regions.80 percent of the global population now lives in less-developed nations. The combination of a continuing high birth rate and a low death rate is creating a rapid population increase in many countries in Asia, Latin America and Africa and people generally lived longer.

The first registered population census in India was conducted by British periodically from 1865, then in 1881 onward to the year 1947. Since from independence in 1947, a census has been conducted every 10 years, and the first census by Ministry of Home Affairs happened in 1951. The Indian population in 2021 is estimated to be 1.39 Billion (139 Crores), According to Unique Identification Aadhar India, updated December 2020, by mid of year 2020 the projected population is 1,370,508,600. With roughly one-sixth of the world's total population, India is the second most populous country, after China and US is the third populous country in the world. India is projected to be the world's most populous country by 2024, surpassing the population of China. It is expected to home to more than 1.5 billion people by 2030 with the current birth rate of 1 person per second and death rate every 1 person per 3 seconds and migrant rate every

ISBN: 978-91-987581-0-8

1 person per 2 seconds. Population explosion, which refers to the rapid and dramatic rise in population, is a major problem of India.

Migration is one of the major reasons of population explosion. Much of human migration follows a rural-to-urban pattern, and, as a result, the Earth's population is also increasingly urbanized. Population growth is the primary force producing large urban centres in developing countries. Only one-third of the world's population lived in cities in 1960. By 1999, the percentage had increased to nearly half (47 percent). The areas of rapid growth of population continue to be associated with net in-migration resulting from:

1) The development of manufacturing industries, mining, trade, and miscellaneous services, all leading to acceleration in the process of urbanization,
2) The development of irrigation and reclamation of land bringing about increased intensity and extension in farming, and
3) Infiltration from neighbouring countries, particularly from Bangladesh.

❖ ENVIRONMENTAL CHALLENGES DUE TO POPULATION EXPLOSION:

Population growth presents problems with respect to employment opportunities. The predicted flood of manpower cannot be totally absorbed by the organized sector; it is argued that the agricultural sector is the only one which can help the country during this period of high population growth. To support this large and rising population, India will need to rapidly increase its average crop yields 2-3 times the present level for a modest improvement process. The expected population growth will also have consequences on environmental deterioration and water supply contamination. The distribution of people around the globe has three main implications for the environment.

i) As less-developed regions cope with a growing share of population, pressures intensify on already dwindling resources within these areas.
ii) Migration shifts relative pressures exerted on local environments, easing the strain in some areas and increasing it in others.

ISBN: 978-91-987581-0-8

iii) Urbanization, particularly in less-developed regions, frequently outpaces the development of infrastructure and environmental regulations, often resulting in high levels of pollution.

The utilization, overuse and misuse of physical resources (land, air, water, soil and minerals) increased manifold due to the growth of human population. So, population explosion may lead to following environmental degradations -

❖ DEFORESTATION:

Forests are an important natural resource of India. They have moderate influence against floods and thus they protect the soil erosion. Forests also play an important role in enhancing the quality of environment by influencing the ecological balance and life support system (checking soil erosion, maintaining soil fertility, conserving water, regulating water cycles and floods, balancing carbon dioxide and oxygen content in atmosphere etc. The total forest cover in India (2021) is **7,12,249** square kilometres which is **21.67%** of the total geographical area. India has added 3,976 sq km of forest cover from 2017 to 2019. The status of forest cover in India (2021) is as follows-

Types of forest cover	Description	Percentage of total geographical area (%)	Area (Square Kilometre)
Very dense forest	All lands with tree canopy density of 70% and above.	3.02	99,278
Moderately dense forest	All lands with tree canopy density of 40% and more but less than 70%.	9.39	3,08,472
Open forest	All lands with tree canopy density of 10% and more but less than 40%.	9.26	3,04,499
Scrub	Degraded forest lands with canopy density less than 10%.	1.41	46,297

Source:https://geographyhost.com/forest-cover-in-india-important-statistics/

As the population grows, more and more forests are cleared. The two most common reasons for deforestation are to make houses for increased number of people to live in, and to use wood as a fuel in the industries. Rapid industrialization, urbanization and over-exploitation have resulted not only in decline but also in permanent loss of forest cover to an alarming rate. The major driver behind all these factors is the uncontrolled

ISBN: 978-91-987581-0-8

population growth of humans which leads to the dramatic increase in the demand for wood and forest products.

According to UN Food and Agricultural Organization (FAO), deforestation is the conversion of forest to another land use or the long-term reduction of tree canopy cover below the 10% threshold. Forest areas around the world are majorly cleared for agriculture, logging, mining and large-scale developmental projects. The loss of forest cover happens for many purposes:

1. To clear space for the production of crops like wheat, maize etc.
2. To create a grazing pasture for animals reared to fulfil the rising demand for meat.
3. For logging purposes, i.e., to meet the demand for wooden products like furniture or the production of charcoal.
4. For mining purposes, as most of the precious resources like Oil, gold, diamond, copper etc are found in and around forests.

The common disturbances that were being observed during the field survey (2017–2019) include fire, grazing, fuel wood collection, forage removal, litter collection, collection of Non-Timber Forest Products (NTFPs), lopping, thatch collection, root collection, soil removal, etc. The forest's canopy cover plays a major role in regulating the global climate, with a carbon sink capacity of around 90-140 billion metric tons. With the current deforestation trends, the release of even the smallest portion can lead to acceleration in global warming.

❖ LOSS OF BIODIVERSITY:

`Rapid population growth also causes intangible damage like climate change, which is yet another important factor behind the deteriorating biodiversity & ecosystems.

`The chemicals used in the mining process also degrade the quality of soil and ends up in water bodies, polluting them and harming the riverine ecosystems. To meet the growing demands, agricultural expansion happened, terrestrial land use was changed. Almost 50 per cent of the global land area is used for agriculture, causing an estimated 80 per cent extinction threat to animal and bird species.

❖ AIR AND WATER POLLUTION:

Air pollution is not the only environmental damage being done by the increasing population. Now a days, water pollution is also one of the increasing problems due to the population explosion. Water is considered the essence of life. As in the case of air pollution, the increasing

population calls for increasing numbers of factories. These factories lead to various kinds of pollution, including water pollution. Also, India being an agrarian country, the water pollution also comes from pesticides used for agriculture. The increased population size is leading to increased pollution, which in turn is leading to a more hostile environment for human beings themselves.

❖ WATER CRISIS

India is suffering from one of the world's worst national water crises. In fact, it is considered the centre of the global water and sanitation crisis. More than 50% of the Indian population has no access to safe drinking water and about 200,000 people die every year for lack of access to safe water. While India's aquifers are currently associated with replenishing sources, the country is also a major grain producer with a great need for water to support the commodity. As with all countries with large agricultural output, excess water consumption for food production depletes the overall water table. Many rural communities in India who are situated on the outskirts of urban sprawl also have little choice but to drill wells to access groundwater sources.

India's water crisis is often attributed to lack of government planning, increased corporate privatization, industrial and human waste and government corruption. The 2018 Composite Water Management Index (CWMI) noted that 6% of economic GDP will be lost by 2050, while water demand will exceed the available supply by 2030. In addition, water scarcity in India is expected to worsen as the overall population is expected to increase to 1.6 billion by year 2050. To that end, global water scarcity is expected to become a leading cause of national political conflict in the future, and the prognosis for India is no different.

❖ LAND DEGRADATION

The land serves as storage for water and nutrients required for plants and other living micro-macro-organisms. The demand for food, energy and other human requirements depends upon the preservation and improvement of the productivity of land. The loss of arable land has been caused by a number of factors, many or most of which are tied to human development. The primary causes are deforestation, overexploitation for fuel wood, overgrazing, agricultural activities and industrialization. On the global basis, the soil degradation is caused primarily by overgrazing (35%), agricultural activities (28%), deforestation (30%), over exploitation of land to produce fuel-wood (7%), and industrialization (4%). Over the

ISBN: 978-91-987581-0-8

past fifty years, while India's total population increased by about 3 times, the total area of land under cultivation increased by only 20.27 percent from 118.75 million hectares in 1951 to 142.82 million hectares in 2001. Most of this expansion has taken place at the expense of forest and grazing land. Despite past expansion of the area under cultivation, less agricultural land is available to feed each person in India.

The spread of green revolution has been accompanied by over exploitation of land and water resources and use of fertilizers and pesticides have increased many folds. The extent of agricultural intensification and extensification is characterized by an increase in cropping and irrigation intensity and higher use of chemical fertilizers, pesticides and insecticides. The process of agricultural extensification and intensification is leading to land degradation, overexploitation of underground water resources, increased use of chemical fertilizers leading to eutrophication and water pollution. Due to the increasing cropping intensity, irrigation intensity and excessive use of chemical fertilizers, agricultural intensification results in water logging, salinization and alkalinization of croplands and eutrophication of water bodies and ill health of oceans and thus leads to reduction in biodiversity.

❖ POVERTY AND ENVIRONMENTAL DEGRADATION

The outcomes of high population growth rates are increasing number of people below poverty line, an increasing population density, and pressure on natural resources. The country's population growth and poverty are imposing an increasing burden on the country's limited and continually degrading natural resource base. The natural resources are under increasing strain, even though the majority of people survive at subsistence level. Human population growth leads to a decrease in per capita income growth, which tends to lead to an increase in poverty, which is in turn linked to poaching. It is a vicious cycle.

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Figure 1: Relationship between poverty and environmental degradation

Poverty is amongst the consequences of population growth and its life style play major role in depleting the environment. Poor people are forced to degrade forest resources to meet their fuel demands for cooking or for earning livelihood for their survival. The unequal distribution of resources and limited opportunities cause push and pull factor for people living below poverty line that in turn overburdened the population density in urban areas and environment get manipulated by manifolds, consequently, urban slums are developed in urban areas.

Currently, about 60 per cent or an estimated 812 million people of India live below the poverty line and if the population growth rate is not arrested or abated even now, the problem may wreck the country's social fabric, increasing the level of unemployment and under-employment even more and further affect the benefits of economic development being imparted to people at the lower strata.

❖ CONCLUSION:

Mahatma Gandhi once said, “The world has enough for everyone's need, but not enough for everyone's greed.” Only through sustainable living, sustainable development and sustainable population growth people can combat the threat and save the planet. Over the years, most of the governments have taken various steps to control the tremendous

ISBN: 978-91-987581-0-8

population growth. However, despite their efforts; the growth rate has accelerated tremendously. Sterilisation and other methods dealing with the issue do not found to be effective as a whole. The real and better solution lies in spreading awareness among people only by changing their attitudes and habits which has been deep rooted in their minds, attitudes and values. It should be known that population control will not come to an end of all the environmental problems, but it will minimise to some extent to eradicate such problems.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.010

SKILL DEVELOPMENT IN INDIA: NEED, CHALLENGES AND WAYS FORWARD

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❖ ABSTRACT:

skill of the Indian workforce in the age group of 15-59 and which was found to extremely low i.e. around 38% of the workforce are not even literate, 25% are having below primary Globalization, knowledge and competition have intensified the need for highly skilled workforce in both the developing and developed nations as it enables them to accelerate their growth rate towards higher trajectory. For Indiaor up-to primary level of education and remaining 36% has an education level of middle and higher level whereas only 10% of the workforce is vocationally trained (with 2% formal and 8% informal training). The study also found that both the Government and its partner agencies have undertaken various measures/initiatives for the effective implementation of the skill development system in the economy, but still development is critical from both socio-economic and demographic point of view. Therefore, the present paper attempts to study the present skill capacity, challenges in front of skill development initiatives in India along with their solutions. The skill capacity has been assessed in the form of general education and vocational training level faces a number of unresolved issues/challenges that need immediate attention of the policy makers. Hence, skill development initiatives of the government should focus on these obstacles and develop the programs accordingly to resolve these hurdles for the complete success of the skill development initiatives.

Keywords: *Skills Capacity; Challenges; Ways Forward; India*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

Globalization, knowledge and competition have intensified the need for highly skilled workforce in both the developing and developed nations as it enables them to accelerate the growth rate of their economy towards higher trajectory. Today all economies need skilled workforce so as to meet global standards of quality, to increase their foreign trade, to bring advanced technologies to their domestic industries and to boost their industrial and economic development. Thus, skills and knowledge becomes the major driving force of socio-economic growth and development for any country. As it has been observed that countries with highly skilled human capital tend to have higher GDP and per capita income levels and they adjust more effectively to the challenges and opportunities of the world of work.

For India, skill development is also critical from both socio-economic and demographic point of view. For the economy to grow at 8% to 9%, with the targeted growth rate of 10% for secondary, 11% for tertiary and 4% for agriculture sectors, a multi-faceted and highly efficient skill development system is imperative. Further, India is destined to be a contributor to the global workforce pool on account of demographic bonus, with the growth rate of higher working age population as compared to its total population and home to the second largest population (with a headcount of around 1.4 billion by 2025) in the world with distinct advantage of having the youngest population with an average age of 29 years as against the average age of 37 years in China and the US and 45 years in Western Europe (FICCI, 2014).

The broad objectives of the present paper are to study the present skill capacity, the various challenges in the development of effective skill system along with their ways forward for the success of skill development initiatives in Indian context. In order to this, the study is divided into the following sections: Section-II discuss the data and methodological issues; Section-III depicts the findings pertaining to present skill capacity, challenges and ways forward for the success of effective skill development programs in India and Section–IV conclude the study

❖ OBJECTIVES OF THE STUDY

1. To study the present skill capacity of India.
2. To study the challenges faced by skill development system in India.
3. To suggest possible solutions or ways forward.

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❖ DATA AND METHODOLOGY:

The proposed study mainly is descriptive in nature. It solemnly based on secondary data and information which is collected from the concerned sources as per need of the research. The relevant books, documents of various ministries/departments and organizations, articles, papers and web-sites are used in this study.

❖ FINDINGS / RESULITS:

India's transition to one of the largest and fastest growing global economies during the last decade has been a remarkable phenomenon. In order to sustain its growth trajectory, an efficient and continuous system of skill development for its workforce is critically imperative for India. Therefore, this section is devoted to portray the current skill capacity of India; the major challenges in the successful implementation of skill development initiatives along with their way outs or suggestions.

❖ PRESENT SCENARIO OF SKILL CAPACITY OF INDIA:

In order to capitalize the demographic dividend, India will need to empower its workers with the right type of skills. Thus this section depicts the present skill levels of the Indian workforce in the age group of 15-59 years in the form of their general educational levels and vocational training levels.

- The drop-out rates of educational institution was estimated to be 50% in the age group of 5-14 years and86% after 15 years of age and in contrast to this the participation rate of the workforce rises rapidly after 14 years of age and it results in a semi-literate workforce which finds it difficult to absorb higher form of skills.
- 38% of Indian workforce is illiterate, 25% has education below primary or up to primary level and remaining 36%has an education level of middle and higher level.
- 80% of Indian workforce does not possess any marketable skills.
- Only about 2% have received formal vocational training and 8% non-formal vocational training, thereby implying that very few new entrants to the work force have any marketable skills as compared to developed economies such as Korea (96%), Germany (75%), Japan (80%) and United Kingdom (68%). In-nutshell, it can be said that despite making considerable progress in terms of literacy, high incidence of illiteracy cripples the Indian workforce

even today. The above facts are a stark reminder that India's demographic dividend can rapidly convert into a demographic nightmare if skills are not provided to both new and existing workforce. Thus, there is a need for increasing capacity and capability of skill development programs.

- **Demand & Supply Mismatch:** The demand made by the industries and supply of labour-force mismatch leads to aggravate all types of skill development initiatives of the Government and its partner agencies as:

➢ The number of people formally trained in a year is only 1,100,000 by Ministry of Labour and Employment and approximately 3,200,000 trained by 17 other central government ministries.

- **Geographical Problem:** It is another serious problem plaguing the labor market and has a more serious impact in larger economies like India as the geographical set-up or outreach of the people for skills in India are uneven and in dismal share:

➢ The states with much higher economic growth rates have more new jobs with lower rate of labour-force while on the other hand; the states with slower economic growth rates have higher population growth rates with fewer new jobs. Thus laggard states need to rely on migrant workers so as to cope with this challenge.

➢ Majority of formal institutions are located in urban areas as compared to rural areas and even private sector institutions are also reluctant to operate in rural areas. Hence, large proportions of rural population do not have any formal vocational training institutions.

➢ Districts notified as backward have serious paucity of formal skill training as majority of skill development institutions in these locations emphasized only on basic livelihood skills and that is generally provided by NGOs or provided by other agencies as a part of social development programs. Therefore, these types of skills are often not formally assessed and as a result are not recognized for employment by industrial sectors.

- **Way forward:** Thus an ideal scenario is one in which supply of labour can be transformed into skilled workforce which is easily absorbed by the industrial-sectors. However, in India a small portion of labour force is actually undergoing for formal training.

ISBN: 978-91-987581-0-8

It has been observed that there are more people than the available jobs at the low skills level, while there are more jobs at the high skills level than those available for such jobs. This demand and supply mismatch indicates that there is a serious mismatch between the education and skills that the youth attain and what the labor market demands. Therefore, in order to create a people-centric approach for skill development, it is required that the skill development initiatives needs to be coordinated with demand and supply scenarios across geographies, industries and labour markets so that new skills required by industry or changes in supply of labour are speedily adjusted with adequate and efficient training programs.

- **Vocational Training:** India is progressively moving towards knowledge economy, where skills are widely recognized as the important lever of economic growth, but the perception about vocational education is still doubtful i.e. it is generally meant for those who fail to get admission in the formal system. Thus, it still need time to be considered as a viable alternative to formal education.

- As it was observed in India, around 90% of the jobs are skill-based i.e. they require some sort of vocational training whereas in reality only 2% of the population (in 15-25 years age group) enrolled for vocational training in India as compared to 80% inEurope and 60% in East Asian countries.

- The current capacity of vocational training is 31 lakh against an estimated annual capacity of 128 lakh workers whereas the overall national target of skilling is 50 corer of workers by 2022 i.e. India needs to impart vocational training to at least 300–350 million people by 2022 which is significantly lower than the government target of 500 million.

- Moreover, the private sector provide skill training as required by service sector mainly to educated youth (especially 12thpass) and largely in urban regions. Ultimately, hundreds of workers in unorganized sector do not get any kind of skill training which results in low productivity levels and employability gaps among majority of workforce.

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- Due to lack of awareness about industrial requirements and the availability of matching vocational courses, most of the prospective students in the country do not go for vocational education.

- **Skill development for women:** In India, women also form an integral and substantial part of the workforce; but the working percentage rate of women in total labor force is declining.
- The share of women workforce (between 25-54 years of age) is about 30% in 2010 as against 39% in 2000, which is quite below as compared to 82% in China and 72% in Brazil. All it depict the under-representation of women in the workforce and results in the wastage of the demographic dividend to India.

- **Private sector participation:** The current situation in respect to the participation of the private sector is as follows:
- The private sector is not involved adequately in curriculum development and policy formulation related to educational and vocational training.

- Mostly private sector institutes are located in urban areas therefore rural population remains lags behind. Furthermore, due to high cost of these institutes the weaker or disadvantaged section also unable to get proper skill training.

- **Multiplicity of Institutional Framework:** Over the past few decades, India has witnessed significant progress in the skill development landscape as various types of organizations have been set up both at national and at state level.

- Around 17 ministries,2 national-level agencies, several sector skill councils, 35 state skill development missions and several trade and industry bodies comes forward with a view to push the national skill development agenda.

- Given this mind-bogglingly complex institutional setup with overlapping and conflicting priorities and little co-ordination and standardization ultimately resulted in fragmented outcomes with limited impact.

- **Informal & Formal Sector Skill-Gap:** As the Government of India has set a target to impart the necessary skills to 500 million

ISBN: 978-91-987581-0-8

people by 2022 in the Twelfth Five Year Plan, whereas in reality the country is facing a significant skilled manpower challenge over the next decade.

- In India, around 12 million people are expected to join the workforce every year whereas the current total training capacity of the country is around 4.3 million, thereby depriving around 64% entrants of the opportunity of formal skill development every year.
- Furthermore, out of approximately 0.4 million engineering students graduating every year in India, only 20% are readily employable.
- Around 93% of the Indian workforce is employed in the unorganized or informal sector, which lacks any kind of formal skill development training.
- Barely 2.5% of the unorganized workforce reportedly undergoes formal skill development in comparison to 11%of organized sector.
- In addition, only around 12.5%and 10.4% of the workforce in the unorganized and organized sectors, respectively, undergoes informal skill development. This indicates that around 85% of the work force in the unorganized sector d

- **Infrastructure Challenge:** One of the important requirements for the proper implementation of the skill and training development programs is the availability of the basic infrastructure for the same. It has been noticed that many skill development institutions suffer from lack of proper infrastruc

planning for skill development initiatives which incorporates local employment demand and skill requirements. Thus, it is imperative for the success of skill development system that market institutions work efficiently and well connected with educational and vocational training institutions. As the main objective of education and vocational training is employment. Therefore educational and vocational system has to be linked to the job market in such a way that it must be competent to provide relevant information about the growing employment opportunities, types of skills required by different jobs, and where and how the skills can be acquired. And this will ultimately lead to enhance the socio-economic relevance of education and vocational training along with strengthening the performance of the market institutions in the economy.

ISBN: 978-91-987581-0-8

❖ CONCLUSION:

To make India internationally competitive and to boost its economic growth further, a skilled workforce is essential. As more and more India moves towards the Knowledge economy, it becomes increasingly important for it to focus on advancement of the skills and these skills have to be relevant to the emerging economic environmentdemographic dividend, an efficient skill development

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.011

GENDER DIMENSION DEVELOPMENT IN INDIA: EMPOWERING WOMEN THROUGH THE VARIOUS EDUCATIONAL SCHEMES IMPLEMENTED BY THE GOVERNMENT OF INDIA

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❖ ABSTRACT:

Education not only makes women literate but it also acts as a tool for their empowerment. But In Indian society, basically in rural areas women are not getting the chance to attend any educational institutions. In traditional Indian society, sons are always considered as assets whereas, girls are considered as liability. So, spending money on their education is not considered as priority. They are only seen as a good daughter, a good mother or a good homemaker. Therefore, attending schools or getting education is also not possible for them due to the prevalence of various age old existing social evils, beliefs, taboos, religious faiths and so on. If they attend school or spend their time to get education, then who will look after the household chores? Moreover, if they become literate they might have been taking parts in various activities outside their homes or might have been asking questions regarding the existing patriarchy which are not at all considered to be "good". This will be considered as an 'immoral' act or a great 'sin'. In other words, they should be only a silent listener and should pay their full attention towards daily chores at home. But women can play a very important role in the upliftment of socio-economic development of a nation. So, it is very important for the government to consider education for female folk as a national issue and should spend fund on them to make them educationally empowered so to make India a true democratic country in reality. In this paper, the researcher wants to bring forth the various educational schemes for girl child as implemented by the Indian government for their empowerment.

Keywords*: Education, women, patriarchy, literate, empowered*

ISBN: 978-91-987581-0-8

❖ INTRODUCTION:

"Be self-reliant, be industrious
Work, gather wisdom and riches
All gets lost without knowledge
We become animal without wisdom
Sit idle no more, go, get education."
(Go, Get Education- Savitri Bai Phule)

Women empowerment is a debatable topic of today's global world. In vedic period, women of India got equal status with that of men and thus this period produced scholars like Ghosha, Lopamudra, Maitreyi and Gargi. They were the epitomes of intellectual and spiritual attainments. But in the modern days, women have to fight for their various rights including educational right; most of the times, they are subjected to discrimination and violence in terms of their gender.

The Indian constitution has given utmost importance to provide equal status and opportunities for both men and women since it has been penned down. There are various Articles, Clauses, etc. in the constitution that clearly states about the provisions for equality among all the citizens of India as well as support for the weaker section of society which includes women, children, differently-abled persons, Scheduled Tribes (STs) and Scheduled Castes (SCs). For instance, the Article 14 of the Indian constitution grants all citizens equality before the law of the land. Article 15 states that the state shall not discriminate against any citizen on the ground of religion, caste, sex, etc. Again, Article 16 states that there should be equality of opportunity in matters of public employment irrespective of sex, religion, caste etc. Article 45 is upon the provision for free and compulsory education for children until they complete the age of fourteen years. Article 46 is on the promotion of educational and economic interests of the STs and the SCs and other weaker sections of the society.

Thus, it has been seen that the Government of India has been trying to support and give a good life to all its citizens, especially, the weaker section as mentioned above. So, women should be provided equal opportunities and education regardless of their caste, religion, etc. at par with men. Though these provisions are there in the constitution, but due to the weak economic base of our Indian society, parents prefer not to send their children, especially, their daughters to school. Instead, they would prefer either to send them to do manual labour so to earn little money or to sit for child marriage. Thus, The Right of Children to Free and

ISBN: 978-91-987581-0-8

Compulsory Education Act or Right to Education Act (RTE), 2009 aims to provide free and compulsory education for children between the age group of 6 to 14 years under Article 21A of the Indian Constitution. It aims to give education to all children of India irrespective of caste, creed, sex, religion, etc. under this particular age group. But in reality, it has been seen that for a girl child this 'free' and 'compulsory' education is like a distant dream to be achieved. From time to time the Indian government has been trying to formulate various effective educational policies, schemes, reforms, reservation, etc. to make their condition or status better in Indian society. But various statistical surveys show that these initiatives have failed to give a chance to access for girls to get enrollment in schools or to pursue for higher education. As a consequence, women are subjected to child marriage, child labour, rape, murder, molestation and so on or have to sit on the pavements for begging.

The Census Report, 2011 shows that women are lagging behind as far as literacy rates are concerned (Male-82.14%, Female-65.46%). Again, according to National Family Health Survey (NFHS-5) male literacy at India level in 2021 stands at 84.4% and female literacy stands at 71.5%. There may be various reasons in this male-female gap in literacy rates. In India, under the influence of patriarchy, the birth of a boy child is very welcoming with grand celebrations and merry- making gatherings. He is like an asset for the family and a lot of money has been spent on his upbringing. Whereas, a girl child is seen as a burden on the family and thus gets least importance regarding the expenses on her upbringing like rearing, health, education, etc. Moreover, most of the important decisions have been taken by a male member of the family. On the other hand, a female member is always thought to be good at taking care of the family members, begetting children as well as rearing them. Thus, her status is subordinated to that of a man in every aspect in the society. But as we know that a society is consisted of both man and woman. The growth of a nation equally lies on the hands of both of them. Thus, she should be given equal opportunities and status so to bring prosperity not only to the society but for the whole of the nation. Thereby, the various educational policies of India have given the priority to provide education to female folk so to change the age old tradition of 'abla nari' to an empowered woman.

❖ EDUCATION IN INDIA CONCERNING WOMEN EMPOWERMENT:

Before the independence of India, there were glorious examples of people who encouraged and fought hard for female education which could

bring dignity and respect for them. Among them, Savitribai Phule (1831-1897), the first lady teacher of India had made a tremendous revolution against the caste system of India as well as for the upliftment of women education. Chandraprabha Saikiani (1901-1972), brought a historic change regarding female education in Assam. Besides, Indira Miri (1910-2004), popularly known as Mereng had put her effort in promoting education in the North East Frontier Agency (NEFA).

After getting the independence from the British rule on August 15, 1947 Indian government got the chance to mould educational policies according to the needs and aspirations of its citizens. Since then, Education Department in the Centre has developed in a full-fledged Ministry under the Central Government. The setting up of the University Education Commission which is popularly known as the 'Radhakrishnan Commission' in 1948 was a major landmark to set goals and objectives for higher education in India. It was the first education commission of independent India. Along with its various aims of education, it has given due priority to women education also and thus it stated: 'There cannot be educated people without educated women'. After that the Secondary Education Commission was appointed by the Government of India on September 23, 1952 under the Chairmanship of Dr. A.L. Swamy Mudaliar which is popularly known as the 'Mudaliar Commission'. The main aim of this Commission was to study deeply the various problems of secondary education and to suggest measures for reforms on aims of education, teaching arrangements, the relationship of secondary education with primary and higher education and so on. For girl's education, it had provided same education as for the boys through co-education but there should be provision of home science teaching for girls. It has also recommended for opening of girls' schools in the areas where required. Then in the year 1964 the Government of India appointed an Education Commission under the Chairmanship of Dr. D.S. Kothari which is popularly known as the 'Kothari Commission'. The basic priority of this commission was on the progress of the nation with the means of education. Thus, the Education Commission opened its report as: *'the destiny of India is now being shaped in her classrooms. This, we believe, is no more rhetoric. In a world based on science and technology, it is education, that determines the level of prosperity, welfare and security of the people'.* The National Policy on Education (NPE), 1986 recognised the empowerment of women is possibly the most critical precondition for the participation of girls and women in the educational process. The main features of the implementation strategy on women has consisted of, 'to

ISBN: 978-91-987581-0-8

gear up entire education system to play a positive interventionist role in the empowerment of women; to encourage educational institutions to take up active programme to enhance women's status and further women's development in all sectors; to widen women's access to vocational, technical and professional education at all levels'. Following this policy, there came up Mahila Samakhya programme in 1988 which recognized that education can be an effective tool for women's empowerment. Besides, prior to these recommendations, educational panel of the Planning commission recommended on July 1957 that, 'A suitable committee should be appointed to go into various aspects of the question relating to the nature of education for girls at the elementary, secondary and higher stages and to examine whether the present system was helping them to lead a happier and useful life'. Thus, the Government of India appointed the national committee on women's education under the Chairmanship of Smt. Durgabai Deshmukh. Moreover, the National Council of Women was established in 1958 to ensure the equal rights of women in society. Its major concern has been on promoting women's education in India along with socio-economic empowerment.

❖ PRIMARY EDUCATION IN INDIA:

The Sarva Shiksha Abhiyan (SSA) is a flagship programme of Government of India for the achievement of Universalization of Elementary Education (UEE) in a time bound manner. It is being implemented in partnership with State Government to cover the entire country and address the needs of 192 million children in 1.1 million habitations. It was launched in 2001-2002 with the aim to provide useful and relevant elementary education to all children in 6 to 14 age group by 2010. It has a special focus on girl's education. In the Manual for Planning for Appraisal (2004) it has been surveyed that majority of girls, especially adolescent girls, are deprived of education owing to various factors such as distance to schools, domestic chores, sibling cares and so on. So, the role of SSA has been found immense as it not only focuses on girl's education but also to ensure the availability of primary schools within one kilometer of the habitation of residence of children and upper primary schools within three kilometers of the habitation. In addition, in 2003 the National Programme for Education of Girls at Elementary Level (NPEGEL) was launched and implemented in Educationally Backward Blocks (EBB) to address the needs of girls who are 'in' and 'out' of school. It has given importance on the prevention of girls from dropping out of schools at primary level. It follows up on girls' enrolment,

attendance and learning achievement by involving village level women's and community groups. Beside this, the Kasturba Gandhi Balika Vidyalayas have been set up in 2004 in educationally backward blocks where schools are at great distances and is a challenge to the security of girls which often compel them to discontinue their education. These are residential upper primary schools for girls where 75% is reserved for Scheduled Castes (SCs), Scheduled Tribes (STs), Other Backward Classes (OBC) and other minor communities and 25% is for the girls from the Below Poverty Line (BPL) families.

❖ SECONDARY EDUCATION IN INDIA:

As SSA has taken the responsibility of elementary education, Rashtra Madhyamik Shiksha Abhiyan (RMSA) has come up as a flagship scheme of Government of India in 2009 to enhance access to secondary education with quality improvement and equity. In its revised programme in 2013, it has given emphasis on the Girls Hostel Scheme and National Incentive to Girls specially to encourage girls in secondary level of education.

❖ HIGHER EDUCATION IN INDIA:

India has occupied world's third position in higher education system after China and the United States of America. The Rashtriya Uchchatar Shiksha Abhiyan (RUSA) is a centrally sponsored scheme, launched in 2013 to provide strategic funding to eligible State higher educational institutions to improve their quality of education and delivery of services to students. It has also taken a number of steps to promote women's education like opening of women colleges in states like Jammu and Kashmir, Himachal Pradesh, Manipur, etc. as well as creation of women's universities across the country to facilitate higher studies to women.

❖ BETI BACHAO BETI PADHAO (BBBP):

Beti Bachao, Beti Padhao (Save girl child, educate girl child) is a Central Government Sponsered Scheme by GOI. This scheme was launched on 22 January 2015 with the tagline 'The Happiness of a Nation lies in the Dignity of its Daughters' with the overall goal of the scheme to celebrate the girl child and enable her education. It was launched by honourable Prime Minister, Narendra Modi from Panipat, Haryana on the occasion of International Day of the Girl Child as a mark for the eradication of female foeticide against the issue of declining Child Sex

ISBN: 978-91-987581-0-8

Ratio (CSR) in India. It acts as a campaign of the Government of India that aims to generate awareness and improve the efficiency of welfare services intended for girls in India. Under this scheme there is an additional scheme, namely, Sukanya Samriddhi Account which encourages parents to build a fund for the future education and marriage expenses for their female child. This account can be opened at any Indian Post office or branch of authorized commercial banks.

❖ UDAAN: A PROGRAMME TO GIVE WINGS TO GIRL STUDENTS:

It is a project launched by Central Board of Secondary Education (CBSE) under guidance of Ministry of Human Resource Development (MHRD). It was launched to address the low enrolment of girl students in prestigious engineering institutions and engineering entrance examination. It is going to provide a platform for empowerment of girl students and will provide better learning opportunities for them. It will be acting like a support for the deserving girl students to pursue higher education in engineering programmes and would assist them to prepare for IIT-JEE examinations to crack through to the best technological institutes in the country while they would be in 11^{th} and 12^{th} standards.

❖ SAINIK SCHOOLS:

The Sainik School was established in 1961 by V.K. Krishna Menon, the then Defence Minister of India to rectify the regional and class imbalance amongst the officer cadre of the Indian Military and to prepare male students mentally and physically for entry into the National Defence Academy (NDA) and Indian Naval Academy (INA).Since then, it has been seen that there are 33 Sainik Schools all over India which have the provision for entry only for boys. But 75^{th} Independence Day of India, 15^{th} August 2021 has been like a red letter day for girl aspirants to enroll themselves in Sainik Schools. It was announced by honourable Prime Minister of India, Narendra Modi that the Sainik Schools will be opened for the enrolment of as well to fulfil their aims and to show their capacities in the field of defence. But before this historical announcement, Mizoram has already set the example to be the first state in India to enroll girl aspirants in Sainik Schools in 2018. It opens the doors of quality training of girl cadets at par with boys for their empowerment in defence sector also.

ISBN: 978-91-987581-0-8

❖ GOVERNMENT TECHNICAL UNIVERSITY FOR WOMEN:

Indira Gandhi Institute of Technology was established by Department of Training and Techincal Education, Govt. of Delhi, in 1998 as the first woman Engineering College in India. But this institute was converted to Indira Gandhi Delhi Technical University for Women (IGDTUW) in 2013 vide Delhi Act 09 of 2021, as a non- affiliating University to facilitate and promote studies, research, technology, innovation, incubation and extension work in emerging areas of professional education among women, with focus on engineering, technology, applied sciences, architecture and its allied areas with the objective to achieve excellence in these and related fields.

❖ CONCLUSION:

The above mentioned schemes and initiatives that have been taken by the Government of India for the upliftment of women has been gaining a good momentum for their empowerment to be independent in every aspect of our society. As free and compulsory education is there by dint of SSA, child labour has been diminishing day by day. Parents prefer to send their daughters to school instead of sending them for bonded labour under unruly masters. Moreover, RMSA and RUSA are also playing great role to provide education in secondary and higher level of studies. Thus, a large number of girl's enrolment has seen in secondary and higher levels of education instead of getting married and begetting children very early in life. As a consequence, they are getting 'wings' to excel in the field of education and to bring glory to our nation.

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.012

DEVELOPED AND DEVELOPING ECONOMY MEANING AND CONCEPT

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❖ ABSTRACT:

Economic development is the process by which developing countries become developed economies. In other words, the process by which countries with low living standards become nations with a higher standard of living. Economic development also refers to the process by which health, welfare, and the level of education in general society improve. During development there is a shift in people from agriculture to industry, and then to jobs. The average life expectancy, for example, is one of the consequences of economic development. Improved productivity, higher literacy rates, and better public education, are also results. In Simple words economic development is about improving the quality of life. 'Improved living standards' refers to higher levels of education and learning, staff income, health, and years of life.

Keyword*: Economic Development, Enhanced Production, Literacy, Health, Lifespan.*

❖ INTRODUCTION:

- **Developed Economy: Definition and Concept.**

A developed economy is a sign of a developed country with a high level of economic growth and security. Common criteria for assessing the level of national development per capita income per household or product, industry standard, standard of living, and value of technology infrastructure. Non-economic factors, such as the Human Development Index (HDI), which measures national standards of education, literacy, and personal health, can also be used to assess economic or developmental status. The most common metaphor used to determine whether the economy is developing or developing is per capita gross domestic product

(GDP), although there is no solid basis for the economy to be considered as development or development. Some economists consider $ 12,000 to $ 15,000 per person's GDP as sufficient for a developed state while others do not consider a developed country unless the individual GDP is above $ 25,000 or $ 30,000. The highest GPA shares in 2019 were 65,111 US dollars. In lands where segregation is difficult, economists are turning to other factors to determine the state of development. Standard life measures, such as infant mortality and life expectancy, are effective although there are no set limits on these measures. However, most developed economies face the death toll of less than 10 per 1,000 live births, and their citizens live to be 75 years or older on average. Individual high GDP alone does not provide an improved economic situation without other factors. For example, the United Nations is still looking at Qatar, which has one of the highest GDP in the world in 2019 at $ 69,688, a developing economy because the country has extreme income inequality, lack of infrastructure, and limited education opportunities for wealthy citizens. Examples of developed countries include the United States, Canada, and most of western Europe, including the United Kingdom and France.

❖ DEVELOPING ECONOMY: DEFINITION AND CONCEPT:

The Developing economy also known as the less developed economy or is a nation with an underdeveloped industrial base, with a lower Human Development Index (HDI) compared to other countries. On the other hand, since the late 1990's, developing economies have been showing higher growth rates than developed ones. There is no general, agreed standard of what makes a developing country comparable to a developed country and which countries are eligible for these two categories, although there are areas that are referred to as GDP per capita compared to other nations. Also, the common denominator of a poorly developed economy should not be confused with a less developed country. Terms such as "emerging countries," "least-developed countries," and "developing countries" are often used to refer to countries that do not enjoy the same level of economic security, industrial development, and growth as developed countries. The term "third-world country" to describe the world today is considered old and invading. The United Nations Conference on Trade and Development notes that the less developed countries in the world are considered to be the most disadvantaged in their development — many of them for local reasons —

ISBN: 978-91-987581-0-8

and are at risk of poverty. "Proponents of globalization often claim that globalization contributes to the development of impoverished economies and to the development of improved living standards, higher wages, and the use of modern technology. These benefits have been proven primarily in the Asia-Pacific region. We have already said that globalization comes with obstacles and need to be considered when foreign investment enters a developing economy.

❖ DIFFERENCES BETWEEN THE DEVELOPED AND DEVELOPING ECONOMY:

- **GDP (Gross Domestic Product)**

In addition, developed countries have a much higher GDPS while less developed countries have a much lower GDPS. The GDP of developing countries, on the other hand, takes a median price between the two.

- **HDI (Human Development Index)**

Developed countries have very high HDI, while less developed countries have very low HDI. The HDI of developing countries, on the other hand, occupies a median value between the two.

- **Technology and Utilities**

People in developed countries have easy access to the latest technological advances, enjoy better health care, education, and other services, while people in developing countries may have access to technology, and health care, education, and other services are at a higher level. On the other hand, the vast majority of people in developed lands have no access to education, health care, or other basic services, and most do not have access to technology.

- **Quality of Life**

The standard of living in developed countries is high, while the standard of living in underdeveloped countries is very low. The standard of living in developing countries are somewhere in the middle.

- **Examples**

Norway, Denmark, Austria, the US, Switzerland, and Canada are some examples of developed countries. India, Indonesia, Nigeria, Saudi Arabia, Russia, and South Korea are some examples of developing countries.

ISBN: 978-91-987581-0-8

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ISBN: 978-91-987581-0-8

DIP: 18.10.9198758101.013

TOWARDS DEVELOPMENT IN POST PANDEMIC INDIA

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❖ ABSTRACT:

The Post Pandemic World needs to rise and shine. There is an urgent need of development. As usual, Women have taken a lead to rebuild their homes, their careers and their own self confidence. Women enter entrepreneurial careers to gain a sense of accomplishment and achievement, as opposed to their male counterparts, who start their businesses for the sake of growth opportunities and profit potential (Hillstrom). Covid-19 presents a proverbial golden opportunity for women entrepreneurs. Women from all sectors and segments of the economy are responding to this extraordinary shock with zeal, agility, and optimism. Vital ecosystem participants must step forward to support women in India and thus unlock this demographic asset. This chapter is an attempt to portray the Post Covid-19 scenario for women entrepreneurs, their trials and tribulations and ways to overcome the same.

Keywords: *entrepreneur, Covid-19, adversity, development*

❖ INTRODUCTION:

The word "entrepreneur" is derived from the French words "entrée" which means "to enter" and "prendre" which means "to take," which connotes "undertaker," but in common terms, entrepreneurs are those who start their own company. They are, nevertheless, the true geniuses who help to strengthen the economy (Rani, 1996). In any culture, the entrepreneur is a powerful force to reckon with. Entrepreneurs are people with a vision, they play a critical part in any country's economic growth (Vinze, 1987).

ISBN: 978-91-987581-0-8

Women are gaining more knowledge and competing equally with their male counterparts in every domain as a result of urbanisation and increased industrialisation. They contribute equally to economic development, whether in the organised or unorganised sectors, as a self-employed person or as an entrepreneur. Women's involvement in productive activities has risen steadily over the ages. However, they are primarily employed in the unorganised sector. (Vinze, 1987).

For women, entrepreneurship is an important option because it not only allows them to be financially independent, but it also allows them to pursue a variety of lifestyle options. It also encourages them to be self-determined and to speak out against discriminatory practises. According to some experts, greater female economic independence promotes geopolitical stability and world peace (Forbes).

Women entrepreneurs in India have faced adversity and criticism on their path to self-sufficiency. Before they could establish themselves as independent entrepreneurs, they had to overcome family opposition and social constraints (Vinze, 1987). Women have their own motivations for starting their own businesses. Women enter entrepreneurial careers to gain a sense of accomplishment and achievement, as opposed to their male counterparts, who start their businesses for the sake of growth opportunities and profit potential (Hillstrom).

Indian history bears witness to the fact that entrepreneurship has always been a male domain (Panchanatham, July 2011). However, increasing educational qualifications, social awareness, and the desire among women to be self-sufficient has prompted more women to pursue entrepreneurship as a career.

❖ ROLE OF WOMEN DURING THE PANDEMIC

Due to supply chain interruptions, the pandemic has impacted self-employed women (including mompreneurs and women of self-help groups), who account for over half of all working women in India. Women-owned businesses have been struck worse by the epidemic than men-owned firms, particularly in the hardest-stricken industries. In addition, nonpayment of past salaries and current arrears has exposed these women and their families to economic shocks.

In the immediate aftermath of the lockdowns, between March and April 2020, an estimated 17 million to 19.3 million women (Misra and Patel 2021) were unemployed (Abraham et al 2021). It's worth noting that women are overwhelmingly represented in high-impact sectors like commerce and services. Personal and non-professional services, which

ISBN: 978-91-987581-0-8

include small-business owners such as tailors, dressmakers, petty shopkeepers, barbers, and beauty salon owners, as well as domestic help and part-time workers, had higher volatility than other industries. Male employment plummeted by 30% and female employment fell by 43% as a result of the lockdown (Abraham et al 2021).

During the pandemic, more women-led businesses (72 percent) reported cash shortages than male-led businesses (53 percent) (Buteau and Chandrasekhar 2020). When compared to men, more women entrepreneurs (69 percent) reported deferring loan payments (50 percent). However, two studies (Buteau and Chandrasekhar 2020; Chawla et al 2020) discovered that women were more confident than men in the full recovery of their businesses. In fact, they showed signs of adapting to the pandemic's changes, with more than 54 percent already making a "business shift" such as adding new products and services. Another 24% intended to make a business change by the end of the year. (Sunil 2020). For example, Shiji, from Kerala turned into an entrepreneur during the Lockdown as she had to tend to her daughters and parents after losing her job with a motorcycle shop during the pandemic. She searched the internet and talked to a farmer in Gujarat and started making papads with vegetable extracts.

While COVID-19 has a disproportionate effect, recovery has been in favour of men. When compared to the pre-pandemic period, men's employment levels were 9.5 percentage points lower than women's, with men's employment levels rising by August 2020. (Deshpande 2020). After controlling criteria such as caste, religion, age, degree of education, employment arrangement, industry, and state of domicile, women were eight times more likely than males to have lost their jobs. Self-employment may have provided a "cushion" for those who have lost jobs in both the formal and informal sectors (World Bank 2020).

Women have been hit harder due to Covid-19 as compared to their male counterparts. They bore extra responsibilities of household chores and caregiving which made a huge impact on their mental, physical and psychological well-being. In most of the homes, support from the male members of the family was minimal which led to less time being spent on their entrepreneurial efforts by the women. Despite these hardships, most women felt that the time they spent in caregiving, running a household, or assisting their spouse's business had remained the same. Others believed that time spent on household work (43 percent) and unpaid work (38 percent) had increased during the pandemic. This is supported by questions about stress levels, in which women entrepreneurs consistently

reported moderate to extremely high levels of stress regarding household responsibilities, staying locked in, and increased expenses.

❖ LESSONS LEARNT - POST COVID-19 SCENARIO:

Generally, businesses owned by women-owned in India are service-oriented, smaller, and less capital-intensive, which led to faster adaptation to changing environments than larger or more capital-intensive businesses. Clothing manufacturers quickly adapted to manufacturing safety equipment (masks, gloves, PPE kits), coaching centres and gyms dramatically increased their clintele by holding "virtual classes," and food and beverage businesses shifted to a new slogan, "vocal for local", positioning to reach a wider audience digitally are examples of the adage, ‘Change is the only Constant’.

A majority of the entrepreneurs' businesses have not recovered to pre–Covid-19 levels. Following a sharp drop in March and April as a result of the lockdown, business growth is now about one-third of pre–Covid-19 levels. Only a few entrepreneurs have been able to return to pre–Covid-19 levels. Enterprises that had already experimented with or adopted digitalisation in various aspects of their business model recovered the fastest.

Despite short-term recession, entrepreneurs are optimistic about the recovery. According to a survey conducted, ninety percent of entrepreneurs believe they will be able to survive the crisis, with two-thirds believing major changes to their business model and cost structure will be required. Eighty percent of entrepreneurs expect demand to return to pre-lockdown levels by the year end.

Women have been quick to change their business models in order to be more relevant. In response to Covid-19, 54% of the women we interviewed have already changed their business model, and another 24% plan to do so by December. Only 6% believe they will be unable to change their business model. Approximately 60% of women have included new products or have started offering new services, 35% of them have shifted over to digital sales and delivery channels, 26% have reoriented supply chain or sales marketing function. While many of them have undergone fresh training a few of them have picked up new skills to be ahead of time. Covid-19 has proved to be a blessing in disguise for working women in India. There is a definite shift in increased recognition and support for women's contributions to family income. Because of the widespread negative impact on jobs and incomes, there is a greater familial and societal acceptance of women working formally, which can strengthen

ISBN: 978-91-987581-0-8

women's role in providing financial support to their families. Thirty percent of respondents believe there will be an increased need to work due to economic uncertainty, while 20% believe there will be a greater acceptance of work among family and community.

Quite surprisingly, up to 30% of women believe that working from home increased their productivity and allowed them to prioritise better. Simultaneously, Covid-19 has pushed the broader ecosystem to rapidly adopt digital business methods. Transactions have moved online as suppliers, customers, and employees adopted remote models; and as B2B commerce has scaled up, entrepreneurship has become more accessible to women. Beyond the difficult near-term circumstances, these shifts toward virtual or remote interactions have the potential to create a more enabling environment for women, who frequently face competing responsibilities that limit mobility. 45 percent of our respondents believe that increased adoption of remote work will make it easier for them to run their business successfully in the future.

Governments need to play a critical role in recognising and elevating female entrepreneurship as a key for reviving economic activity in the current environment. Priority initiatives include a state-led "call to action" for women to directly participate in the economic reconstruction effort, backed up by tailored government-led digital interventions to attract and empower women-run businesses. Multiple Digital India initiatives, for example, such as the engagement of small and medium-sized enterprises (SMEs) and the Aatmanirbhar Bharat Innovate Challenge, should be tailored to drive greater participation and enablement of women. Better still, Azadi ka Amrit Mahotsav and Ek Bharat Shrestha Bharat Campaigns can include schemes and competitions for women entrepreneurs.

The Government must move quickly to promote gender equality in the post-COVID era by financially boosting women-led enterprises. Schemes that bring together the public and private sectors to speed up technology adoption, innovation, and digital skills training for people with disabilities need to be implemented to revive the economy of the nation in general and motivate women in particular. Funds should be earmarked for MSME's and emergency loans must be created to streamline requirements for small businesses.

Women entrepreneurs should have access to adoption, innovation, and digital skills training, as well as improved financing and tax help. Programs, possibly in collaboration with state governments, aimed at assisting women entrepreneurs in starting and scaling businesses in high-

growth sectors such as EdTech, B2B commerce, health and nutrition should be initiated.

Women-focused Covid-19 recovery programmes, which include capacity building, data tracking, and infrastructure enablement, need to be implemented through collaborations between private and non-governmental organizations.

The most important change required is the change of perception in society, by celebrating the educational, health, and economic benefits of women's labor-force participation. Men (and families) who model positive behaviours should share domestic responsibilities. Formal and informal networks will help foster inclusivity in virtual and physical interactions. This will help reduce the gender gap in society and lead the nation towards development.

External shocks have a powerful impact on societies. This crisis presents a proverbial golden opportunity. Women from all sectors and segments of the economy are responding to this extraordinary shock with zeal, agility, and optimism. Vital ecosystem participants must step forward to support women in India and thus unlock this demographic asset.

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red'shine
Publication
SWEDEN

RED'SHINE Publication
62/5834 Harplingegränd 110,
LGH 1103. Älvsjö, 12573
Stockholm, Sweden
Email: info.redshine.se@europe.com
Website: www.redshine.se

eBook

ISBN 978-91-987581-0-8

9 789198 758108 >

kr 100/-

Available on

kindle amazon goodreads Google Books

Smart and Sustainable Cities: A Systematic Review

Smart Cities for India

National Conference on Sustainability IN Built Environment(NCSBE 2020)

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***Abstract* - To support the rapid increase in economy and urbanization and to mitigate the issues emerging due to continuous growth and development there is an urgent need for a reasonable plan of action and a unified approach. The concept of smart and sustainable cities has turned up as one of the smartsolutions. However, urban areas in a developing country like India lack not only basic amenities but also the basic infrastructure because of different reasons which range from improper administration and absence of appropriate planning, management and evolving lifestyles. This paper attempts to find out the need and relevance of the smart city projects that are undertaken by the government of India by comparing the ongoing or already completed projects internationally. This was done by comparingthe initiatives undertaken by the government of India to the initiative undertaken by Dubai and Singapore in the light of smart characteristics derived from the definitions of smart cities. The paper ultimately seeks to evaluate the challenges faced by the Indian government and planners while implementing the smart city proposals. The results convey thatdevelopment of a city, as a smart and sustainable city depends on local setting factors and project management.**

Key words-Implementation approaches, Indian Perspective, Smart cities, Smart Dubai plan, Smart Nation Singapore, Sustainability.

SMART CITIES: INTRODUCTION

People relocate to urban communities essentially for work. To help themselves with congenial living, they likewise need a good quality of all the basic amenities may it be housing or utilities like water, sanitation, power, clean air, medicinal services, security, amusement, and so on. Production units located in cities become an agglomeration economy which gives simple access to employment and different components of manufacturing. In this scenario, Smart Cities are the ones which are dedicated to impart all these facilities. A great foundation, straightforward online procedures that make it simple to set up and run any venture effectively are significant for the prosperity and success of not only the nation but its citizens as well. There exists many definition of a smart city. It means different to different people, state, or a country. One of the definitions suggests a Smart City is a city well performing in 6 characteristics, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens: Economy, Mobility, Environment, People, Living, Governance (Giffinger, 2007). Increase in population of urban areas has led to enormous increase in the consumption of resources. This has, in turn, created another challenge of creating smart cities that are sustainable.U4SSC defines a sustainable smart city as "an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects" (U4SCC, 2016). This implies that sustainability should be among thestrategic goals of Smart Cities.

METHODOLOGY

The vision, primary issues and priorities of the citizens of any city play a significant role in planning and management of smart cities. Since every city has varyingpositive and negative qualities, their particular paths to building up a smart city are likely to be different.This papermakes an attempt to compare the different paths taken by three growing national initiatives, namely India, Dubai and Singapore. The choices of countries/ states were made based on the Global Competitiveness Report (GCI)and Network Readiness Index (NRI).

TABLE 1
THE GLOBAL COMPETITIVENESS INDEX 4.0 2019 RANKINGS OF SELECTED COUNTRIES

Country	2018-19	2019-20
Singapore	2	1
UAE	33	25
India	58	68

Table 1 and Table 2 give an idea that Singapore is an all-rounder in terms of economy and network-readiness. India is at the lowest position whereas UAE is almost averagely placed between Singapore and India.Present methods and ways to deal with the implementation process of smart cities

TABLE 2
NETWORK READINESS INDEX-2019 RANKINGS OF SELECTED COUNTRIES

Country	2018-19	2019-20
Singapore	1	2
UAE	26	29
India	91	79

in different nations are majorly determined by initiatives taken by the government and motivating factors for public-private involvement. However, Global Competitiveness Report and Network Readiness Index can be another mode of kick start for the nations to drive their smart city goals. Covering 141 economies and presented by the World Economic Forum yearly, Global Competitiveness Report measures national competitiveness defined as the set of institutions, policies and factors that determine the level of productivity and long term economic growth of a nation. It gives ranking on 12 drivers of growth including infrastructure and ICT adoption amongst others (WEF, 2019).Similarly, assessment of network readiness of more than 120 economies is done every year using the Network Readiness Index provides holistic framework for assessing the multi-faceted impact of ICT on society and the development of nations (Portulans Institute, 2019).

From the viewpoint of Smart city execution, the above two markers are a decent beginningby which countries can determine where they stand amongst other countries on the smart city parameters and therefore how they should move forward with smart city solutions. While NRI will mention thedigital readiness of the country that is indispensable for smart solutions, Competitiveness positioning will givenoticeable knowledge on how the public-private models will work under the given conditions and rules for smart cities.

Next,the perspectives of a smart city of the three selected nations were obtained by analyzing smart city vision statements and smart city implementation approaches.Local reports and guidelines from the states on Smart city plans ofSingapore, Dubai and Indiawere studied in detail for exploringtheir visions and initiatives.

I. Singapore: The Smart Nation Plan

The Smart Nation plan for Singapore was launched in November 2014. The vision statement given by the Prime Minister Lee Hsien Loong in 2014 is:

"Therefore our vision is for Singapore to be a Smart Nation – A nation where people live meaningful and fulfilled lives, enabled seamlessly by technology, offering exciting opportunities for all. We should see it in our daily living where networks of sensors and smart devices enable us to live sustainably and comfortably."

The amalgamation of public and private sector is playing the key role in achieve this vision. According to U4SSC,Singapore has aimed to achieve this by integrating the aspect of 'smartness' into its city planning and incorporating ICTs into economic and domestic sectors, to improve energy efficiency at the household and business level and to promote intelligent sustainable buildings, efficient water management, better education and awareness related to smart initiatives (U4SSC, 2016).

Key pillars that support Smart Nation goals aredigital economy, digital government and digital society(Pillars of Smart Nation, 2020). People, all the private organizations and public firms have a key role to play in achievement of the goals. According to recent reports, Singapore is persistently driving the ICT revolution and digital movements, particularly e-administration and smart city solutions.According to a report published by the Singapore Authorities on Smart City vision, an all-inclusive and extensive plan has beenillustratedwhich includes institutes of higher education in Singapore and health facilities, funding for research and development work and quickly developing network of new businesses related to technologies. The Next Generation smart city plan of Singapore is based on the presumption that comprehensive use of ICT by the government and private companies will help not only in better livings but also prominent business openings. This is validated by the fact that Singapore offers most promising and encouraging business and development conditionsacross the world and is profoundly positioned for the nature of its administrative structure. To achieve the goal of digitalization throughout Singapore, numerous strategic national projects have been identified. A good caseexample of this is the 'virtual Singapore.'It is the 3D digital platform that will empower the government, organizations and society to run simulations and make amendments in the planning using a high-scope city model of Singapore. This helps in making the long-term decisions on infrastructure and resource-planning (Initiatives, 2020).

II. Dubai: Smart Dubai 2021

In March 2014, Sheik Mohammed made an announcement to change Dubai into a Smart City. The objectives of Smart Dubai plan include **smart living, smart economy, smart people, smart mobility, smart environment, and smart governance**. In a new announcement, he has envisioned Dubai to be the happiest city on the earth. The official website of smart city 2021 Plan was explored in detail to understand the vision and initiatives taken by UAE government(Smart Dubai 2021, 2020).

"We are making Dubai the happiest city on earth by embracing technology innovation making Dubai a more seamless, safe, efficient and personalized city experience for all residents and visitors."

The Smart Dubai initiativeorganizes its ultimate objectives over a deliberately created set of key pillars (Fig. 1). These are Efficient, Seamless, Safe and Personalized. The pillars give an unmistakable perspective on the effect the city needs to make, tandem with all public and private partners.

FIGURE 1
PILLARS OF SMART DUBAI INITIATIVE

FIGURE 2
THE CITY'S TRANSFORMATION AGENDA: SMART DUBAI 2021

The above city's transformational Agenda (Fig. 2)characterizes a city wide approach to deal with the accomplishment of four objectives of Smart Dubai.The methodology highlights 6 key areas and 100 initiatives to tackle these areas of interventions. These 6 areas of intervention are:

- Transportation
- Communication
- Infrastructure
- Electricity
- Economic services and
- Urban and environmental planning

In a nut shell, the plan focuses on creating positive impact on three major areas including citizens, finance and economics and overall city environment including resource and infrastructure. All this is achieved by harnessing technology and ICT innovations.

On realizing that the consumption of resources and efforts that were put in were being doubled because of the absence of government-wide electronic shares services (ESS), The Dubai Government ESS initiative came into conceptualization which evolved as Smart Dubai initiative in 2014. Due to the implementation of ESS, the need for government entities to individually invest in ICT equipment and installation has considerably reduced. Consequently, this plan has led to reduced carbon emissions and a positive impact on the environment(U4SSC, 2016).

III. India: The Indian Smart Cities Mission

The process of urbanization is ever increasing throughout the world, and India is no less impacted by it.India, a developing nation, is seeing a rapid shift of people from rural to urban areas which increased to 31 % in 2011 and is likely to grow to 40% by 2030 and more than 50% by 2050. Due to this enormous boom in the population size of cities, the government is facing challenges related to infrastructure and delivery of services. Serving to the ever increasing needs of urban areas, authorities have come up with the solution of smart cities. Smart Cities Mission is a national initiative by the Ministry of Urban Development to build a foundation for 100 smart cities in five years (FY 2015-16 to FY 2019-20) (Gupta & Hall, 2017).

Smart Cities Mission Guidelines issued by the government of India does not have a holistic and comprehensive approach for the vision of smart cities. This is due to the fact that Indianstates and cities have diverse characteristic and therefore, one Smart City vision cannot be implemented to all the urban areas. Every city needs to figure its own idea, vision, strategic arrangement for a Smart City Plan.

The main objective of the Mission is to drive monetary development and enhance the standard of living of the citizens, their well-being and welfare by an area-based development of neighborhoods that has three segments:

1. city improvement (retrofitting),
2. city renewal (redevelopment) and
3. city extension (greenfield development)

All these initiative and smart solutions are applied pan-city to cover larger parts of the specific urban area.

The MoUD initiated the SCM through the IndiaSmart Cities Challenge. To take part in this challenge, Indiancities competed for central government funding by submitting a smart city proposal (SCP).As of now, 60 cities (from the list of 100 proposed smartcities) have been shortlisted in the SCM and provided withinitial funding for SCP implementation (Gupta & Hall, 2017). These cities will contend with each other in order to come up with designs and become models. For this, sustainability has been mentioned as the key component by the government. With the increasing frequency of natural disasters, abnormal weather patterns and the looming threat of global warming, the concept of a smart city must be merged with sustainability for the welfare of people and our planet as a whole (Ratan, 2015).

ANALYSIS AND FINDINGS

The reasons of why India is holding a backseat in becoming a smart nation were analyzed through the studies of the overall nature of Singapore and Dubai as a nation.

Firstly, what matters is the population size. India is a vast nation in terms of population. Justifiably, Singapore and UAE are smaller ones with digital infrastructure already developed and in place. This is already established by their rankings in the WEF reports. So, a country like India which is a developing country with a large population size definitely needs to first establish itself as a good infrastructure ready nation at a smaller, may be district level before plunging itself straightaway for a larger goal of smart cities.

Secondly, as stated above, the smart city model of Singapore is based on its infrastructure and relies largely on its public-private partnership. Also, the participation of citizens has been instilled under strong government initiatives for 30 years. Henceforth, their vision for smart cities is driven by KPIs. They have set up different stages of

KPIs to be accomplished in specific terms particularly on transportation and energy utilization. Monitoring this implementation work by the government is a task and Singapore no doubt is excelling in it by prioritizing their KPIs. On the other hand, Dubai, one of the seven emirates of UAE is under focus by its federal government, and is closely similar in population size and economic profile to the Singapore. UAE model is to empower "smart districts" contending each other to accomplish the objectives of smart city while the Dubai Government is effectively giving an incorporated digital stage for managing data, infrastructure and resources. From Indian viewpoint, detailed point by point levels of introspection is required to permeate the targets and more extensive guidelines for the Smart City Plans which can be converted into feasible models are needed.

In a nut shell, Smart Nation model of Singapore is more KPI driven with clear order that it is feasible by rousing and empowering public-private associations. Similarly, Dubai Smart City plan puts weight on government empowerment and unified data control. The two methodologies are legitimate given their targets and guidelines and will additionally be evolving as Smart City ventures advance.

TABLE 3
COMPARISON OF THE SMART CITY FEATURES OF SINGAPORE, DUBAI AND INDIA
SOURCE: AUTHOR

Characteristics	Singapore	Dubai (UAE)	India
1. Smart Energy	Smart Urban Energy Smart Environment Clean and renewable energy	Smart Environment Smart District Certification Smart remote working Tools	Energy Management
2. Smart Building	Smart Building Green mark Certified Buildings (80%) Zero energy Building in 5 yrs. Smart Towns	Smart Buildings Centralised Mgmt. of Building Assets Security and Access control Lighting Management HVAC & CWS Management	Energy efficient and Green Building
3. Smart Security	Smart Security Smart Elderly Alert System	Fire Alarm System Management Smart Homes Home Energy Management Home safety & Security Home Automation Home Health Home Infotainment	
4. Smart Technology	Smart Technology Broadband Penetration (100%) LTE Coverage Smart Home Solutions (50%house hold)	Smart ICT Infrastructure Unified Control Centre Wireless Communication Predicts Analytics Platform (for collaborative social activities)	
5. Smart Mobility	Smart Mobility 70% traffic by Public Transport Real time travel Information by mobile/Web 40% rebate on purchase of Green Vehicles	Smart Mobility Infra for Smart Roads , Bridges, Tunnels Intelligent Transport system Smart Traffic Parking management	Urban Mobility Smart Parking Intelligent Traffic Management Integrated Multimodal Transport
6. Smart Infrastructure	Smart Infrastructure Smart Water Meters Digital innovations in planning	Smart Infrastructure Smart Water Irrigation Smart Waste management Smart Sewage Water	Water Management (smart meters, leakage, Water quality, management Waste Management (waste to energy, compost reduction of C&D waste)
7. Smart Governance	Smart Governance Inter-ministerial committee for sustainable development OneService App	Smart Governance Public realm Fidelity management	E-Governance and Public Info, grievance redressal Electronic service delivery Citizen Engagement –Citizen Eyes & Ears Video crime Monitoring
8. Smart Healthcare	Smart Healthcare Integrated Health Info system Cloud computing Model in Healthcare	Infra Management Including Procurement Operations managed Managed security	Tele medicine
9. Smart Citizen	Smart Citizen Commute to work by Public Transport (50%) 100% population access to sanitation, Waste Recycle 65%	Digital Services	Incubation, Trade Facilitation centre Social development Centre
			Components of sustainability: ----------

Next, a comparative analysis was done keeping smart city characteristics as major parameters of comparison. Listing of these characteristics is based on compilation of various definitions of smart cities. These smart characteristics are:

1. Smart Energy
2. Smart Building
3. Smart Security
4. Smart Technology
5. Smart Mobility
6. Smart Infrastructure
7. Smart Governance
8. Smart Healthcare
9. Smart Citizen

Table 3 compares the smart city features as provided by the governments of Singapore, Dubai and India. Noticeably, all three nations are taking steps forward towards sustainability. It is very evident from the studies that 'smartness' to a large extent results in sustainability. However the proportion of incorporating the features which lead to sustainability, visibly, is different (table 4).

TABLE 4
COMPARISON OF THE COMPONENTS OF SUSTAINABILITY
SOURCE: AUTHOR

Characteristics	Singapore	Dubai (UAE)	India
1. Smart Energy	+ + +	+	+
2. Smart Building	+	-	+
3. Smart Security	-	+	-
4. Smart Technology	-	-	-
5. Smart Mobility	+	-	-
6. Smart Infrastructure	+	+ + +	+
7. Smart Governance	+	-	-
8. Smart Healthcare	-	-	-
9. Smart Citizen	+ + +	-	-

All three countries are in favor of moving towards smartness in energy and are providing features resulting in energy efficiency. Smart and sustainable building aspects have gained popularity in Singapore and India whereas Dubai is only focusing on smart parameters. Smart security feature has been dealt by Singapore and Dubai in good capacity, which remains absent in India. Similar trend has been seen for smart technology. However Dubai takes a front seat in initiating sustainable parameters in the above two features by proving home energy management and unified data control through ESS respectively. All the nations are working to provide smart mobility solutions and smart governance, with Singapore leading on the sustainability front in both. Importance of Smart infrastructure, mainly water is clearly visible in the corresponding features of all three nations.Sustainability feature is lacking in the smart healthcare parameter of all three nations. Singapore is leading in making its citizens smart, followed by Dubai and then India.

It is clearly evident from table 4 that India is lagging behind in the development of smart and sustainable cities. This is due to various challenges faced by Indian Smart City Mission in its execution and rollout.

One of the major challenges is to replace the existing infrastructure of a city to prepare it for smart city. Any city can only become a sustainable smart city once it has achieved the level of a developed city. An underdeveloped city or a developing city will face a lot of struggle in reaching the goal of becoming a sustainablesmart city.

Furthermore, managing a multivendor environment is a difficult task. Programming and software framework in Indian urban areas contains components provided by various merchants. Subsequently, the potential required to deal with complex mixes of smart city solutions created by numerous sellers turns out to be huge. That is why features like security and technology are absent from the components of smartness as well as sustainability.

Moreover, another area of concern is the sort of business and work opportunities these smart urban areas will create. No doubt that the smart city will act as a focal point of financial development, it ought to likewise give the correct blend of means of living to those moving to it. Else, the relocation of individuals will keep on representing a danger to the social and financial situation of the city. Innovative solutions corresponding to Smart governance, smart healthcare and smart citizens will surely help in dealing with this challenge.

CONCLUSION

The findings of this research has uncovered that there is no common definition of Smart City worldwide. Similar is the case for smart sustainable cities. The definitions for smart cities focussed primarily on the performance of transportation, healthcare, education and government. On the other hand definitions for smart sustainable cities majorly focused on impact on the environment, well-being of citizens, mobility and administration.

The current patterns and evolution examples of any individual Smart city rely generally upon the local setting factors. Also, development of a smart city greatly depends upon teamwork. The team includes government, policy makers, urban planners, engineers, vendors and citizens. Understanding,assessingand merging their viewpoints is of utmost importance to tackle the smart city development challenge. Policy makers subsequently should comprehend these constants and variables and shape the strategies accordingly for the development of smart cities in their countries.

In a nut shell, a city, which is in the initial stage of development as a smart city should learn from the positive and negative experiences of other successfully developed smart nations and this trend is expected to continue in the future as well. A smart and sustainable city will definitely lead to a better future where cities understand the role of earth, air, water, nature and its citizens,

RECOMMENDATIONS FOR FUTURE AUTHORS

The present study focuses on comparison of three nationalities.Future research could be directed towardsstudying case examples of other smart city projects

globally to discover different design choices for the development of smart cities and to discover different pathways followed. A probe can also be made on the levels of smartness and sustainable aspects acquired by a nation by recommending unified standards for smart areas.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to Ar. Mohammad Aamir and Ar. Mohammad Saquib.They have guided and supported us in every manner during the research. They have been very kind and patient while correcting our doubts. Without their encouragement, this research would not have been possible. We would also like to thank our family for the continuous support in achieving the goal. Finally and above all we are grateful to Almighty for making this research a successful one.

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Decay of Vernacular Architecture in Rural India

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Abstract
The cultural traits and attributes give vernacular architecture a range of values, which makes it into an individual built heritage resource, which is irreplaceable. Continuity is maintained through generation by keeping alive these traditions that forms the essence of vernacular architecture but at the same time also assimilates new values, making then valuable. While in the past, the techniques and approach was strictly local and bound to tradition, nowadays, the use of new building techniques has introduced elements and styles that are totally foreign to the local environment. The new imposes itself on the old and on the surrounding landscape and, while ignoring any reference to typologies, layout, building techniques, it has a strong visual impact on the landscape. The heritage value of vernacular architecture is under threat due to socio-culture change occurring in modern society as a result of globalization. This is bringing people closer, assimilating ideas and concepts which cater to with current trends and practices in building construction, thereby putting the vernacular building tradition at risk. Migration from the villages left only a handful knowing the skills of vernacular craft and architecture. Time has come, where a serious thought has to be given to find a sustainable and local solution to keep the skill living. The upcoming gap between the local and nature has to be preserved. The essence of vernacular architecture needs to be maintained because in true terms it is the 'Architecture of masses'. As a consequence the scenario becomes disturbing which stand out against historical farmsteads in ruin. New buildings are the result of international border-free architecture, introduced by industrialization, which tends to ignore any local values. This paper explores the meaning and importance of Vernacular Architecture in India and tries to intervene the factors leading to the loss of the same in Indian villages. An attempt is also being made to find probable solutions in keeping Vernacular Architecture thriving.

Keywords: Globalization, Heritage, Industrialization, Masses, Migration, Socio culture, Vernacular architecture

1. INTRODUCTION

India is a country which is known for its rich history and culture. There is abundant reservoir of local knowledge in every part of the country. The vernacular building technologies in India are being passed down from generations to generations with the local climate, available materials and the strong cultural ethos. Vernacular enables Indian people to create their own solutions with respect to their micro possibilities.

"The architectural language of the people' with its ethnic, regional and local 'dialects". (Oliver, 1997) Unnoticeably, new India is growing disregard for traditional architectural language around the world due to modern building technology quickly spreading a "loss of identity and cultural vibrancy" through what the Architectural Review recently described as "a global pandemic of generic buildings." (Stott, 2016)

People have come to see steel, concrete and glass as architecture of high quality, whereas a lot of vernacular methods including adobe, reed or peat moss are often associated with underdevelopment. Ironically, these local methods are far more sustainable and contextually aware than much contemporary architecture seen today, despite ongoing talks and debates about the importance of sustainability. As a result of these trends, a tremendous amount of architectural and cultural knowledge is being lost.

2. ISSUES

The onset of industrialization and modernization has started the dilution of this knowledge transfer. The vernacular skills are fast disappearing as the construction is time taking, skill based and there is lack of understanding of materials and their usage. From igloos to bamboo houses, from thatched roofs to terraced roof, people create shelter and comfort in unique structures in response to their locations on the globe. (Praharaj, 2014). A lack of understanding of materials and their usage has led to a slow decay of vernacular architecture. This was the result of repeated cycles of trial and error and the experience of generations of builders, which satisfies the occupants' demands for thermal comfort and durability. Different regions of India have different types of indigenous building technology. History reflects how over the years man has responded to the evolving ecological system surrounding him by developing various systems to mitigate the adverse impacts of environment. His response has been recorded in terms of his lifestyle, work patterns and

the built spaces. Vernacular architecture evolved over time, reflecting environmental, cultural, technological and historical context of a specific location on which it was built. (Nguyen, A.T., Reiter, S., 2017).
The traditional buildings are very good examples of bioclimatic architectural design. The wisdom embodied in vernacular architecture needs to be conveyed over the generations to show our gratitude and respect towards nature and our culture. The technological advancement amalgamated with science has brought us at the cross roads where we have to wisely choose between healthy environment and urbanization. The ills of urbanization in the form of ecological imbalance, increased pollution, increased anxiety levels, social exclusion, spatial segregation etc. has again forced us to recall and learn from the traditional vernacular system and blend it with modern technology. Globalization has brought a drastic shift in the construction techniques and materials used (from traditional materials towards steel and concrete) in the villages.

3. RATIONALE

A G K Menon believes that because of our education most Indian architects feel like strangers in their own land. They have lost touch with the values of tradition especially rural society. Only a handful of architects practicing in India today are sensitive towards the sustainable and vernacular architectural principles of Laurie Baker. Trupti Doshi of Puducherry has a philosophy that buildings are meant to complement their environment, not compete with it. She has taken a step forward to revive traditional craftsmanship, harness local talent and build addressing the local needs of the people. (Eartha, 2017)
So culmination of modern ideas and traditional techniques is the answer to address our present day challenges of development. We need to focus on developing a quantitative understanding of behavior of vernacular structures so that we can analytically improve upon them and integrate them to plan new settlements and upgrade the existing ones.

4. AIM

This paper aims to explore the probable reasons behind the decay of vernacular architecture in rural areas of India where the foundation is local & regional. Also we will try to go through possible recommendations by taking the problem back to its roots in Indian scenario.

5. OBJECTIVES

- To understand the importance of vernacular architecture in contemporary context.
- To figure out the issues which are forcing vernacular architecture to stick out from villages.
- To establish the fact of loss of vernacular from rural areas through literature surveys.
- To recommend the probable solutions for revival of vernacular architecture in rural India.

6. CASE STUDY

The inroads of development into hill settlements, increase in population, restrictions in felling of trees have forced the village people to move away from the traditional use of building techniques and materials. Villagers now prefer cement and brick over stone and wood for construction of their buildings. These new materials and buildings styles have also become a status symbol of them. This is truly being reflected in the villages of Himachal Pradesh. Cuddled in the backdrop of majestic peaks of Sharangcha, situated at the height of 2500 m above mean sea level, Dodra and Kwar are two beautiful villages in remote part of Himachal Pradesh. These villages got connected to the outer world with the help of motorable road in 2009.
These villages are well known for their indigenous character of slated roofed, wood and stone houses, with the distinct design of a cowshed on the ground floor, living quarters on the floors above and an attic for storing ripe grain at the top. This traditional style is known as Kathkuni style of architecture.

FIGURE 1
LOCATION MAP OF ROHRU VILLAGE

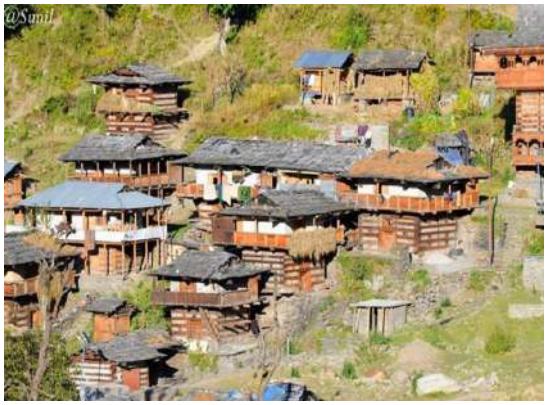

FIGURE 3
OVERVIEW OF THE VILLAGE

FIGURE 2
STREET PATTERN OF THE VILLAGE

Development in the form of connectivity has widened the scope of urbanization in the villages but at the same time has hit the vernacular buildings styles hard. People have opened up to availability of new building materials and technology. Locals now believe that brick and RCC structures are clean as compared to the traditional ones.

The traditional Kathkuni walls are 18" – 25" thick. Issues associated with space crunch have started cropping up due to increased population. This has affected the lower castes the most. These people already have less space and on top of that most of the space is lost in the walls. Thus the net livable space achieved is very less. But if the structures are build using brick they get more livable areas. The stone staircase is steep and the elderly face difficulty to move around. Now with the option of brick the locals have started preferring it to ease their movement.

FIGURE 5
TRADITIONAL WOOD HOUSES -II

FIGURE 4
TRADITIONAL WOOD HOUSES -I

Kathkuni houses act as catalyst in case of fire as they are majorly built of stone and wood. Stone and wood have become costly compared to brick and cement. Also their availability has started becoming difficult. Supreme court has put a blanket ban on felling of trees in 2019. The state government of Himachal Pradesh has put regulations on quarrying of stone.

New techniques and development attracts people to shift on contemporary materials over local material. Also the villagers are attracted with the appearance of new materials which makes their buildings looks good. Even the government buildings have switched to Kathkuni. The new Bus terminal of the town has adopted RCC structure with some visual appearances factors in the roof to visually blend in the context of the town.

RCC has gained so much popularity that even during restoration of temples the compound walls are now being replaced by RCC walls. Today in these villages of Dodra and Kwar only 20% structures are left which

reflect purely vernacular style while majority have switched to modern materials. The designing space has been improved over time as per the need from single unit to multiple units separated. The orientations of the buildings were mostly chosen on the basis of topography, solar movement and wind direction. Design features have been mostly influenced by the local skill.

FIGURE 6
GOVERNMENT POST GRADUATE COLLEGE

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FIGURS 7
COLLEGE IN MODERN STYLE OF ARCHITECTURE

FIGURE 8
VILLAGE BUS TERMINAL OF RCC STRUCTURE

FIGURE 9
MODERN CONSTRUCTION OF BUS TERMINAL

7. ANALYSIS

Globalization has caused the people to change the vernacular pattern of living. This is being clearly reflected in the housing patterns in rural areas of Himachal Pradesh and Orissa. The cost of maintenance and acute shortage of skilled craftsmen are also responsible for loss of rich architectural heritage of the region.

Vernacular buildings retain some indigenous construction techniques for thermal comfort. With the passage of time such buildings are vanishing due to change in functional requirements. New buildings are being constructed in the contemporary style ignoring the lessons of vernacular architecture with the introduction of alternative building materials. The retrofitting of old buildings is also done using present day materials. Lack of integration of new constructions to the local environment and social context has started causing serious damage to the environment. In Himachal Pradesh inorder to avail the view of the hills dwellings are constructed as a large enclosed glazed space with no provision for ventilation and protection from the sun. To maintain comfort levels in summer people are increasingly dependent upon air-conditioning aggregating to climate change and global warming.

The race of changing of architecture in the rural context fails to fulfill some of the sustainability criteria such as economic, social and environmental aspects while the vernacular architecture showed its sustainability. One should promote vernacular practices to ensure sustainable economic development and positive social change with many projects of rural tourism through encouragement of community participation and mobilization.

8. CONCLUSION AND RECOMMENDATIONS

"Tradition and modernity are two sides of the same coin, no society referred to itself as traditional before the first few centuries, and the idea of the traditional did not arise until the invention and articulation of the modern. To understand the tradition-modernity dialectic, its historic continuum and its effects on the built environment, it is important to focus on one of the most significant aspects of modernity itself, that is, modernity as an experience." (Sayyad, 2014).

Being a developing country where every day many people are fighting for their daily survival we need to focus on every possible way in which we could generate livelihood for all. People in global cities are submerged in high stress levels and in order to ease their stress levels they want to go back to the times when life was slow and people were contended with whatever they had. Giving that experience is what has been tapped upon nowadays to ensure the conservation of our culture and traditions as well as to generate livelihood. Rural areas are best examples to achieve this. Undoubtedly they will emerge as an important instrument for sustainable human development including poverty alleviation, employment generation, environmental regeneration and development of remote areas. It would also lead to advancement of women and other disadvantaged groups in the country apart from promoting social integration and international understanding.

Our case study reflects that still there are rural areas where the essence of vernacular architecture in the form of tangible and intangible heritage exists but it is at the verge of decay. Promoting rural tourism would help both the economy as well as the village's identity. There are many a success stories of Indian Villages like Kangra Valley villages, Rakhigarhi village in Haryana, (Anima, 2019), Holipura, Agra (Qureshi, 2016) etc, where through community participation the concepts of vernacular culture were developed and enhanced tourism of the village, marketed the same and benefitted socially and economically out of the efforts.

By preserving our indigenous architecture, we can achieve much larger number on the scale of rural tourism by tapping following potentials.

- Identifying the villages with immense potential for development of rural tourism destinations to showcase core competencies of rural India
- Proper documentation of tangible and intangible heritage of rural & tribal areas of India for promotional campaigns
- Amalgamating local architecture with modern technology to enhance the style without losing its true character.
- Restructuring and liberalization of policies to promote vernacularism of the region.
- Encouragement for financial investments in rural areas and human resource development.
- Encouraging the local people to involve in vernacularism at all levels for their benefit only.
- Promotion of public-private partnerships.
- Improving the service quality with a focus on creativity and innovation.

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ICAST94

ASSESSMENT OF SOLAR HUB POTENTIAL AT NEIGHBOURHOOD LEVEL – CASE STUDY COIMBATORE, TAMIL NADU, INDIA

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Executive Summary

The global agenda of sustainable development and communities emphasises on the role of adoption of cleaner and greener energy sources. Renewable energy resources presently account for India's 23.39% of the total installed generation capacity. There is an ever-increasing demand for energy in spite of the rising prices of oil & other fossil fuel / depletion of fossil fuels. The Government of Tamil Nadu is committed to mitigate the climate change effects by bringing out policies conducive to promote renewable energy generation in the State. The state of Tamil Nadu has a solar potential of approximately 17.67Gwp out of which the installed capacity with the state is only 1143.412MW. This clearly states that there is huge potential in the direction of solar power within the state. When we look at the city of Coimbatore we find that the city has around 305 sunny days in a year and an average annual radiation of about 5.08 kWh/m^2/day, with maximum radiation being received during the first half of the year. Currently there are few solar projects running successfully within the city. Through this research paper we are proposing solar hub at the neighbourhood level consisting of many solar initiatives like solar roof top, solar street lights, solar benches and solar bus stops, etc. and aim at reduction of carbon emission. The paper explores a framework for the assessment of the potential for the development of solar - hub at neighbourhood level by considering features like land ownership, land use, building use, building height, tree canopy and roof area availability.. Also the current electricity usage of the ward is high, 14 MU and the ward is a hotspot area due to the high amount of carbon emissions. Based on the sun path, the building heights and shaded and non-shaded areas, the site zoning is done, identifying the potential locations where rooftop panels can be installed in the site. Potential have been further assessed by quantifying the various benefits of such a solar hub including the environmental and social impacts of the development of such a project. Focus on the reduction in the carbon emissions with respect to the energy production and consumption has been quantified in the paper.

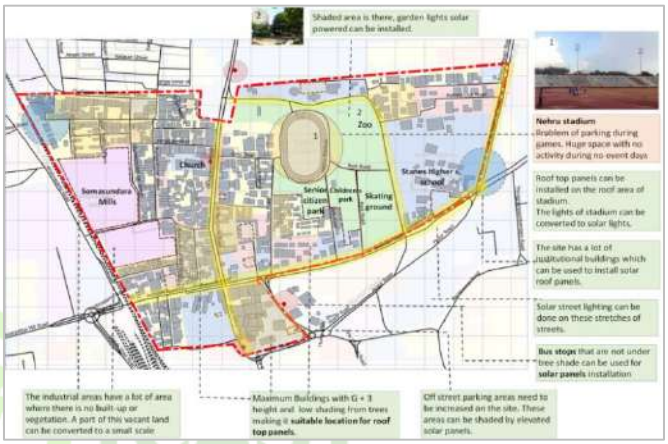

Figure 7 Solar hub potential in ward no. 72 Coimbatore, Tamil Nadu (Source: Based on analysis)

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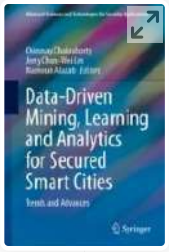

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Data-Driven Mining, Learning and Analytics for Secured Smart Cities

Trends and Advances

Editors: (view affiliations) Chinmay Chakraborty, Jerry Chun-Wei Lin, Mamoun Alazab

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Book Title
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Book Subtitle
Trends and Advances

Editors
Chinmay Chakraborty, Jerry Chun-Wei Lin, Mamoun Alazab

Series Title
Advanced Sciences and Technologies for Security Applications

DOI
https://doi.org/10.1007/978-3-030-72139-8

Publisher
Springer Cham

eBook Packages
Computer Science, Computer Science (R0)

Hardcover ISBN
978-3-030-72138-1

Softcover ISBN
978-3-030-72141-1

eBook ISBN
978-3-030-72139-8

Series ISSN
1613-5113

Series E-ISSN
2363-9466

Edition Number
1

Number of Pages
X, 383

Number of Illustrations
19 b/w illustrations, 74 illustrations in colour

Topics
Computer Communication Networks, Data Mining and Knowledge Discovery,

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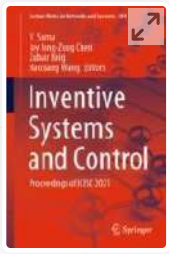

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Editors: (view affiliations) V. Suma, Joy Iong-Zong Chen, Zubair Baig, Haoxiang Wang

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This book presents selected papers from the 5th International Conference on Inventive Systems and Control (ICISC 2021), held on 7–8 January 2021 at JCT College of Engineering and Technology, Coimbatore, India. The book includes an analysis of the class of intelligent systems and control techniques that utilises various artificial intelligence technologies, where there are no mathematical models and systems available to make them remain controlled. Inspired by various existing intelligent techniques, the primary goal is to present the emerging innovative models to tackle the challenges faced by the existing computing and communication technologies. The proceedings of ICISC 2021 aim at presenting the state-of-the-art research developments, trends, and solutions for the challenges faced by the intelligent systems and

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Dr Zubair Baig works in the School of Science and a member of the ECU Security Research Institute. He completed Doctor of Philosophy, Monash University, 2008. He received many Research Grants which includes Academic Centre of Cyber Security Excellence, Department of Education and Training, Academic Centres of Cyber Security Excellence, 2017–2021, Investigation of social media for radicalisation and terrorism in the Maldives, Edith Cowan University, Edith Cowan University, School of Science Collaborative Research Grant Scheme, and Authentication and Authorisation for Entrusted Unions (AU2EU), European Commission, Grant - Seventh Framework Programme (FP7).

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Book Title	Book Subtitle	Editors
Inventive Systems and Control	Proceedings of ICISC 2021	V. Suma, Joy Iong-Zong Chen, Zubair Baig, Haoxiang Wang
Series Title	**DOI**	**Publisher**
Lecture Notes in Networks and Systems	https://doi.org/10.1007/978-981-16-1395-1	Springer Singapore
eBook Packages	**Copyright Information**	**Softcover ISBN**
Intelligent Technologies and Robotics, Intelligent Technologies and Robotics (R0)	The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2021	978-981-16-1394-4
eBook ISBN	**Series ISSN**	**Series E-ISSN**
978-981-16-1395-1	2367-3370	2367-3389
Edition	**Number of**	**Number of**

Number	Pages	Illustrations
1	XXIX, 995	123 b/w illustrations, 398 illustrations in colour

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Agriculture & Allied Sciences

Innovations in Agricultural and Biological Engineering

Novel Processing Methods for Plant-Based Health Foods

Extraction, Encapsulation, and Health Benefits of Bioactive Compounds

Editors: Megh R. Goyal, PhD, PE
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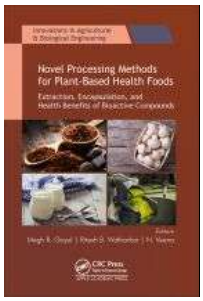

In Production
Pub Date: August 2022
Hardback Price: $179.95 USD | £139.00
Hard ISBN: 9781774910740
Pages: Approx. 351p w/index
Binding Type: Hardback
Series: Innovations in Agricultural and Biological Engineering
Notes: 14 color and 12 b/w illustrations

This new volume presents an array of new and emerging techniques in the food processing sector, focusing on the extraction, encapsulation, and health benefits of bioactive Compounds. It illustrates various applications of novel food processing extraction and encapsulation techniques along with the health and safety aspects of plant-derived bioactive compounds and functional foods

Some of the sustainable and green extraction techniques discussed include novel extraction techniques, such as microwave-assisted extraction (MAE), ultrasonic assisted extraction (UAE), supercritical fluid extraction (SFE), accelerated solvent extraction (ASE), and rapid solid-liquid extraction (RSLE).

The volume also covers the principles and methods of encapsulation, its role and application in protection and stabilization and as a targeted delivery system for enhanced nutritional health benefits. Various encapsulation methods, such as spray drying, spray cooling/chilling, fluidized bed coating, coacervation, liposome entrapment, extrusion, inclusion complexation, etc., are discussed in detail for application in the food industry.

Novel Processing Methods for Plant-Based Health Foods: Extraction, Encapsulation, and Health Benefits of Bioactive Compounds also highlights the potential of nutraceuticals and biological active compounds in human health, various sources, consumers' acceptance, safety aspects, and their application in development of functional foods.

This volume offers many tremendous applications in different areas of the food industry, including in food processing, preservation, health-promoting properties, and safety and quality evaluation of plant-based foods. The book provides a wealth of information and will be an excellent reference material for researchers, scientists, students, growers, traders, processors, industry professionals, and others on the emerging food processing approaches for extraction and encapsulation of plant-based bioactive compounds and health-promoting properties of plant-derived nutraceuticals and safety aspects in production of functional foods.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 2

CELLULOSE BASED NANOCOMPOSITES FOR BIOMEDICAL AND PHARMACEUTICAL APPLICATIONS

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ABSTRACT

In recent years cellulose-based nanocomposites have gained attention owing to the enhanced mechanical, thermal, high strength and stiffness, renewability and biodegradability, along with their production and application in the expansion of composites. These are emerging renewable nanocomposites that hold potential in many different applications such as food, chemicals, personal care, packaging and products, automotive, construction, electronics and furniture along with. High-performance nanocomposites can be prepared by appropriate modification of cellulose fibers as reinforcement material, resulting in improved physical, chemical as well as biological properties. The chapter provides an overview of cellulose nanocomposites focusing on the processing, properties, and applications in pharmaceutical and biomedical fields.

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Keywords: cellulose, nanocomposites, pharmaceutical, biomedical

1. INTRODUCTION

Cellulose is the most plentiful form of living terrestrial biomass material in nature (Crawford 1981) which is a common plant biopolymer, complex polysaccharide or carbohydrate comprising of 3,000 or more glucose units with 33 percent of all vegetable matter and the annual production is estimated to be around 10^{11} tons. It is a natural polymer, which is a long chain macromolecule and made by the linkage of smaller molecules. In the cellulose chain, the links are made by consisting of sugar, β-D-glucose (Dorée 1947). These sugar units are connected when water is removed by merging the H and –OH group. Above two of these sugars linkage results, a disaccharide is known as cellobiose (Kalia et al. 2011). Cellulose is most profuse of all naturally existing organic compounds and it is the basic structural component of the cell wall. In 1980, *Anselm Payen* (Payen 1838) first recognized the existence of cellulose as the communal material of plant cell walls. Several natural fibers like cotton and higher plants have cellulose as their main component. It comprises of long chains of anhydrous-D-glucopyranose units (AGU) and is insoluble in water as well as most common solvents. Therefore, chemical modification of cellulose is performed to enhance processability and to yield cellulosic (cellulose derivatives) so that they can be tailored for specific industrial applications. Cellulose has been widely investigated due to its advantageous properties, like low-cost, hydrophilicity, non-toxicity, biocompatibility, biodegradeability, low density, combustible and nonabrasive (Fu et al. 2019).

Composites are a combination of two or more different components with knowingly different chemical and physical properties. They have improved mechanical performance along with new functionalities. Generally, a composite contains a stiff and strong component known as the reinforcement which is embedded in a softer constituent, the matrix. In this way, the composite has advantageous properties of reinforcement and the matrix. Composites can be classified into three categories in terms of matrix used

are (1) ceramic matrix composites (2) metal matrix composites (3) polymer matrix composites. There are many thermoplastic polymers like poly (ethylene) (Lu, Lin, and Chen 2007), poly (ethylene oxide) (Chen and Tsubokawa 2000) and poly (vinyl chloride) (Chazeau et al. 1999) while thermosetting polymers like phenolic resin (Zárate, Aranguren, and Reboredo 2008), unsaturated polyester (Vilay et al. 2008), rubber (Setua and De 1984) and epoxy resin (Zhou et al. 2006). With increased awareness on environmental protection and sustainability, researchers have been shown interest in yield biodegradable polymer composites based on starch (Kvien et al. 2007) poly (lactic acid) (Bondeson and Oksman 2007) and cellulose (Gindl and Keckes 2005). Composites achieve the properties of both reinforcement and matrix with enhanced properties of compressive and strengths. Booker and Boysen (2005) presented special efforts towards nanotechnology and gave a high expectation for researchers. A nanoparticle is usually considered when as a minimum one of the linear dimensions is lesser than 100 nm (Henriksson et al. 2007). The perspective of nanocomposites in several areas of research and application is auspicious and attracting. Nanocomposite materials have many advantages properties like their superior mechanical, thermal, and barrier properties at low reinforcement levels along with their transparency, low weight, and better recyclability when compared with conventional composites (Oksman et al. 2006; Sorrentino, Gorrasi, and Vittoria 2007). Loads of research works have been carried out all over the world for the preparation of various types of nanocomposites by using cellulose fibers as a reinforcing material. The main reason to utilize cellulose nanofibers in composite materials is that one can potentially exploit the high stiffness of the cellulose crystal for reinforcement. This can be done by breaking down the hierarchical structure of the plant into individualized nanofibers of high crystallinity, with a reduction of amorphous parts.

2. METHODS

2.1. Cellulose Nanocomposite Processing

Processing of nanocomposites of cellulose makes them suitable candidate for low-cost engineering material with plant fiber reinforcement in industry (Berglund and Peijs 2010) along with its cheaper, renewable and low abrasive nature, impressive mechanical properties, abundance, low weight, and biodegradability of cellulose nanocrystals (Azizi Samir, Alloin, and Dufresne 2005; Oksman et al. 2002; Hornsby, Hinrichsen, and Tarverdi 1997; Bledzki, Reihmane, and Gassan 1996). In determining the composite properties, processing condition plays an important role such as Glass fibers have high strength when freshly drawn whereas the condition was altered i.e., exposed to humid air then fibers absorb water surfaces of fibers become damaged because of rubbing action during processing, the strength decreases. The temperature of processing is also restricted for specific materials like for lignocellulosic materials, it is controlled to about 200°C due to their degradation temperature starts from 230°C (Hamad 2013). Cellulose nanocomposites can be processed using conventional processing methods. Before processing, drying of fibers is the key point as the water content in the fiber can outcome in weak adhesion in between fiber and polymer or it may cause voids in the nanocomposite when the water evaporates during processing.

Nishino, Matsuda, and Hirao (2004) reported the two typical routes for the preparation of cellulose nanocomposites, one-step and two-step methods (Figure 1). In this method, cellulose is firstly dissolved in a solvent which was followed by regeneration of the cellulose in the existence of another cellulose component which was undissolved. Vallejos, Peresin, and Rojas (2012) synthesized all-cellulose composites by electrospinning cellulose acetate (CA) solution having dispersed cellulose nanocrystals (CNC) to yield precursor CA/CNC composites. However, in the one-step method, cellulosic fibers are slightly dissolved in a solvent and then redeveloped in situ to obtain a matrix around the undissolved part. Cellulose composites are prepared using different composites manufacturing techniques like injection

molding, resin transfer molding (RTM), compression molding and vacuum bagging. Rånby (1951); Ranby (1952) firstly synthesized cellulose nanocrystals by hydrolysis of cellulosic biomass in mineral acid (hydrochloric or sulfuric). Processing starts with milling the pulp for small uniform particles followed by acid hydrolysis of the cellulose raw material for removing the bonded polysaccharides on cellulose fibril surface and a disordered or amorphous portion of cellulose that separates the fibrils (Revol et al. 1992). Acid hydrolysis is terminated by acid's rapid dilution, followed by the removal of acid via dialysis or centrifugation. Some mechanical forces like sonication are applied to terminate the aggregation of cellulose fibrils in order to yield cellulose nanocrystals having high crystallinity (Guo and Catchmark 2012). Cellulose nanocomposites show the different appearance from different sources, Figure 2 (Azizi Samir, Alloin, and Dufresne 2005).

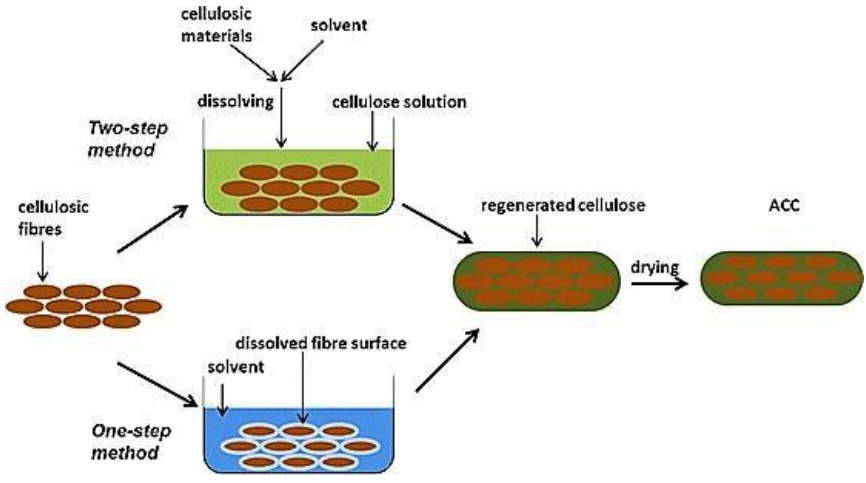

Figure 1. Schematic representation of the two-step (top) and one-step (bottom) preparation methods of ACCs Reprinted with permission from *(*Miao and Hamad 2013) Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262.

Favier (1995) first published the preparation of cellulose nanocrystals-reinforced polymer nanocomposites by using a latex which was achieved by the copolymerization of butyl acrylate (poly (S-co-BuA) and styrene and

tunicin whiskers (the cellulose mined from tunicate-a sea animal). Numerous studies have been furnished on isolation and characterization of cellulose nanofibers due to in the development of nanocomposites, cellulose nanofibers have a great potential to be used in a various different area as reinforcement from various sources. These nanofibers can be extracted by only chemical or both chemical and mechanical methods from the cell walls (Alemdar and Sain 2008) Compatibility of fibers and polymers is a very common problem in cellulose fiber-based composites due to high polarity and hydrophilic nature of fibers but non-polar and hydrophobic nature of polymers. To overcome this problem surfaces of fibre can be treated using various methods such as physical (stretching (Haig Zeronian, Kawabata, and

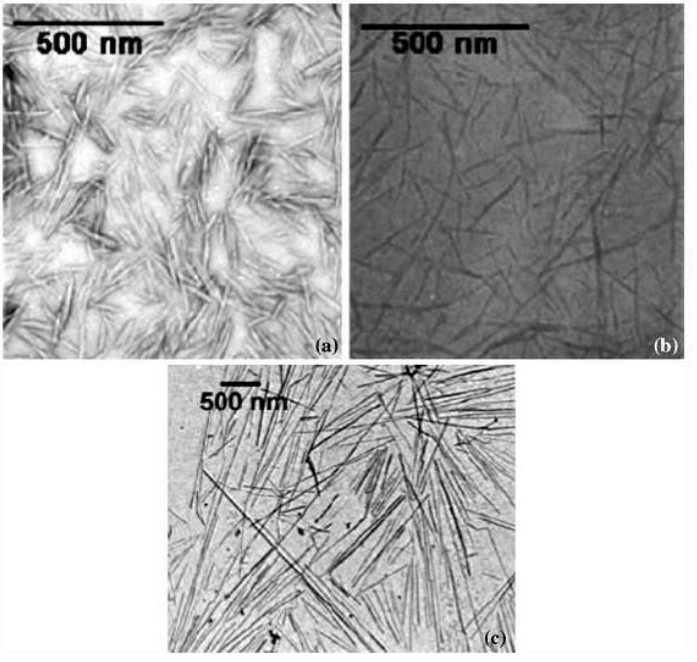

Figure 2. TEM images of CNC from different sources. a Cotton, b sugar-beet pulp, and c tunicin (the cellulose extracted from tunicate, a sea animal) Reprinted with permission from *(*Miao and Hamad 2013) Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262.

Alger 1990), calendering (Semsarzadeh 1986) and thermo-treatment Ray, Chakravarty, and Bandyopadhaya (1976), Physico-chemical (Takacs et al. 1999; Uehara and Sakata 1990; Carlsson and Stroem 1991; Kato et al. 1999; Kolar et al. 2000) and chemical methods (Belgacem and Gandini 2005). Various techniques can be used to characterize the modified fiber surface including scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FT-IR), contact angle measurements, confocal laser scanning microscopy (CLSM), elemental analysis, inverse gas chromatography (IGC), nuclear magnetic resonance (NMR) and atomic force microscopy (AFM) (Belgacem 2005; Mohanty, Misra, and Drzal 2001). Processing of cellulose nanofibers-reinforced nanocomposites by extrusion methods are explored rarely. The synthesis of cellulose nanocomposites by melt extrusion was prosecuted by injecting the suspension of nanocrystals into the polymer melt throughout the extrusion process (Oksman et al. 2006).

2.2. Properties of Cellulose Nanocomposites

2.2.1. Thermal Stability

Azizi Samir (2004) and Samir (2004) performed thermogravimetric analysis (TGA) experiments inspect the thermal degradation and stability of tunicin whiskers/POE nanocomposites and suggested that there was no effect of cellulosic fibers on POE nanocomposites degradation temperature. Choi and Simonsen (2006) suggested the effect of cotton cellulose nanocrystals content on the thermal behavior of CMC plasticized with glycerin revealed a close connotation between the filler and the matrix.

2.2.2. Mechanical Performance

Hajji (1996) studied the effect of preparation methods on the mechanical properties of a CNC-based nanocomposite. Nishino, Matsuda, and Hirao (2004) synthesized the cellulose nanocomposite films with cellulose I and II in the different ratio by the slight dissolution of microcrystalline cellulose powder in N, N-dimethylacetamide /lithium chloride and subsequent film

casting and the structure and mechanical properties of these films were characterized by XRD and tensile strength. The resulting films are transparent to visible light, isotropic, highly crystalline having different amounts of undissolved cellulose I crystallites. By varying the cellulose I and II ratio, the mechanical recital of the nanocomposites can be tuned. studied The consequence of preparation or processing methods on the mechanical properties of a CNC-based nanocomposite was studied by Hajji (Hajji et al. 1996). He suggested that the composite film synthesized by water evaporation reveals the best mechanical property due to less impact on the orientation of CNC, offers better dispersion of CNC in matrices which safes CNC structure from damage. Hence, Table 1 shows the importance of processing methods and even dispersion of the reinforcement in the matrix on nanocomposite properties.

Table 1. Mechanical properties of CNC based nanocomposites processed by different methods (Miao and Hamad 2013) Reprinted with permission from Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262

CNC content (wt%)	E		HP		XP	
	Modulus (MPa)	Tensile strength (MPa)	Modulus (MPa)	Tensile strength (MPa)	Modulus (MPa)	Tensile strength (MPa)
0	0.2	0.15	0.2	0.12	0.2	0.12
1	0.6	0.49	0.5	0.31	0.4	0.23
6	32.3	5	5.2	1.63	1.5	1.06

The factors which affect the mechanical properties of cellulose nanocomposites are compatibility of polymer resin and CNC, the molecular structure of the matrix, the aspect ratio of CNC particles and composite preparation procedure.

3. APPLICATIONS

Application in the field of development of composites by cellulose nanofibers is a comparatively new research area. Eichhorn (2009) incorporated uses of cellulose-based nanocomposites in reinforce adhesives for making optically transparent paper designed for electronic display and to produce DNA-hybrid materials, to create hierarchical composites aimed to use in foams, aerogels and for improved coupling between fiber and matrix. Cellulose nanocomposites have proven to be an unusually multipurpose biomaterial that may be used in an extensive variety of applied scientific endeavors like electronics, paper products, acoustics, automotive industry and most important in pharmaceutical and biomedical devices.

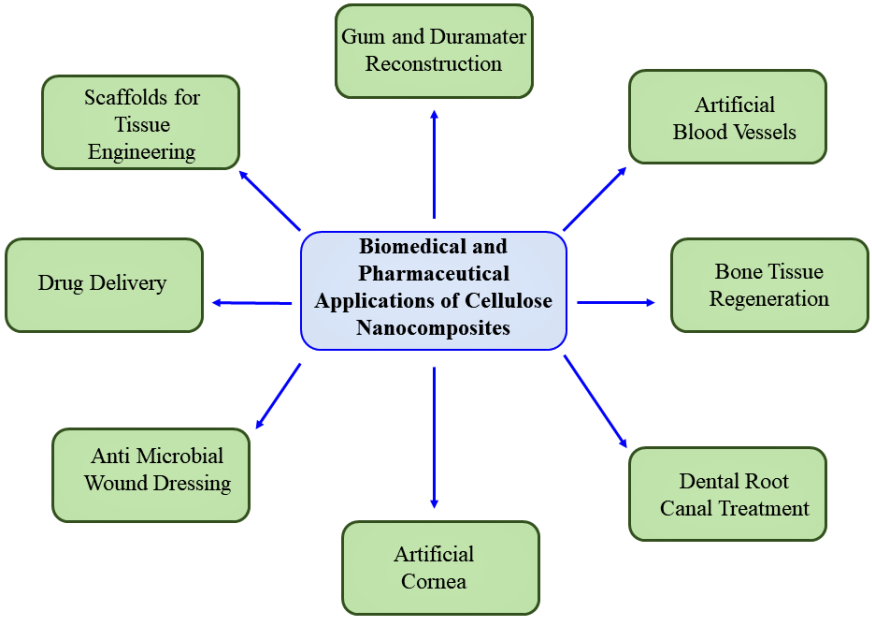

Figure 3. Biomedical and pharmaceutical applications of cellulose nanocomposites.

3.1. Pharmaceutical

Cellulose-based nanocomposites are highly useful in the pharmaceutical industry as cellulose has an outstanding property of compaction which blended smoothly with excipients in order to drug-loaded tablets form condensed matrices suitable for the oral management of drugs (Longer and Robinson 1990; Alderman 1984). Various potential advantages as a drug delivery excipient are offered by crystalline nanocellulose (Baumann et al. 2009; Watanabe et al. 2002). A large number of drugs can be found on the surface of cellulose nanocomposites due to high surface area along with the negative charge, makes them a potential candidate for high payloads and optimal control of dosing and it is also suitable because of established biocompatibility of cellulose. The hydroxyl groups present on the surface of crystalline nanocellulose offer a place for the surface amendment of the material with a wide range of chemical groups via many different methods. Modification of surface can be used to modulate the drug loading and release that would not normally tie to nanocellulose i.e., hydrophobic and nonionized. (Lönnberg et al. 2008; Shaikh et al. 2007).

3.2. Medical

Nowadays, eyes of biomaterial term has been used for nanocellulose because of its high applications in biomedical industry including drugs releasing system, skins replacements for wounds and burnings, nerves, blood vessel growth, scaffolds for tissue engineering, gum and dura mater reconstruction, stent covering and bone reconstruction (Mello et al. 2001; W. K. Czaja et al. 2007; Negrão et al. 2006; Klemm et al. 2001). Odontology is defied to find novel materials to substitute the bones in numerous procedures like facial deformities, maxillary, bone malformation and the loss of alveolar bone is the biggest challenge in this. Nanocellulose with appropriate porosity that provides the mat an infection barrier, painkiller effect, loss of fluids and allows medicines to be effortlessly applied and also works on purulent fluids by absorbing it during all inflammatory phases,

ousting it later on in a painless and controlled manner (W. Czaja et al. 2006). Cellulose nanocomposites have all types of properties like physical, mechanical and chemical along with huge superficial areas that give outstanding water absorption capacity and also elasticity shows characteristics of an ideal healing bandage. Barud (2009) have developed a biological membrane with cellulose nanocomposites to standardized extract of propolis, it has several biological properties with anti-inflammatory and antimicrobial activities which makes the membrane for good treatment for chronic wounds and burns. Raghavendra (2013) reported the antibacterial activity of the cellulose nanocomposites against Escherichia coli which was done by inhibition zone method, suggested that the synthesized CSNCFs can function effectually as anti-microbial agents and can be used for tissue scaffolding.

3.3. Others

Other applications of nanocellulose composites are mainly focused on paper and packaging products as well as furniture, automotive, electronics, electroacoustic devices, construction, cosmetics, and pharmacy. Additionally, they are applied in ultrafiltration membranes (water purification), additives for a high-quality electronic paper (e-paper), membrane for combustible cells (hydrogen) and membranes used to retrieve mineral and oils (Brown 1998). The high stiffness and strength along with the small dimensions of nanocellulose may enhanced properties to composite materials reinforced with cellulose fibers and these could afterward be used in wide range of applications. Cellulose nanocomposites have been used in audio diaphragms due to its property to bear two essential properties that are low dynamic loss and high sonic velocity. It is stated that the sonic velocity of films was virtually equivalent to those of titanium and aluminum (Iguchi, Yamanaka, and Budhiono 2000). Jonas and Farah (1998) reported that SONY had already been using it in headphones diaphragm. In Kyoto University, researchers prepared strong but enhanced transparent composite material by isolating nanofibrillated cellulose structure by

improving the dispersion of nanofibers in the matrix and on this basis, an organic display system is being developed recently (Shimazaki et al. 2007; Iwamoto et al. 2005).

CONCLUSION

Cellulose nanocomposites are unique nanomaterials derived from most abundant natural polymer, cellulose, which is made from superfine fibrils in nanoscale diameters. It has been observed that from last 15 years there has been steady progress in the field of cellulosic nanocomposites. Cellulose nanofibers have exciting potential to be used as reinforcement in nanocomposites as these are non-toxic, sustainable, renewable and biocompatible nanomaterials. The present chapter gives an overview of the use of cellulose fibers as reinforcement material in polymer matrices. The aim of chapter is to provide knowledge of cellulose nanocomposites for further research and studies. The chapter also summarizes the effect of processing methods and other parameters on thermal and mechanical properties of nanocomposites. The potential mechanical properties of cellulose nanocomposites vie well with other engineering materials and devices. Processing methods, properties, and applications in various fields such as pharmaceutical, medical and others are well discussed in the chapter.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 4

POLYLACTIDE (PLA) BASED NANOCOMPOSITES FOR APPLICATIONS IN ANTIBACTERIAL/MICROBIAL AND BIOMEDICAL ENGINEERING

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ABSTRACT

For the last few decades, there has been growing interest in bio-based polymers and nanocomposites open an opportunity for the use of new, high-performance material. The use of biodegradable polymers and nanocomposites are of great importance currently in many applications, Polylactide (PLA) represents the best polymeric substitutes in the framework of environmentally friendly and sustainable processes and products for several petropolymers due to its renewability, bio-compatibility, ease of surface chemistry modification, biodegradability, good thermomechanical and optical properties. Having the above properties polylactide (PLA) nanocomposite shows immense potential in food packaging, antimicrobial as well as in pharmacology and biomedical engineering areas.

Keywords: polylactide (PLA), nanocomposites, food packaging, biomedicine

INTRODUCTION

Polylactide (PLA) is a thermoplastic that can be derived from renewable sources and degrades to nontoxic compounds in landfills (Martin and Averous 2001; Tsuji and Ikada 1998). Polylactide (PLA) has been the leader in all biopolymers due to its outstanding mechanical properties, biodegradability, renewability, and relatively low cost and also justify environmental concerns of greenhouse gas emissions, environmental pollution and the depletion of fossil resource (Auras, Harte, and Selke 2004; Kümmerer 2007; Jenck, Agterberg, and Droescher 2004). It is a polymer of monomer lactic acid, which may be easily produced by carbohydrate feedstock's fermentation. Hence, PLA provides more disposal options and its production is less environmentally burdensome in comparison to other traditional petroleum-based plastics (Doi and Steinbüchel 2002; Lunt 1998). Low molecular weight PLA was firstly prepared by *Pelouze* in 1845 by the action of condensation of l-lactic acid followed by removing of water continuously (Carothers, Dorough, and Natta 1932). To substitute the conventional petroleum-based plastics, Polylactic acid (PLA) has been explored recently by researchers or polymer scientists as potential biopolymer (Sinha Ray, Maiti, et al. 2002; Sinha Ray et al. 2003; Ray and Okamoto 2003). PLA, in comparison to some other polymers, is stiff and brittle with low impact strength and low deformation at break (Jacobsen et al. 1999). In recent, PLA has grabbed attention as of biodegradable polymers, though, as packaging material, the use of PLA is still a barrier due to its high cost and low performance as compared to other commodity polymers. The most important limitation is its low gas barrier properties for the application of PLA in food packaging. For applications in various fields, PLA suffers some other limitations like heat distortion temperature, low thermal resistance, and rate of crystallization, while some other precise properties are essential by different end-use sectors such as antistatic to

conductive electrical characteristics, flame retardancy, antibacterial, anti-UV or barrier properties, etc.

Polymer nanocomposites have grabbed a lot of attention from the last few years. These are low cost and high-performance materials for applications in various fields from tissue engineering to automotive to food packaging have become enchanting to researchers around the world (Vaia and Giannelis 2001; Alexandre and Dubois 2000; Giannelis 1996). Nanocomposites technology has the great potential to enhance polymer properties and inflate the applications of PLA, therefore, by adding nanofillers in PLA represents an interesting way to outspread and to enhance the properties of PLA (Raquez et al. 2013; Thellen et al. 2005; Rhim, Hong, and Ha 2009; Sinclair 1996). A number of researchers have been worked on PLA-based nanocomposites with layered silicates so as to mark highly exfoliated structures. *Bordes* et al. (Bordes, Pollet, and Avérous 2009) reported routes for the synthesis of PLA/layered silicate nanocomposites which was based on solvent intercalation, melt-intercalation and in situ intercalation.

METHODS

Preparation and Properties of Polylactide (PLA) Nanocomposites

Sinha Ray and Maiti (2002) synthesized polylactide (PLA)/layered silicate nanocomposites by simple melt extrusion of PLA with organically modified montmorillonite. These intercalated nanocomposites revealed outstanding enhancement of materials properties in both melt and solid states in comparison to PLA matrices without clay. Cabedo (2006) reported nanocomposites of amorphous PLA and chemically modified kaolinite and noticed good interaction within polymer and clay led to an increase in oxygen barrier properties of about 50%. They also studied the addition of plasticizers to conquer the inherent brittleness of PLA. Schmidt, Shah, and Giannelis (2002) developed many poly(l-lactic acid) (PLA) nanocomposites

which were based on different layered inorganics. These nanocomposites exhibited enhanced mechanical properties with higher moduli in compare to pure PLA. The increment was above T_g, by which work temperature was enhanced and this enhancement did not hinder biodegradation. In nanocomposites, the rate of biodegradation was enhanced six to ten times and it was cleared by marine respirometry and crystallinity measurements in solution pretending a physiological environment. PLA/PBAT bio-nano composites were prepared by *Moustafa* and coworkers for their application in antimicrobial natural rosin for green packaging. They used green modification method of organoclay, non-toxic reinforcing material makes the material to maintain its green character. The attained results revealed the outstanding possibility of using expanded OC modified PLA/PBAT polymer blends in which green material antimicrobial natural rosin was added, for their applications in food packaging and biomembranes (Moustafa et al. 2017).

Table 1. Comparison of material properties between neat PLA and PLACN4 reprinted with permission from Nano Letters, 2002, 2 (10), pp 1093–1096. Copyright (2002) American Chemical Society

Material properties	Neat PLA	PLACN4
Storage modulus/GPa at 25°C	1.63	2.32
Flexural modulus/GPa at 25°C	4.8	5.5
Flexural strength/MPa at 25°C	86	134
Distortion at break/%	1.9	3.1
HDT/°C	76.2	94
O_2 gas permeability coefficient ($mL.mm.m^{-2}.day^{-1}.MPa^{-1}$)	200	177

Ray and coworkers developed polylactide (PLA)-layered silicate nanocomposite and studied material properties and biodegradability. They found that material properties were increased after nanocomposite formation in comparison to neat PLA, Table 1 (Sinha Ray, Yamada, et al. 2002). D. R. Paul and Robeson (2008) reported that the addition of montmorillonite increased the biodegradation of PLA under compost. In these conditions, PLA firstly fragmented and followed by a biodegradation process, when PLA underwent fragmented to about 10,000 g/mol.

Sabet and Katbab (2009) prepared PLA based nanocomposites with improved biodegradability and abridged oxygen permeability via melt hybridization of poly (lactic acid) (PLA) and organomodified clay which showed a correlation between the structure of nanocomposites and rate of biodegradation.

Preparation of Poly(L-lactide)/layered aluminosilicate nanocomposites in the presence of two organo-modified montmorillonites by ring-opening polymerization was reported by Paul and coworkers (M. A. Paul et al. 2003). They suggested that the obtained exfoliated nanocomposites having enhanced thermal stability were attained by directly grafting of polymer chains on the surface of clay via hydroxyl-functionalized ammonium cations or these nanocomposites with high molecular weight were obtained via solid-state polymerization (Katiyar and Nanavati 2011). As sepiolite/PLA nanocomposites are less studied, the PLA nanocomposites melt-elaboration and characterization in the presence of Cloisite 30B and sepiolite was studied by Fukushima and coworkers (Fukushima, Tabuani, and Camino 2009).

Polylactide (PLA) nanocomposites were prepared by solution and melt mixing in the presence of carbon nanotubes (CNTs) for the studies of crystallization kinetics and morphology. Figure 1, represents the DSC cooling traces for nanocomposites cooled from the melt at various rates. Neat PLA showed very slow crystallization kinetics while with increasing CNT content faster crystallization kinetics are attained (Barrau et al. 2011).

Poly(lactic acid) (PLA) with organically modified montmorillonite (oMMT) in the presence of triallyl cyanurate (TAC), have been cross-linked by high-energy electrons in order to prepare its nanocomposites. TEM of PLA nanocomposites, Figure 2, revealed the internal structure of composites, like the dispersion position of the nanofiller in the matrix (Wang et al. 2012). Zheng (2009) prepared biocompatible (PDLLA)/magnetite (Fe_3O_4) nanocomposites by chemical co-precipitation and analysis of these were done by glass transition temperature (Tg), micro-surface morphology, mechanical properties, and functional groups change. Their shape memory effect was also reported in their studies.

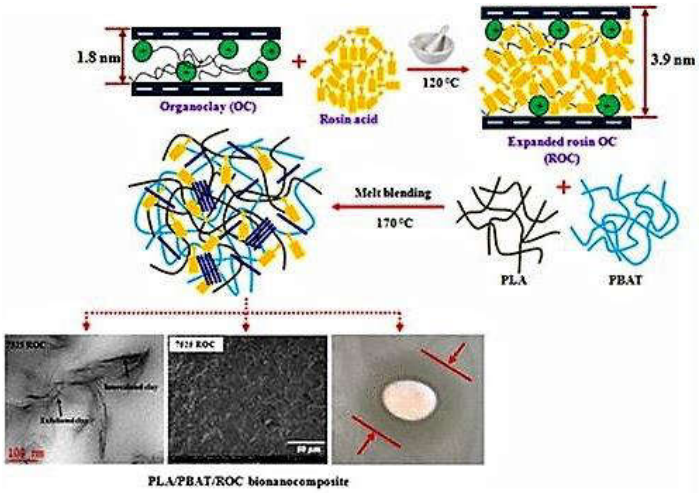


Figure 1. Synthetic scheme of PLA/PBAT/ROC bionanocomposite. Reprinted with permission from *ACS Appl. Mater. Interfaces, 2017, 9 (23), pp 20132–20141*. Copyright (2017) American Chemical Society.

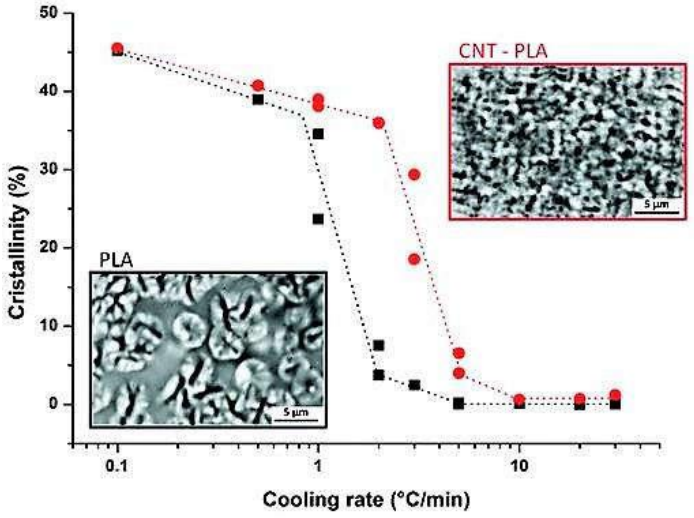


Figure 2. PLA crystal content versus cooling rate for NT0 (black squares), NT01 (green triangles), and NT1 (red circles). Reprinted with permission from *Macromolecules*, 2011, 44 (16), pp 6496–6502. Copyright (2011) American Chemical Society.

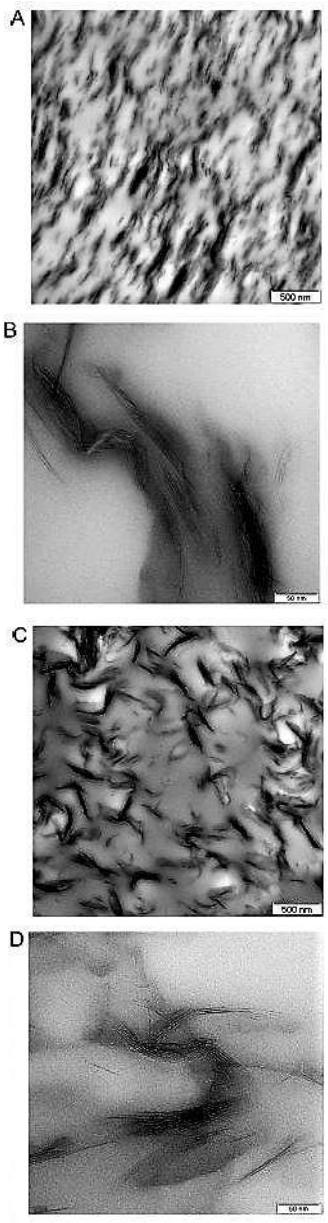
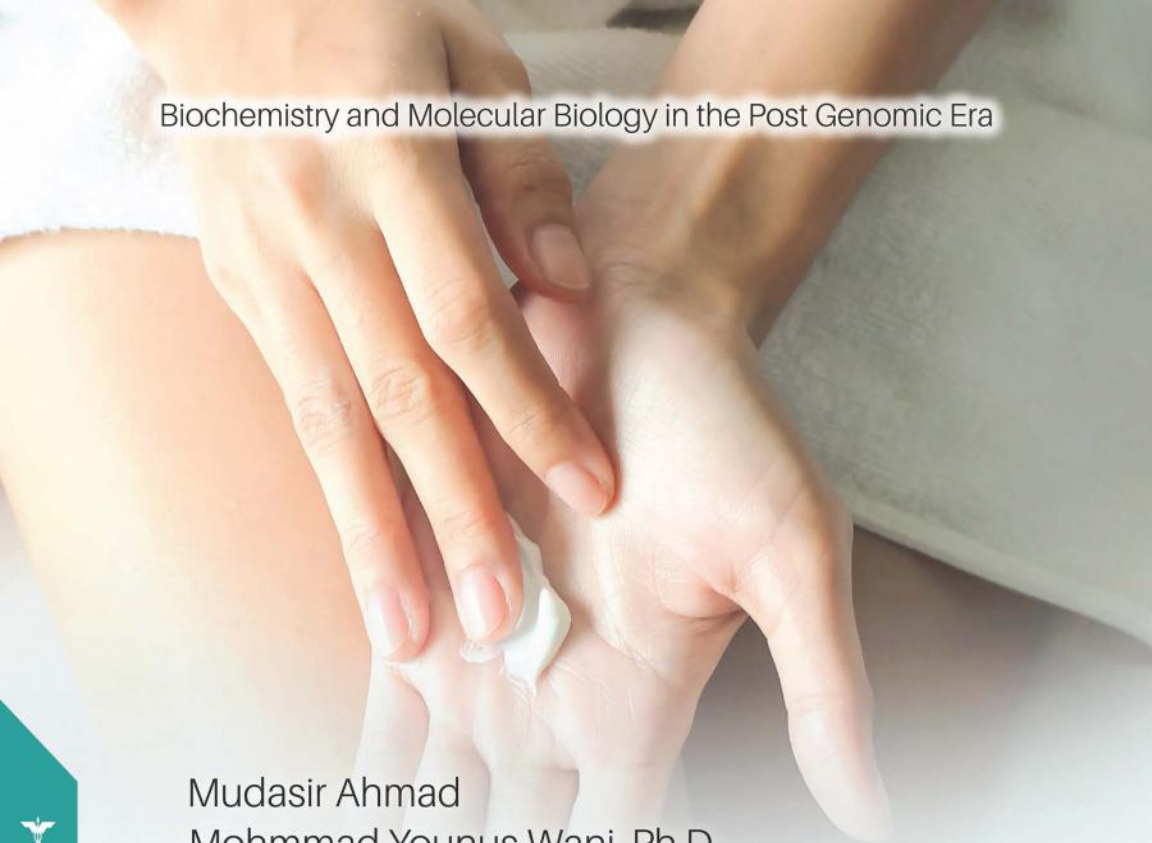


Figure 3. TEM patterns of PLA nanocomposites showing the nature of the dispersion of nanoclay in the matrix: (A, B) PLA-MMT-TAC 0kGy and (C, D) PLA-MMT-TAC 70kGy. Reprinted with permission from *Langmuir, 2012, 28 (34), pp 12601–12608*. Copyright (2012) American Chemical Society.



Biochemistry and Molecular Biology in the Post Genomic Era

Mudasir Ahmad
Mohmmad Younus Wani, Ph.D.
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Baoliang Zhang
Editors

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IN THE POST GENOMIC ERA

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Library of Congress Cataloging-in-Publication Data

ISBN: *978-1-53616-248-6 (ebook)*
Library of Congress Control Number:2019950487

Published by Nova Science Publishers, Inc. † New York

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PREFACE

Biocomposites are a classic types of materials obtained from a matrix (renewable and non-renewable resources) and reinforcement of natural fibers. It often resembles the compositions of a living material implicated with a definite biological process. Industrialists and researcher's interest in biocomposites is rapidly growing due to the great benefits they offer such as being renewable, cheap, recyclable and biodegradable. The high potential for exploiting natural biopolymers with their broad range of structural, functional and physicochemical properties in various applications has provided the stimulus for the search for new or modified biocomposites. At present, research and development efforts in this field are relatively small, but the growing use of biocomposites based materials in wound healing management, drug delivery, and orthopedics repair products has stimulated scientists, engineers, and government agencies to put more efforts in fostering greater collaboration and bringing more advanced biopolymer-based biocomposites to replace the synthetically derived materials in biomedical applications.

The book covers the advanced traces of Biopolymers such as lignin, cellulose-based nanocomposites for biomedical and pharmaceutical applications, gelatin, polysaccharides based nanocomposites for applications in antibacterial/microbial/biomedical engineering, drug delivery system and tissue engineering. Further, presents the opportunities and applications in the field of biocomposites highlighting recent advances

in areas commencing chemical synthesis and biosynthesis for end-user applications. This book will serve as a comprehensive literature guide for beginner researchers to grab the attention of biomedical researchers in both academia and industries to help streamline the efforts and understand the need to develop new biocomposites that could solve some of the most serious biomedical problems. The book is aimed to be a reference material for the academic and research community involved in biomedical research.

Finally, it is expected that this book will find a prominent place in the traditional universities and research institutions libraries where chemistry, biology technology, medicines as well as environmental studies, and other practical and theoretical mechanized topics are taught, studied and implemented.

In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 1

ENZYMATIC MODIFICATION OF BIOPOLYMERIC SURFACES FOR CO_2 SEQUESTRATION

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ABSTRACT

Due to the increased demand for energy, which underlies the projected increase in CO_2 emission, parallel to clearing of the forests which reduces the photosynthesis to CO_2 from atmosphere; resulting in the net increase of CO_2 concentrations higher than earlier. Carbon sequestration–capturing and storing carbon emitted from the global energy system – could be a major tool for reducing atmospheric CO_2 emissions. Over last decades, Biopolymers are considered as most encouraging and assuring materials for modification of their surfaces due to the presence of amino, hydroxyl, carboxyl, sulphydryl, etc. functional groups among the biopolymers which contributes possible interactions among pollutants and biopolymers. With growing concern of environmental sustainability and non-biodegradation

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of plastic waste, the biopolymers are emerging as the tool for the selective applications for reducing the pollution. Biopolymers are behind many important inventions of the past several decades, like 3D printing. So-called "engineering plastics," used in applications ranging from automotive to construction to furniture, have superior properties and can even help solve environmental problems; where the sequestration of CO_2 is in line with among the most prominent treatments. The arrays of biopolymers have been attempted with high precession and selectivity of CO_2 by many researchers. A series of modified biopolymer surfaces have been synthesized, to investigate the interaction between them with CO_2. The present chapter investigates and provides comprehensive information about the latest innovations in the biopolymers based renewable resources, along with the immobilization of different enzymes onto their surfaces to achieve the bio-mimicking for the above purpose.

Keywords: biopolymers, composite carriers, enzymes, modification of polymers, immobilization methods, applications

1. INTRODUCTION

From the earliest times, since life began Polymers have existed in natural forms such as DNA, RNA, proteins, and polysaccharides which play essential roles in plant and animal life. They are also known as macromolecules that are crucial to our very existence without which life seems very difficult. Large no. of single structural units called monomers are linked together in a regular manner by the chemical reaction known as polymerization give rise to the gaint molecule called "polymer". To form a molecule of high molecular weight, a chemical reaction occurs in which two or more substances coupled with or without an evolution of heat, water or any other solvents. With the growing advancements in the scientific and technological world, polymer chemistry plays an interesting role in providing solutions to the critical problems of food, cloth, shelter, education, air, health, energy resources, etc. As polymers serve comfort zone in the areas of medication, nutrition, communication, transportation, irrigation, recording history, buildings, etc.

In today's environment, renewability, recyclability, sustainability, triggered biodegradability all can make a huge difference. Eco-friendly composites, bio-composites derived from natural renewable resources having recycling capability and stability in their intended lifetime are called sustainable bio-based products. Cellulose, soy plastics, Microbial synthesized biopolymers i.e., polyhydroxyalkanoates (PHAs) polymers, starch is all the best-suited examples of biopolymers based on renewable resources.

Due to the presence of most preferable features in biomaterials such as molecular weight, material chemistry, shape and structure, solubility, lubricity, hydrophobicity, erosion mechanism, etc. they are perfectly considered for biomedical applications, tissue engineering scaffolds, and organ substitution. These materials improve the cell's performance in biological system since they exhibit bioactive properties and have better interactions with the cells. Numerous advantages are available for biodegradable polymeric materials over synthetic ones because of their versatile nature and have capability to not to accumulate or harm the environment. Some enlighten merits are the presence of important functional groups like amino, hydroxyl, Carboxyl on the surface of natural polymers which bear potential for tissue engineering and also less prone to produce toxic effects in the environment. Naturally, derived materials are biocompatible in nature and can be easily incorporated while synthetic ones are less compatible and get easily degraded into bio-products.

With the growing recent advances in biotechnology, various methods are employed for modification of biopolymer surfaces to achieve desired functional properties in such a way we are able to functionalize the surface of biopolymer by introducing some enviable functional groups so that it would be easy for biomacromolecules to interact with the surface of polymers. In this article, we are trying to familiarize the impact of recent advances in biotechnology as well as contemporary sciences of microbiology and interface between biotechnology and enzymology(S. Roller and 1. C. M. Dea. 1992). Before throwing the light on the impacts of biotechnology i.e., modification of biopolymers, the primary requirement is to figure out the concepts and the basic knowledge of biopolymers.

2. BIOPOLYMERS AS SUSTAINABLE RESOURCES

Biopolymers are acquired from plant and animal materials which can be grown indefinitely can be considered sustainable, and are always renewable. They are the guiding fundamentals for the polymers of next-generation which have nil impact, sustainability, eco-efficiency, and green chemistry. Over the last two decades, polymer chemistry has attracted the huge attention due to the extrusive or eye-catching apprehensions predominantly concern for the environment and secondly which is the major and most imperative reason i.e., recognition of synthetic materials or petroleum resources are finite that's why researchers nowadays fascinate towards the polymers which are renewable i.e., Biopolymers. The term "biopolymer" is also referred as organic polymer which is produced naturally by living organisms. Biodegradable or compostable polymeric materials can be derived from renewable resources under specific environmental conditions. One of the major blessings of biopolymer is that they are fully competent in biodegradation at accelerated rates, eco-friendly or used as green approaches by shattering down themselves into simple molecules such as carbon dioxide, methane or water by the action of microorganisms enzymatically in a limited period of time. Detailed classification of biopolymers on the basis of source or method of production given below:-

(i) Polymers such as polysaccharides or proteins which are directly extracted from biomass.
(ii) Polymers synthesized from renewable sources such as polylactic acid (PLA) by a classical chemical approach.
(iii) Polymers originated by genetical modification of bacteria such as polyhydroxyalkanoates (PHAs), bacterial cellulose, etc.

2.1. Natural Resources Derived from Fauna

2.1.1. Chitin and Chitosan

Chitin is the second most pervasive biopolymer present on the earth after cellulose (which comes under the category of fauna species and have

discussed later in this chapter) and it is mainly found in the tightly bound complexes with other substances in the cuticles of crabs and shrimps as well as in the internal structure of invertebrates. It occurs in the forms of three allomorphs viz. α-Chitin, β-Chitin & γ-Chitin (a combination of both) which can merely individuated by infrared and solid-state NMR spectroscopies together. From the studies of these crystallographic invariants of two isomorphs, conclusion revealed that in α-Chitin, two antiparallel molecules per unit cell are present but only one parallel orientation exists in β-chitin, Islem Younes and Marguerite Rinaudo. (2015). The chains of α-Chitin & β-Chitin are organized in sheets and held by intra-sheet hydrogen bonds. Chitin is composed of β(1-4)-linked 2-acetamido-2-deoxy-β-D-glucose (N-acetylglucosamine) and often considered as cellulose derivative although it does not present in cellulose producing organisms but is structurally identical to cellulose despite it has acetamide groups (-$NHCOCH_3$) at the C-2 positions (Pradip Kumar Dutta et al. 2004). Chitin and its derivatives can be tailored or functionalized via certain chemical modifications like nitration, xanthation, sulphonation, acylation, phosphorylation, hydroxyalkylation, Schiff base formation, alkylation, ionic reactions or the one which is the most promising pathway of tailoring the chitin and its derivatives are graft polymerization. It is becoming a very optimistic remarkable material in this 21 century because of its advanced perspective on the grounds of medical, pharmaceutical, food industry, bio-science related advancements, tissue and protein engineering and so on (Keisuke Kurita 2006). Many researchers or authors have reviewed the laxation of chemical structure of chitin and chitosan in order to improve their solubility in conventional organic solvents (M. Jalal Zohuriaan-Mehr. 2005). Other biopolymers can easily blend or crosslinked with cell walls of many organisms and plants made up of chitin and can be cast into sheets or films. Because of having strong positive charge on the chitin and its derivatives, this property of natural biopolymer (chitin) can be exploited in many ways as we have seen its abundant applications in biomedical era. Due to its film-forming properties, it has enough potential for packaging materials in food packaging, edible films or coatings (Elisabeta Elena TĂNASE et al. 2014). This fascinating polymer has a huge variety of applications as well as

chitosan which is a widely accepted biopolymer is extracted from chitin itself. On the other hand, Chitosan is a nitrogenous polysaccharide having amino group in its structural moiety called chitosan (poly-β-(1→4)-2-amino-2-deoxy-D-glucose) which is chiefly formed by deacetylation of chitin (George Z. Kyzas et al. 2015). Nowadays, Chitosan is becoming a very crucial topic especially in the fields of food, medical, protein or tissue engineering as well as in pharmaceutical applications. Chitosan is a marine polysaccharide that is widely used in biomedical research due to its encouraging properties like biocompatibility, biodegradability, low production cost, very little toxicity and highly abundant renewable material in the market. Its antibacterial activity has attracted wide attention to the researchers as this activity is affected by molecular weight and degree of acetylation where low molecular weight chitosan is harmless to the human body and has strong antimicrobial properties (Elisabeta Elena TĂNASE et al. 2014). Numerous natural polysaccharides of acidic in nature like cellulose, pectin, dextrin, alginic acid, agar, agarose are widely accepted or known to the researchers, among them, chitin and chitosan are the ones which are known for their basic nature due to the presence of amino groups which would be highly beneficial for chemical modifications. Now, moving towards to describe its preparation and its structural properties as chitosan is derived from deacetylation of α-chitin by giving aqueous alkali treatment i.e., 40 -50% at 120-150°C under heterogeneous conditions (Keisuke Kurita. 2006). This natural renewable polymer also is known as the deacetylated form of chitin. By repeated treatment of alkali, complete deacetylation of chitin can be achieved. The N-deacetylation of chitin can be implemented by homogeneously and heterogeneously approaches. Among these two, heterogeneous method can be considered best as it provides better results i.e., deacetylated up to 85-99% where homogeneous up to 45-55%. In heterogeneous method, chitin is treated with the hot concentrated solution of alkali NaOH during few hours which produced insoluble residue of chitosan. While in a homogeneous medium, chitin is dispersed in concentrated NaOH at 25°C for 3 hours or more than that, followed by dissolution in crushed ice around 0°C. This technique leads to the soluble chitosan with an average degree of acetylation of 48% - 55%. In nature, two

types of chitin are available α-chitin and β-chitin. From these two types β-chitin from squid pens are most responsive to deacetylation reaction because of comparatively weak intermolecular forces of attraction, in addition to this, it tends to produce chitosan in a light tan to brown color under similar conditions (Keisuke Kurita. 2006). By deacetylation of chitin (poly-β-(1→4)-N-acetyl-D-glucosamine) which is one of the most interesting natural biopolymers, is mainly found in marine media and specifically in the exoskeleton of crustaceans or cartilages of mollusks, cuticles of insects and cell wall of microorganisms (George Z. Kyzas et al. 2015). Due to the availability of primary amino and secondary hydroxyl group, it is easily derivatized by introducing several functional groups which are easily accessible for interaction with the enzyme. To scrutinize their full potential, special stress has been put on structural metamorphosis of chitin and chitosan (Keisuke Kurita. 2006). In further discussion, the tailoring pathways for the modification of chitosan as renewable resources are explained.

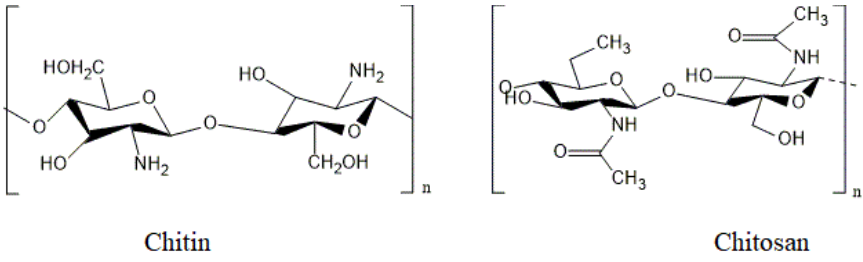

Figure 1. Chemical Structure of chitin and chitosan.

2.1.2. Collagen

Special attention should also be paid to *collagen*. As collagen proteins are chiefly found in extracellular matrices of vertebrate animals. Being a natural polymer, collagen is a major structural component of tendon, bone and connective tissues of animal hides and skins that provides mechanical support and structural organization of connective tissues. Due to its biodegradable and biocompatible nature, collagen has outstanding applications in the field of biomedical grounds like tissue engineering,

wound healing, drug delivery, and cosmetics. Moreover, for the improvement of the wound healing process, human tissues are replaced by animal-derived tissues because of the presence of collagen. It comprised of three polypeptide chains of triple helix and supramolecular structures are formed by all the members of the collagen family in extracellular matrix despite their variation in size, function and in tissue distribution (Figure 2) (K. Gelse et al. 2003). Collagen has been practiced for immobilization of tannase introducing glutaraldehyde as a cross-linking agent. Magnificent supporting matrix, Fe^{3+} collagen fibers have been proved beneficial for catalase immobilization as enzyme retains its significant activity even after 26 reuses (Sumitra Datta et al. 2012).

2.1.3. Alginates

Alginate is another natural polymer extracted from seaweeds that has gained tremendous interest in immobilization and microencapsulation technologies. It comprised of chains of alternating of α-L-guluronic acid and β-D-mannuronic acid residues (Figure 3). Carrier matrix of alginates is customarily built by crosslinking the carboxyl groups of α-L-guluronic acid with a solution of a cationic crosslinker such as barium chloride, calcium chloride and poly(L-lysine). Instability in the physiological environment or in the common buffer solutions with high concentration of phosphate and citrate ions that have ability to extract Ca^{2+} from the alginate matrices which are crosslinked with Ca^{2+} ions and liquefy the system is the major limitation of alginate matrices. In order to conquer the limitations of alginate as an immobilization material, numerous researchers or investigators have proposed to form microcapsule system or gel for protein immobilization by ionic complexation of chitosan (a positively charged material) and alginate (a negatively charged material). Several studies reveal that novel core-shell microcapsule technology for enzyme immobilization is proved to be very impressive technique in which enzyme is localized and protected in a core matrix, while the shell can regulate entry and exit of substrate and product. Chitosan crosslinked with sodium tripolyphosphate resulted in the phosphate ions diffusing into the Ca^{2+} alginate core and liquify it. Hence, we are in a condition to immobilize β-galactosidase in Ca^{2+} alginate (liquid

core) as well as in Ba^{2+} alginate (solid core) enveloped by the perm-selective chitosan shell (Ehab Taqieddin et al. 2003). One of the major disadvantages is the leaching of enzyme from the support matrix of alginate when used without combination of any divalent ions such as Ca^{2+} ions or without any crosslinker like glutaraldehyde. To boost the interactions between enzyme and support matrix, composite of chitosan and alginate proved to be more reliable with high porosity and good hydrophilicity for trapping of enzyme (Sumitra Datta et al. 2012). This may be attributed to the presence of both hydroxyl & amino groups present in structure for covalent binding of enzyme.

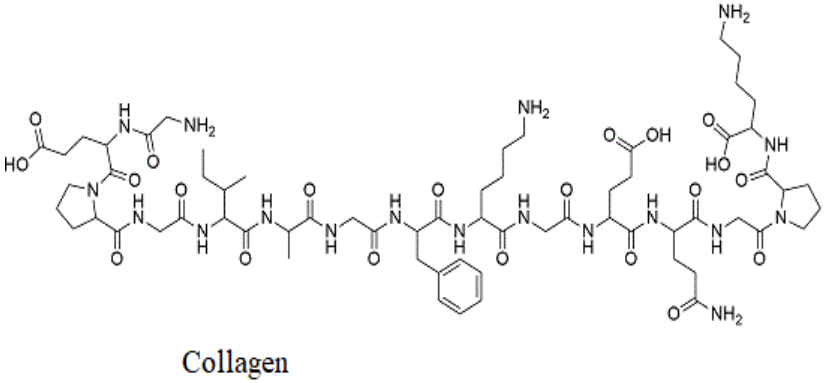

Figure 2. Chemical structure of collagen.

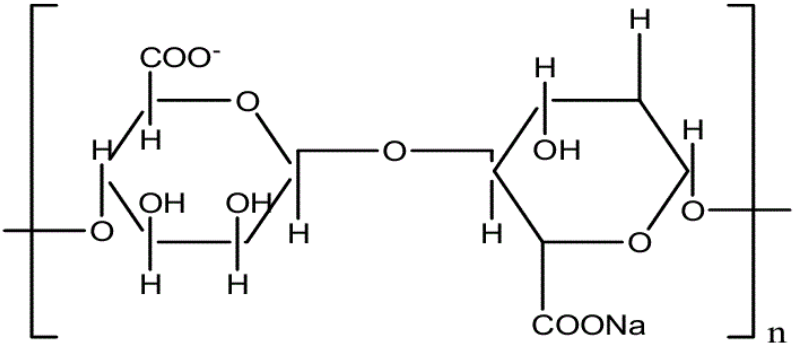

Figure 3. Chemical structure of alginate.

2.1.4. Gelatin

Gelatin is another renewable resource derived from natural resources like collagen taken from animal body parts which consist of many glycine residues, proline, and 4-hydroxy proline residues. The arrangement of the structure is Ala-Gly-Pro-Arg-Gly-Glu-4Hyp-Gly-Pro (Figure 4). It is most abundant polymer found in nature, possesses high hydrophilicity resulting in high swelling properties in aqueous media which helps in stabilizing in immobilizing the enzyme. It attracts attention for its use as a carrier matrix for an immobilized enzyme because it can be easily transformed into porous microcapsules. Earlier research papers revealed that gelatin would be used as a support matrix for the immobilization of glucoamylase (Exo-1,4-a-D-glucosidase) by cross-linking with glutaraldehyde followed by entrapment methodologies for the commercial process(J. F. Kennedy et al. 1984).

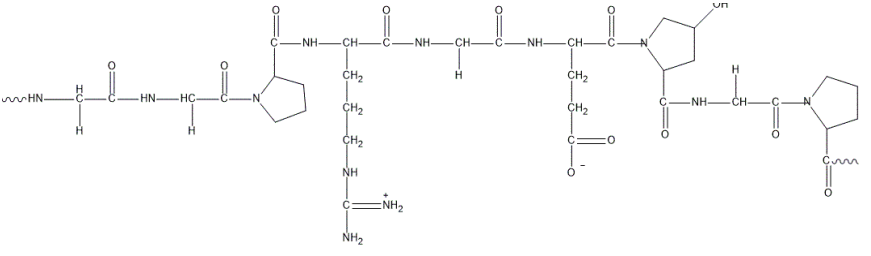

Figure 4. Chemical structure of gelatin.

2.2. Natural Resources Derived from Flora

2.2.1. Starch

Another striking and appreciating feature of biodegradable polymer is *Starch*. Due to its huge abundancy, cheaper and renewability, starch can minimize the use of synthetic polymers in plastic industries. Amylose and Amylopectin are the two main primary constituents of the starch. Although pure starch lacks mechanical strength despite this, it has been widely used in making biodegradable plastics (Elisabeta Elena TĂNASE et al. 2014). The hydrophilic nature of starch is the main limitation that inhibits its use in moisture environment. Entrapment of bitter-gourd peroxidase and surface

immobilization of enzymes was carried out by calcium alginate-starch hybrid supports. In the presence of denaturants like urea entrapped enzyme was more stable due to internal carbohydrate moieties. In order to obtain high yield of products, industrial techniques are widely accepted such as grafting of substances like acrylamide & dimethylaminoethyl methacrylate on to starch for the immobilization process (Sumitra Datta et al. 2012).

2.2.2. Cellulose

Another very important and interesting biopolymer falls under the light of renewable resources which is known as unlimited and sustainable natural polymeric raw material having wide applications in grounds of both industries and domestic purposes. This raw material is mainly present in the form of microfibrils with the helical organization on the various levels containing domains of amorphous and crystallinity appearances. It is chiefly found in the cell walls of superior plants (Elisabeta Elena TĂNASE et al. 2014). The structure of cellulose reveals that it consists of linear chains of homopolysaccharide comprised of β-D-glucopyranose units linked together by β-1-4-linkages with a degree of polymerization (DP) of approximately 15000 for native cellulose cotton and 10000 for cellulose chain (Figure 6 represents the chemical structure of Cellulose unit). Mostly natural resources are characterized as rigid and partially crystalline materials. Cellulose is considered as the main constituent of compounds present on the earth especially within wood and natural fibers such as kenaf, palm, hemp, flax, etc. It lacks solubility in water, this property of cellulose reveals that it comprised of strong inter and intramolecular hydrogen bonding within and among individual chains. Consequently, the exterior surface of the cellulose fibers exhibits hydrophobic nature which renders it an assuring material for enzyme immobilization. Moreover, presence of hydroxyl groups on the cellulose surface proves to be an ideal site for taking part in covalent bonding of enzyme immobilization and also capable of bringing almost all the chemical reactions. The stability of cellulose is due to the formation of well-ordered hydrogen bonds because of the presence of hydroxyl groups on its surface of moiety of each monomer unit which is also a special evident in the crystalline packing of cellulose (Safwan Sulaiman et al. 2014).

Carboxymethylcellulose (CMC), cellulose acetate (CA) and cellulose nitrate are the few known derivatives of cellulose which are used as a raw material in chemical and biological industries at a high commercial level due to their features like inexpensive, non-toxic, biodegradable, and biocompatible (Yue Liu and Jonathan Y Chen. 2014).

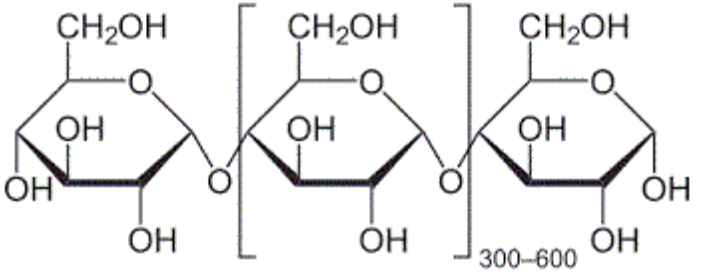

Figure 5. Chemical structure of starch.

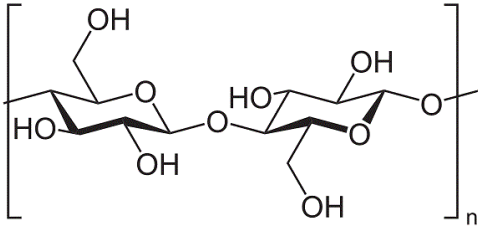

Figure 6. Chemical structure of cellulose unit.

2.2.3. Agar-Agar and Agarose

Agarose is one of the attractive biopolymer practiced in enzyme immobilization. Agar composed of two main components i.e., Agarose which is a linear neutral gelling heteropolysaccharide and Agaropectin is a heterogeneous mixture of smaller molecules. A major fraction of Agar i.e., agarose, a linear polymer consisting of two monosaccharide units i.e., (β-D-galactose) and (3,6-anhydrous-α-L-galactose) linked by glycosidic bonds β(1-4) & α(1-3) linkages. There are two repeating disaccharide units present in Agarose i.e., Agarobiose & neoagarobiose. Figure 7 represents the chemical structure of Agar-Agar & Agarose. 2 or 6 positions of 3,6-anhydrous-α-L-galactose residues can be substituted by $-OSO_3^-$,$-OCH_3$,

glucuronate or pyruvate residues. Because of the presence of favorable functional properties, both agar and agarose gels have been used as a carrier matrix for electrophoresis and protein immobilization. Highly ordered stable and rigid structures can result without addition of any ions into the agarose solution at the temperature below 35°C which described its superlative ability of gelation (Jakub Zdarta et al. 2018). The most tempting feature of agar and agarose is their ability to form stable and firm gels. Moreover, agarose is an extremely inert colloid and possesses an outstanding strong hydrophilic and lyophilic nature in aqueous solutions that provides an ideal site for enzyme immobilization (Paolo Zucca et al. 2016).

In addition to inertness and stiffness, beads based on agarose are highly porous, mechanically resistant, chemically and physically inert and sharply hydrophilic. Linear galactan polysaccharide agar belongs to the Rhodophyceae class and is extracted from seaweeds. Agar/Agarose gels are suitably advised for immobilization because having ability to form derivatives as each monomer agarobiose unit has four alcoholic functional groups in which three of them are secondary and one is primary functional group that is the main target of derivatizations. Though 100% derivation is neither accessible nor commendable, few chemical reagents such as amine, carboxyl, sulfonate, cyano and so on can be grafted along with the polymer chain. For example, Glyoxal agarose in which the primary hydroxyl group is etherified by glycidol to produce diols which further oxidized by sodium periodate to get glyoxal group has been proved an excellent covalent attachment with an enzyme.

2.3. Inorganic Composite Carriers

Inorganic matrixes are prudently contemplated for enzyme immobilization because of superlative features such as the highest degree of thermal and mechanical resistance, rigidity, porosity moreover these supports are completely resistant for bacterial and fungal growth. A comprehensive discussion about the properties of inorganic supports is

beyond the capacity of this chapter, therefore, we are presenting only some miscellaneous features of inorganic carriers for enzyme immobilization.

2.3.1. Silica-Based Supports

Silicon dioxide (SiO_2) exists as a 3-D polymer in which SiO_4 tetrahedra units are arranged by sharing their vertices and composed a rigid entity while the Si-O-Si angles are highly flexible which shows remarkable polymorphs of silica ranging from highly ordered crystalline forms to mesoporous amorphous solids. Quartz and cristobalite are the crystalline forms of SiO_2. Natural mineral viz. stishovite is another metastable form of SiO_2 obtained by applying high temperature and pressure conditions on silica solids where each silicon atom is hosted within an octahedral cluster of six oxygen atoms such as it appears as a rutile form of titania (TiO_2) is extremely compact and unreactive towards mineral acids. Silica-based materials have combination of both hydrophobic and hydrophilic sites on its surface having a high tendency to show hydrogen bonding which describes complex adsorptive properties of immobilizing enzymes onto the surface of silica. Glutaraldehyde or 3-aminopropyltriethoxysilane is the surface modifying agents that facilitate the enzyme attachment with the hydroxyl groups present on its surface (Paolo Zucca and Enrico Sanjust. 2014). Various enzymes like oxidoreductases, transferases, hydrolases or isomerases have been immobilized on sol-gel silica, fumed silica, colloidal silica nanoparticles with high catalytic retention and good thermal or mechanical properties. (Jakub Zdarta et al. 2018).

2.3.2. Ceramics

The phrase '*ceramics*' chiefly illustrates metal oxides or mixed metallic/non-metallic oxides based on inorganic and non-metallic materials. These materials are suitable for immobilizing proteins because of encouraging properties such as they exhibit extremely high resistance to temperature, pressure, and chemicals and also provide the highest degree of mechanical strength. The unique feature of these materials is when enzymes become catalytically inactive, they get easily regenerated and again used for the immobilization of new biocatalyst. Non-specific interactions are

possible due to the presence of hydroxyl groups on their surface which facilitates adsorption immobilization of enzymes. Alumina, Titania, Zirconia, Iron-oxide, Silica, and Calcium phosphate, Composite ceramic membranes (TiO_2/Al_2O_3) are several ceramic materials which have been used as a biomolecule carrier for immobilizing enzymes (Jakub Zdarta et al. 2018).

2.3.3. Alumina

Corundum being abundant in nature called Alumina i.e., Aluminium oxide (Al_2O_3) obtained from aluminum ores in hydrated form. Different crystalline forms of alumina could be prepared either by strong heating of Aluminium hydroxide ($Al(OH)_3$) or by applying the base treatment on aqueous aluminum salts. All these forms appear to have high porosity, high specific surface but can change into α-Alumina on heating above 1000°C which shows inert nature and devoid of any interest in the field of protein immobilization. Other crystalline forms (η & γ-Alumina) are obtained by moderate calculations called sandy alumina which could represent alternatives for silica-based supports. The surfaces of this alumina are coordinatively unsaturated and this feature is responsible for both catalytic and adsorptive properties and can seldom found as a support for enzyme immobilization (Paolo Zucca and Enrico Sanjust. 2014).

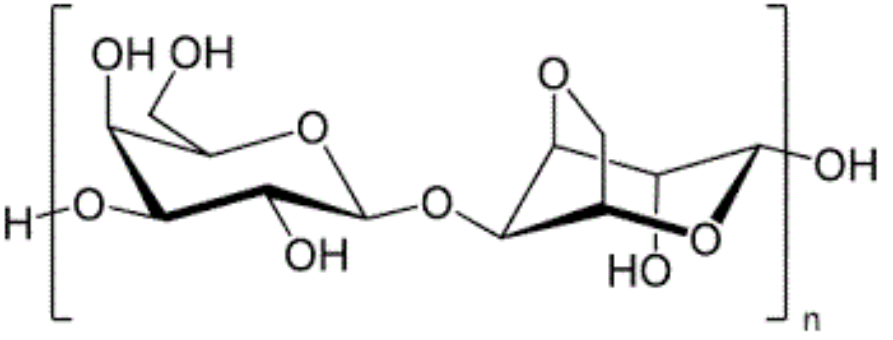

Figure 7. Chemical structure of agar-agar and agarose.

2.3.4. Carbon-Based Materials

During the last two decades, activated carbons, modified and unmodified charcoals are some prototypes of Carbon-based materials have been used as effective and valuable support materials in enzyme immobilization. The promising features of these materials are a presence of various functional groups, high adsorption capacity, well-developed porous structure having various sizes and volumes, high surface area (up to 1000 m^2/g), the minimal release of fine particulate matters make carbon-based materials suitable carriers for the adsorption immobilization of various enzymes. For instance, amyloglucosidase was immobilized on unmodified charcoal support.

2.4. Classic Materials

Both inorganic and Organic materials are termed as Classic materials used for enzyme immobilization have been described in the above sections. Silica-based supports, carbon-based materials, inorganic oxides, ceramics which have described under the category of Inorganic and Composite carriers are acknowledged for their good sorption properties, thermal and chemical stability as well as by excellent mechanical resistance. All these astonishing features ensure numerous contact sites for effective enzyme immobilization. Auxiliary materials such as biopolymers and synthetic polymers also assembled under classic materials endeavors various functional groups which facilitates even covalent binding of enzymes without cross-linking agents. With respect to synthetic polymers, biopolymers are consistently symbolized by high protein affinity as well as biocompatibility that restraint negative effects of the support on the structure of enzymes. Moreover, Classic materials are found lavishly in nature (mineral, biopolymers) and are effortlessly synthesize which makes them relatively cheap. These superlative facts of these materials play an imperative role as carriers for use for the immobilization of enzymes. Summarized form of Classic materials and types of enzymes that may be immobilized using these supports grouped with information about

immobilization type, cross-linking agents and binding group in tabular form is given below (Jakub Zdarta et al. 2018) (Table 1).

Table 1. Summary and selected examples of Classic materials of both inorganic and organic origin applied for enzymes immobilization

Support Material	Binding groups	Crosslinking Agents	Immobilization Type	Immobilized Enzyme
Inorganic Materials				
Activated Charcoal	-OH, C=O, COOH	-	Adsorption	Papain
Sol-gel Silica	-OH	-	Adsorption	Lipase from *Aspergillusniger*
Silica gel	-OH, C=O	glutaraldehyde	Covalent Binding	Commercial lipase
Commercial Activated Carbon	-OH, C=O	-	Adsorption	Cellulose from *Aspergillus niger*
Organic Materials				
Polyaniline	$-NH_2$, C=O	Glutaraldehyde	Covalent Binding	α-amylase
Polyvinyl alcohol	-OH, C=O	Glutaraldehyde	Covalent Binding	Laccase from *Trametes Versicolor*
Polystyrene	C=O, epoxy groups	Poly(glycidyl methacrylate)	Covalent Binding	lipase
Chitosan	-OH, $-NH_2$	Glutaraldehyde	Entrapment	Lipase from *Candida rugosa*
Agarose	-OH	-	Entrapment	α-amylase
Cellulose nanocrystals	-OH	-	Adsorption	Lipase from *Candida rugosa*

3. IMPACT MODIFICATION OF ENGINEERING BIOPOLYMERIC SURFACES AND BULKS

The unique proposition or the main agenda of this chapter is to bring out various modifications or functionalization of the surfaces of biopolymers and introduce some new functionality. Over the last few decades, researchers have focussed on the investigation and utilization of microbial cellulose in functional materials. Functional bacterial cellulose-based materials are enough capable to produce improved or new properties by mixing multiple constituents and exploiting synergistic effects such as electronic, optical, magnetic and catalytic properties. The performance of

biopolymers must be increased in order to extend its applications in immobilizing the proteins or other macromolecules. Alterations or fabrications are done by incorporation of fillers and reinforcements, blending, plasticization & impact modifications. The development of novel polymeric materials is the fastest method in tailoring the properties of polymers which consequently play a very crucial role in increasing the competitiveness and biocompatibility of biopolymers. Figure 8 describes all the possible techniques of surface modification.

3.1. Physically Modified Biopolymers

3.1.1. Biopolymer Composites

Biocomposites are the modified form of biopolymers which can be made by incorporation of fillers and reinforcements into a polymer matrix results in a heterogeneous system. Comprehensive work done by several researchers stated that under the effect of external load heterogeneities induce stress concentration, the magnitude of which depends on the geometry of the inclusions, on the elastic properties of the components and on interfacial adhesion. Overall performance of the composites, deformation and failed behavior is determined by heterogeneous stress distribution and local stress maximums initiate local micromechanical deformations. Another factor that must be taken into account during the analysis of micromechanical deformation processes is the interaction of the components. Characters and strength both factors are present in interactions. Secondary forces created by adhesive interactions are relatively weak. The coupling may result in covalent bonding between the components.

Most studies focus on the potential use of natural lignocellulose fibers i.e., wood flour, sisal, flax, etc. for modification of biopolymers. Biocomposite materials have wide applications in the building and automotive industry. Renewable and biodegradable based matrices are the leading carriers due to growing environmental concerns. PLA (polylactic acid) is one of the most important biopolymers which is frequently used for the production of fiber-reinforced composites.

Biocomposites are present in nanometre-scale called bio-nano composites possessing unique characteristics with respect to gas and water vapor permeability, thermal stability, fire resistance, mechanical and optical properties, etc. Alternatively, these characteristics can be modified using either natural nanofibers such as cellulose or inorganic nanofillers such as silica, layered silicates, etc. different combinations of properties are achieved. In order to achieve nanoscale dispersion, i.e., intercalated or exfoliated structure resulting in superior properties, nano clays must be modified with suitable organic compounds in order to promote the separation of the silicate layers (Paolo Zucca et al. 2016).

3.1.2. Blends

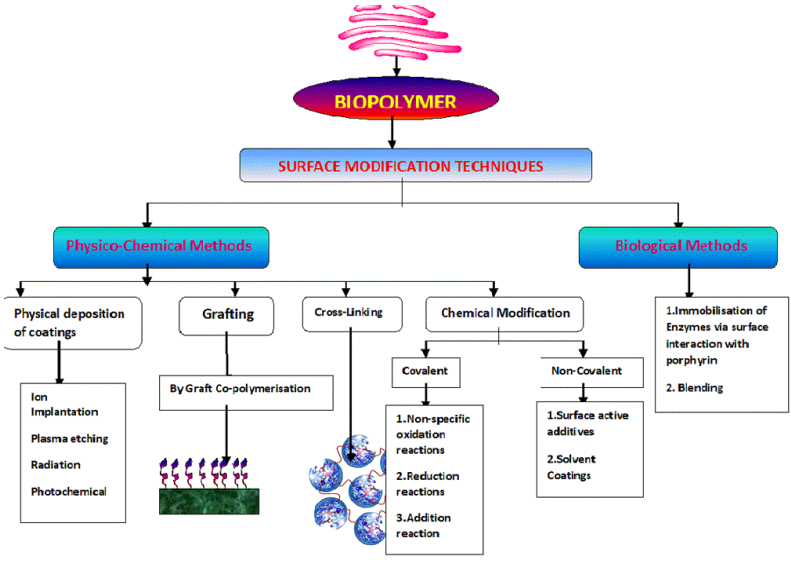

Figure 8. Surface modification techniques.

By Physical blending, we figure out that in fused state polymeric materials are simply fused or blend without causing any chemical reaction to occur. To create new materials with desired combination of properties, this is a satisfactory route. In this process, no extra investment is required and this process can be carried out by using conventional machinery which is a crucial aspect for industry. With the help of this technique, we can target

our application in a very short interval of time and at cheaper rates as compared to the development of new monomers and polymerization techniques. Polylactic acid (PLA), starch is the most often used material for physical blending process.

3.2. Chemically Modified Biopolymers

Another major approach for immobilization of macromolecules on the biopolymeric surfaces is “Chemical modification”. For this purpose, ample of chemical reactions and reagents have been explored. The procedure of surface tailoring begins with the surface activation, which creates desirable functionalities on the surface of polymer that enables the surface immobilization of ligands under mild conditions. Earlier, several methods have been proposed to create 3-D scaffolds of varying size, shape, and architecture, still are challenging situations. Alkali hydrolysis of aliphatic polyester surfaces is the most frequently used technique in chemical modification method. As alkali treatment is driven by small, highly mobile protons that can diffuse easily between the uncharged polymer chains and therefore has the capability to penetrate into porous 3-D scaffolds. New active functionalities are created after surface hydrolysis that causes the cleavage of ester bonds, which results in the formation of free hydrophilic carboxyl and hydroxyl functionalities that permits the covalent attachment of other biomolecules such as enzymes or proteins on the surface of the polymer. Mostly, ligands have a biological origin for improving cell interactions. After hydrolysis, biodegradable polymers like PLA (polylactic acid), PLGA (poly lactic-co-glycolic acid) undergo conjugation with primary amines are mostly accepted. Common diamines which are used in this procedure are ethylenediamine,1,6-hexane diamine, N-aminoethyl-1,3-propane diamine, etc. For instance, carboxylate groups can also be activated by the formation of a highly active species which are generated by carbodiimides after further reactions with amine nucleophiles that leads to the stable amide bonds. The most fascinating methodology is to introduce nitrogen and sulfur moieties with the help of N-hydroxysuccinimide (NHS)

or N-hydroxysulfosuccinimide (Sulfo-NHS) to form stable ester derivatives. Signaling proteins can then be immobilized on aminolysis matrices/ scaffolds with the help of these cross-linking agents (Jakub Zdarta et al. 2018).

3.3. Plasma Treated

The surface properties of the biomaterials can be altered without affecting their bulk properties by technique called Plasma. To enable the creation of glow discharge plasma, low-pressure gases such as argon, ammonia or oxygen are filled in the evacuated vessel. Energy sources such as electric discharge, heat, radio-frequency energy, alternating/direct current are able to excite the gas. Free radicals, ions, protons, electrons, gas atoms and molecules of different energies are generated by ionization of gases. Successive bombardment with these high energy species on biopolymer surfaces results in the transfer of energy from plasma to the substrate which consequently leads to chemical and physical changes on the surface of the substrate. A very interesting feature of plasma technique that these energetic species can interact with polymer surface ranges from several hundred angstroms to 10 microns without inducing any changes in their bulk composition. Cold or low-temperature plasma & hot or elevated temperature plasma are the two major types of plasma where hot plasma is generated by atmospheric pressure arcs while low-temperature glow discharge generates cold plasma. From these two types, cold or low-temperature plasma is often preferred over hot plasma because, in high-temperature plasma, thermal motion of surface molecules is high and is very difficult to maintain whereas plasma generated effects in low plasma are efficiently maintained. Earlier studies have been acknowledged the use of plasma techniques for surface modification of polymers. By using plasma techniques in functionalization and alteration of polymeric surfaces, various studies came across numerous attractive and fascinating qualities such as enhanced cell adhesion, surface wettability, improved biocompatibility, and molecular immobilization.

Moreover, this can also lead to improving surface hydrophilicity of the polymer.

3.4. Photochemical Modification

Surfaces of biopolymers can be modified photochemically through free radical polymerization which results in polymer cross-linking, photopolymerization of monomers or grafting of molecules. Free radicals are generated by highly energetic UV rays, X-rays, γ-rays or by photo-initiators to initiate the chemical reactions on the surface of the biopolymers. Thus, radicals which are generated then interacts with another monomer molecule that ultimately leads to the propagation of the reaction and polymer chain formation. Organic compounds such as alkyl hydroperoxides (R-OOH) or halogens are some common photo-initiators required in these modifications. It is very beneficial technique with respect to other modifications due to selective immobilization of the target species at specific regions of the biomaterial, forming graft layers. Established studies adopt protocols of photo-polymerization for creating functionalities for applications of tissue engineering. This chapter reveals introduction of various functional groups such as (-OH), (-COOH), and ($-CONH_2$) to activate the surface of biopolymer by applying photo-grafting treatment on hydroxyethyl methacrylate, methacrylic acid or acrylamide respectively. Presently, there are two approaches by which immobilization of proteins was performed. In the first one surface of biomaterials such as collagen and gelatin can be activated by methyl sulphonyl chloride followed by adsorption of proteins. And in second one, polymer film can be activated via EDAC treatment followed by immersion in gelatin and collagen solution. Consequently, wettability of the surface was improved. For tissue engineering applications, numerous photopolymerization studies have been conducted on polymeric films and have produced astonishing results (Jakub Zdarta et al. 2018).

4. APPLICATIONS OF BIOPOLYMERS: GLOBAL SCENARIO

4.1. In Biotechnology

In the above sections, we have discussed physical adsorption, chemical modification, treatment through photochemically and via plasma methodology for protein immobilization. This portion briefly debates on protein immobilization having focus on the development of protein delivery systems as an approach towards tissue engineering. Numerous carrier matrix based on renewable biomaterials has been explored over the last two decades such as protein encapsulated hydrogels. Several published articles disclosed that although physical adsorption or entrapment/encapsulation are the leading methods for immobilization of proteins studies also revealed that bioactivity of enzymes is lost due to their random orientations, over-crowding and rapid desorption of adsorbed proteins or due to the short half-lives of signaling proteins combined with reduced bioavailability. For these reasons, protein delivery systems based on adsorption or entrapment are restraint. So, the concept of covalent immobilization of proteins is achieving higher heights for tissue engineering applications. This technique implements oriented immobilization with minimum structure losses, conformation and protein spreading. Minimum spreading permits immobilized protein to become more realistic and quantized. Moreover, immobilization through covalent binding diminishes the amount of signaling/therapeutic protein essential for provoking an appropriate function as compared to adsorption techniques. Protein can be readily used for covalent binding with polymeric surfaces due to the presence of a variety of functional groups such as amino groups, carboxyl groups, hydroxyl and thiol moieties on the surface of proteins.

4.2. For Enzyme Immobilisation

There are two approaches by which proteins can be covalently immobilized on biopolymeric surfaces i.e., (i) By tailoring the structures of

proteins and polymers or (ii) By chemically crosslinking between protein and polymer surfaces. Random and oriented covalent attachments are the two broad categories of Covalent attachments.

Previous papers revealed that a known hormone called insulin was successfully immobilized onto the polymers with the help of water-soluble carbodiimides as a cross-linking agent that is capable to form a covalent bond between the carboxyl group of the polymer and the amine terminals on proteins.

Another approach is also implemented in industries known as Oriented covalent immobilization where protein activity is critical and has the ability to reuse immobilized protein multiple times. Several reagents and cross-linkers that have been used as degradable and non-degradable have published for specific modifications of protein and biomaterial attachment. Prognosis about polymer and protein attachment still remains a challenge because of extreme diversity, sensitivity, and complexity of signaling/ therapeutic proteins. Moreover, threat is consistently maintained for protein denaturation due to the use of chemicals and crosslinkers. Therefore, the urgent contribution is required for improving the performances that can overcome these limits (Jakub Zdarta et al. 2018, Paolo Zucca et al. 2016, Paolo Zucca et al. 2014).

4.3. For CO_2 Sequestration

In order to reduce the level of carbon dioxide released in the atmosphere, biomimetic sequestration of carbon dioxide is one of the proposed methods comes under the various studies. To alleviate the challenges of carbon dioxide, biodegradable, biocompatible and thermostable biopolymers such as (Polyhydroxyalkanoates (PHAs) are introduced into the system as they are capable of fixing atmospheric CO_2 into useful products like calcium carbonate ($CaCO_3$). Biopolymer such as chitosan contains large no. of amino functional groups which can be chemically modified to undergo intermolecular hydrogen bonding that facilitates the acidic CO_2 molecule to

get adsorbed on to the surface of the polymer. CO_2 uptake capacity increases by crosslinking and functionalization of biopolymers.

Moreover, carbonic anhydrase enzyme which is mainly present in the red corpuscles in the human blood is capable of inter-conversion of CO_2 into harmless products; such as bicarbonates and hydrogen ions. Similarly, enzymatic systems are designed for sequestration or biomineralization of atmospheric CO_2 into solid carbonates or in the production of commodity fuels and chemicals.

CONCLUSION AND FUTURE ENDEAVOURS

Surface or bulk modifications of biopolymers via immobilizing or covalently attached proteins, carbohydrates, lipids, and any other species is incredibly important for several reasons. It is well known that a series of interactions occur between the surfaces of biopolymers and the chemical ligands after they have been implemented into a particular environment. Hence biopolymers surfaces are playing an extremely important role in the response towards artificial medical devices to the biological environment. To transform any surface, to be hydrophilic or hydrophobic, there are lots of possibilities. In the presented chapter, comprehensive literature is compiled for the functionalization of polymer surface properties via protein/peptide immobilization. In this compilation, the enzyme (carbonic anhydrase) has been given special attention in various researches for carbon dioxide sequestration. The performance of immobilized carbonic anhydrase has been greatly improved when it was immobilized on polyester polymer via covalent method. Furthermore, this article provides an insight into the development of the new natural polymer-based materials for environmental applications particularly in carbon dioxide capture and its biomineralization and biotransformation. To characterize the operating life span of both native carbonic anhydrase and the enzyme mimics particularly after immobilization, however, more work needs to be conducted and new elaborative research needs to be focused on the methods of immobilization

that would immobilize enzyme especially carbonic anhydrase (CA) for CO_2 sequestration that will control Global warming to the larger extent.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 2

CELLULOSE BASED NANOCOMPOSITES FOR BIOMEDICAL AND PHARMACEUTICAL APPLICATIONS

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ABSTRACT

In recent years cellulose-based nanocomposites have gained attention owing to the enhanced mechanical, thermal, high strength and stiffness, renewability and biodegradability, along with their production and application in the expansion of composites. These are emerging renewable nanocomposites that hold potential in many different applications such as food, chemicals, personal care, packaging and products, automotive, construction, electronics and furniture along with. High-performance nanocomposites can be prepared by appropriate modification of cellulose fibers as reinforcement material, resulting in improved physical, chemical as well as biological properties. The chapter provides an overview of cellulose nanocomposites focusing on the processing, properties, and applications in pharmaceutical and biomedical fields.

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Keywords: cellulose, nanocomposites, pharmaceutical, biomedical

1. INTRODUCTION

Cellulose is the most plentiful form of living terrestrial biomass material in nature (Crawford 1981) which is a common plant biopolymer, complex polysaccharide or carbohydrate comprising of 3,000 or more glucose units with 33 percent of all vegetable matter and the annual production is estimated to be around 10^{11} tons. It is a natural polymer, which is a long chain macromolecule and made by the linkage of smaller molecules. In the cellulose chain, the links are made by consisting of sugar, β-D-glucose (Dorée 1947). These sugar units are connected when water is removed by merging the H and –OH group. Above two of these sugars linkage results, a disaccharide is known as cellobiose (Kalia et al. 2011). Cellulose is most profuse of all naturally existing organic compounds and it is the basic structural component of the cell wall. In 1980, *Anselm Payen* (Payen 1838) first recognized the existence of cellulose as the communal material of plant cell walls. Several natural fibers like cotton and higher plants have cellulose as their main component. It comprises of long chains of anhydrous-D-glucopyranose units (AGU) and is insoluble in water as well as most common solvents. Therefore, chemical modification of cellulose is performed to enhance processability and to yield cellulosic (cellulose derivatives) so that they can be tailored for specific industrial applications. Cellulose has been widely investigated due to its advantageous properties, like low-cost, hydrophilicity, non-toxicity, biocompatibility, biodegradeability, low density, combustible and nonabrasive (Fu et al. 2019).

Composites are a combination of two or more different components with knowingly different chemical and physical properties. They have improved mechanical performance along with new functionalities. Generally, a composite contains a stiff and strong component known as the reinforcement which is embedded in a softer constituent, the matrix. In this way, the composite has advantageous properties of reinforcement and the matrix. Composites can be classified into three categories in terms of matrix used

are (1) ceramic matrix composites (2) metal matrix composites (3) polymer matrix composites. There are many thermoplastic polymers like poly (ethylene) (Lu, Lin, and Chen 2007), poly (ethylene oxide) (Chen and Tsubokawa 2000) and poly (vinyl chloride) (Chazeau et al. 1999) while thermosetting polymers like phenolic resin (Zárate, Aranguren, and Reboredo 2008), unsaturated polyester (Vilay et al. 2008), rubber (Setua and De 1984) and epoxy resin (Zhou et al. 2006). With increased awareness on environmental protection and sustainability, researchers have been shown interest in yield biodegradable polymer composites based on starch (Kvien et al. 2007) poly (lactic acid) (Bondeson and Oksman 2007) and cellulose (Gindl and Keckes 2005). Composites achieve the properties of both reinforcement and matrix with enhanced properties of compressive and strengths. Booker and Boysen (2005) presented special efforts towards nanotechnology and gave a high expectation for researchers. A nanoparticle is usually considered when as a minimum one of the linear dimensions is lesser than 100 nm (Henriksson et al. 2007). The perspective of nanocomposites in several areas of research and application is auspicious and attracting. Nanocomposite materials have many advantages properties like their superior mechanical, thermal, and barrier properties at low reinforcement levels along with their transparency, low weight, and better recyclability when compared with conventional composites (Oksman et al. 2006; Sorrentino, Gorrasi, and Vittoria 2007). Loads of research works have been carried out all over the world for the preparation of various types of nanocomposites by using cellulose fibers as a reinforcing material. The main reason to utilize cellulose nanofibers in composite materials is that one can potentially exploit the high stiffness of the cellulose crystal for reinforcement. This can be done by breaking down the hierarchical structure of the plant into individualized nanofibers of high crystallinity, with a reduction of amorphous parts.

2. METHODS

2.1. Cellulose Nanocomposite Processing

Processing of nanocomposites of cellulose makes them suitable candidate for low-cost engineering material with plant fiber reinforcement in industry (Berglund and Peijs 2010) along with its cheaper, renewable and low abrasive nature, impressive mechanical properties, abundance, low weight, and biodegradability of cellulose nanocrystals (Azizi Samir, Alloin, and Dufresne 2005; Oksman et al. 2002; Hornsby, Hinrichsen, and Tarverdi 1997; Bledzki, Reihmane, and Gassan 1996). In determining the composite properties, processing condition plays an important role such as Glass fibers have high strength when freshly drawn whereas the condition was altered i.e., exposed to humid air then fibers absorb water surfaces of fibers become damaged because of rubbing action during processing, the strength decreases. The temperature of processing is also restricted for specific materials like for lignocellulosic materials, it is controlled to about 200°C due to their degradation temperature starts from 230°C (Hamad 2013). Cellulose nanocomposites can be processed using conventional processing methods. Before processing, drying of fibers is the key point as the water content in the fiber can outcome in weak adhesion in between fiber and polymer or it may cause voids in the nanocomposite when the water evaporates during processing.

Nishino, Matsuda, and Hirao (2004) reported the two typical routes for the preparation of cellulose nanocomposites, one-step and two-step methods (Figure 1). In this method, cellulose is firstly dissolved in a solvent which was followed by regeneration of the cellulose in the existence of another cellulose component which was undissolved. Vallejos, Peresin, and Rojas (2012) synthesized all-cellulose composites by electrospinning cellulose acetate (CA) solution having dispersed cellulose nanocrystals (CNC) to yield precursor CA/CNC composites. However, in the one-step method, cellulosic fibers are slightly dissolved in a solvent and then redeveloped in situ to obtain a matrix around the undissolved part. Cellulose composites are prepared using different composites manufacturing techniques like injection

molding, resin transfer molding (RTM), compression molding and vacuum bagging. Rånby (1951); Ranby (1952) firstly synthesized cellulose nanocrystals by hydrolysis of cellulosic biomass in mineral acid (hydrochloric or sulfuric). Processing starts with milling the pulp for small uniform particles followed by acid hydrolysis of the cellulose raw material for removing the bonded polysaccharides on cellulose fibril surface and a disordered or amorphous portion of cellulose that separates the fibrils (Revol et al. 1992). Acid hydrolysis is terminated by acid's rapid dilution, followed by the removal of acid via dialysis or centrifugation. Some mechanical forces like sonication are applied to terminate the aggregation of cellulose fibrils in order to yield cellulose nanocrystals having high crystallinity (Guo and Catchmark 2012). Cellulose nanocomposites show the different appearance from different sources, Figure 2 (Azizi Samir, Alloin, and Dufresne 2005).

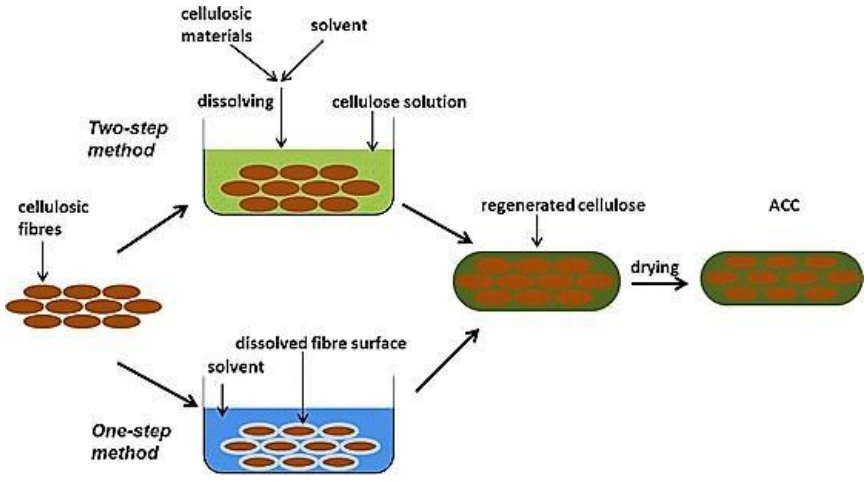

Figure 1. Schematic representation of the two-step (top) and one-step (bottom) preparation methods of ACCs Reprinted with permission from *(*Miao and Hamad 2013) Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262.

Favier (1995) first published the preparation of cellulose nanocrystals-reinforced polymer nanocomposites by using a latex which was achieved by the copolymerization of butyl acrylate (poly (S-co-BuA) and styrene and

tunicin whiskers (the cellulose mined from tunicate-a sea animal). Numerous studies have been furnished on isolation and characterization of cellulose nanofibers due to in the development of nanocomposites, cellulose nanofibers have a great potential to be used in a various different area as reinforcement from various sources. These nanofibers can be extracted by only chemical or both chemical and mechanical methods from the cell walls (Alemdar and Sain 2008) Compatibility of fibers and polymers is a very common problem in cellulose fiber-based composites due to high polarity and hydrophilic nature of fibers but non-polar and hydrophobic nature of polymers. To overcome this problem surfaces of fibre can be treated using various methods such as physical (stretching (Haig Zeronian, Kawabata, and

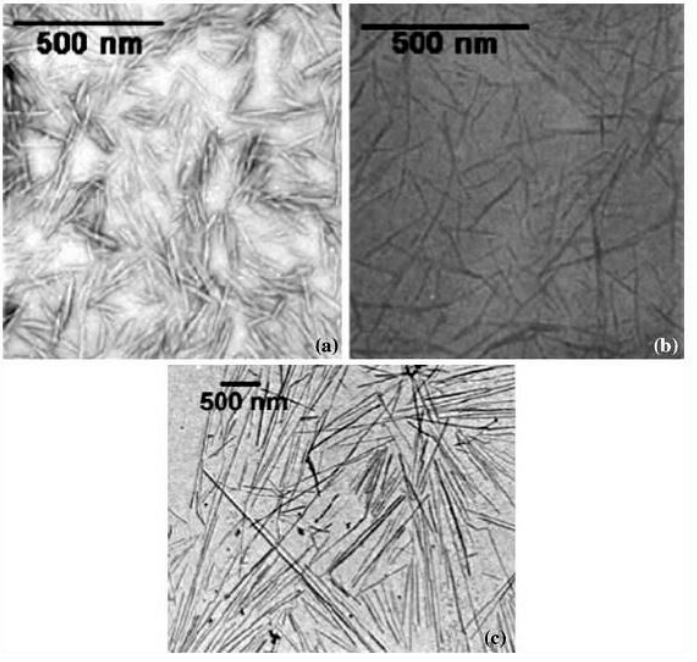

Figure 2. TEM images of CNC from different sources. a Cotton, b sugar-beet pulp, and c tunicin (the cellulose extracted from tunicate, a sea animal) Reprinted with permission from *(*Miao and Hamad 2013) Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262.

Alger 1990), calendering (Semsarzadeh 1986) and thermo-treatment Ray, Chakravarty, and Bandyopadhaya (1976), Physico-chemical (Takacs et al. 1999; Uehara and Sakata 1990; Carlsson and Stroem 1991; Kato et al. 1999; Kolar et al. 2000) and chemical methods (Belgacem and Gandini 2005). Various techniques can be used to characterize the modified fiber surface including scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FT-IR), contact angle measurements, confocal laser scanning microscopy (CLSM), elemental analysis, inverse gas chromatography (IGC), nuclear magnetic resonance (NMR) and atomic force microscopy (AFM) (Belgacem 2005; Mohanty, Misra, and Drzal 2001). Processing of cellulose nanofibers-reinforced nanocomposites by extrusion methods are explored rarely. The synthesis of cellulose nanocomposites by melt extrusion was prosecuted by injecting the suspension of nanocrystals into the polymer melt throughout the extrusion process (Oksman et al. 2006).

2.2. Properties of Cellulose Nanocomposites

2.2.1. Thermal Stability

Azizi Samir (2004) and Samir (2004) performed thermogravimetric analysis (TGA) experiments inspect the thermal degradation and stability of tunicin whiskers/POE nanocomposites and suggested that there was no effect of cellulosic fibers on POE nanocomposites degradation temperature. Choi and Simonsen (2006) suggested the effect of cotton cellulose nanocrystals content on the thermal behavior of CMC plasticized with glycerin revealed a close connotation between the filler and the matrix.

2.2.2. Mechanical Performance

Hajji (1996) studied the effect of preparation methods on the mechanical properties of a CNC-based nanocomposite. Nishino, Matsuda, and Hirao (2004) synthesized the cellulose nanocomposite films with cellulose I and II in the different ratio by the slight dissolution of microcrystalline cellulose powder in N, N-dimethylacetamide /lithium chloride and subsequent film

casting and the structure and mechanical properties of these films were characterized by XRD and tensile strength. The resulting films are transparent to visible light, isotropic, highly crystalline having different amounts of undissolved cellulose I crystallites. By varying the cellulose I and II ratio, the mechanical recital of the nanocomposites can be tuned. studied The consequence of preparation or processing methods on the mechanical properties of a CNC-based nanocomposite was studied by Hajji (Hajji et al. 1996). He suggested that the composite film synthesized by water evaporation reveals the best mechanical property due to less impact on the orientation of CNC, offers better dispersion of CNC in matrices which safes CNC structure from damage. Hence, Table 1 shows the importance of processing methods and even dispersion of the reinforcement in the matrix on nanocomposite properties.

Table 1. Mechanical properties of CNC based nanocomposites processed by different methods (Miao and Hamad 2013) Reprinted with permission from Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262

CNC content (wt%)	E		HP		XP	
	Modulus (MPa)	Tensile strength (MPa)	Modulus (MPa)	Tensile strength (MPa)	Modulus (MPa)	Tensile strength (MPa)
0	0.2	0.15	0.2	0.12	0.2	0.12
1	0.6	0.49	0.5	0.31	0.4	0.23
6	32.3	5	5.2	1.63	1.5	1.06

The factors which affect the mechanical properties of cellulose nanocomposites are compatibility of polymer resin and CNC, the molecular structure of the matrix, the aspect ratio of CNC particles and composite preparation procedure.

3. APPLICATIONS

Application in the field of development of composites by cellulose nanofibers is a comparatively new research area. Eichhorn (2009) incorporated uses of cellulose-based nanocomposites in reinforce adhesives for making optically transparent paper designed for electronic display and to produce DNA-hybrid materials, to create hierarchical composites aimed to use in foams, aerogels and for improved coupling between fiber and matrix. Cellulose nanocomposites have proven to be an unusually multipurpose biomaterial that may be used in an extensive variety of applied scientific endeavors like electronics, paper products, acoustics, automotive industry and most important in pharmaceutical and biomedical devices.

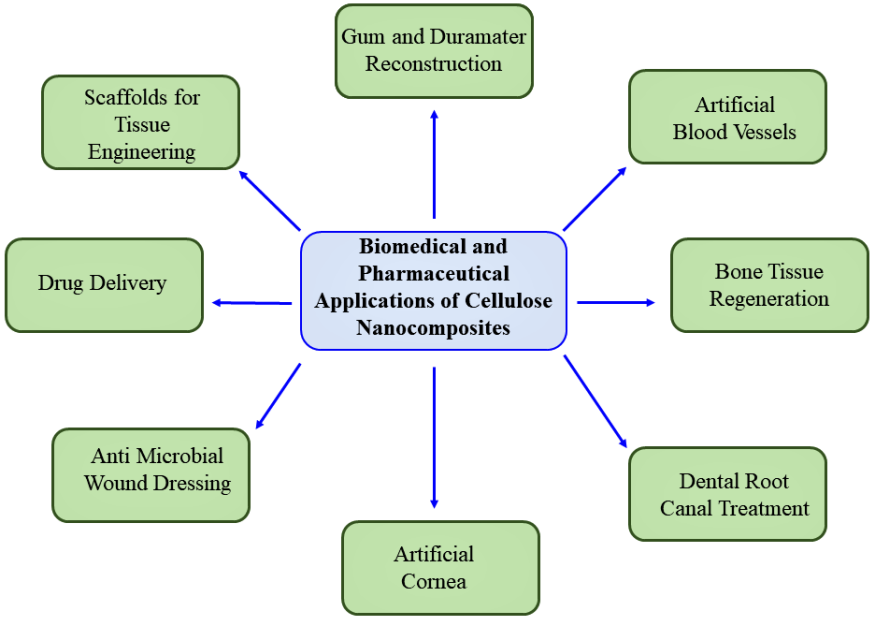

Figure 3. Biomedical and pharmaceutical applications of cellulose nanocomposites.

3.1. Pharmaceutical

Cellulose-based nanocomposites are highly useful in the pharmaceutical industry as cellulose has an outstanding property of compaction which blended smoothly with excipients in order to drug-loaded tablets form condensed matrices suitable for the oral management of drugs (Longer and Robinson 1990; Alderman 1984). Various potential advantages as a drug delivery excipient are offered by crystalline nanocellulose (Baumann et al. 2009; Watanabe et al. 2002). A large number of drugs can be found on the surface of cellulose nanocomposites due to high surface area along with the negative charge, makes them a potential candidate for high payloads and optimal control of dosing and it is also suitable because of established biocompatibility of cellulose. The hydroxyl groups present on the surface of crystalline nanocellulose offer a place for the surface amendment of the material with a wide range of chemical groups via many different methods. Modification of surface can be used to modulate the drug loading and release that would not normally tie to nanocellulose i.e., hydrophobic and nonionized. (Lönnberg et al. 2008; Shaikh et al. 2007).

3.2. Medical

Nowadays, eyes of biomaterial term has been used for nanocellulose because of its high applications in biomedical industry including drugs releasing system, skins replacements for wounds and burnings, nerves, blood vessel growth, scaffolds for tissue engineering, gum and dura mater reconstruction, stent covering and bone reconstruction (Mello et al. 2001; W. K. Czaja et al. 2007; Negrão et al. 2006; Klemm et al. 2001). Odontology is defied to find novel materials to substitute the bones in numerous procedures like facial deformities, maxillary, bone malformation and the loss of alveolar bone is the biggest challenge in this. Nanocellulose with appropriate porosity that provides the mat an infection barrier, painkiller effect, loss of fluids and allows medicines to be effortlessly applied and also works on purulent fluids by absorbing it during all inflammatory phases,

ousting it later on in a painless and controlled manner (W. Czaja et al. 2006). Cellulose nanocomposites have all types of properties like physical, mechanical and chemical along with huge superficial areas that give outstanding water absorption capacity and also elasticity shows characteristics of an ideal healing bandage. Barud (2009) have developed a biological membrane with cellulose nanocomposites to standardized extract of propolis, it has several biological properties with anti-inflammatory and antimicrobial activities which makes the membrane for good treatment for chronic wounds and burns. Raghavendra (2013) reported the antibacterial activity of the cellulose nanocomposites against Escherichia coli which was done by inhibition zone method, suggested that the synthesized CSNCFs can function effectually as anti-microbial agents and can be used for tissue scaffolding.

3.3. Others

Other applications of nanocellulose composites are mainly focused on paper and packaging products as well as furniture, automotive, electronics, electroacoustic devices, construction, cosmetics, and pharmacy. Additionally, they are applied in ultrafiltration membranes (water purification), additives for a high-quality electronic paper (e-paper), membrane for combustible cells (hydrogen) and membranes used to retrieve mineral and oils (Brown 1998). The high stiffness and strength along with the small dimensions of nanocellulose may enhanced properties to composite materials reinforced with cellulose fibers and these could afterward be used in wide range of applications. Cellulose nanocomposites have been used in audio diaphragms due to its property to bear two essential properties that are low dynamic loss and high sonic velocity. It is stated that the sonic velocity of films was virtually equivalent to those of titanium and aluminum (Iguchi, Yamanaka, and Budhiono 2000). Jonas and Farah (1998) reported that SONY had already been using it in headphones diaphragm. In Kyoto University, researchers prepared strong but enhanced transparent composite material by isolating nanofibrillated cellulose structure by

improving the dispersion of nanofibers in the matrix and on this basis, an organic display system is being developed recently (Shimazaki et al. 2007; Iwamoto et al. 2005).

CONCLUSION

Cellulose nanocomposites are unique nanomaterials derived from most abundant natural polymer, cellulose, which is made from superfine fibrils in nanoscale diameters. It has been observed that from last 15 years there has been steady progress in the field of cellulosic nanocomposites. Cellulose nanofibers have exciting potential to be used as reinforcement in nanocomposites as these are non-toxic, sustainable, renewable and biocompatible nanomaterials. The present chapter gives an overview of the use of cellulose fibers as reinforcement material in polymer matrices. The aim of chapter is to provide knowledge of cellulose nanocomposites for further research and studies. The chapter also summarizes the effect of processing methods and other parameters on thermal and mechanical properties of nanocomposites. The potential mechanical properties of cellulose nanocomposites vie well with other engineering materials and devices. Processing methods, properties, and applications in various fields such as pharmaceutical, medical and others are well discussed in the chapter.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 3

APPLICATION OF GELATIN IN BIOMEDICAL FIELD

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ABSTRACT

Gelatin is remarkably known for its various merits like biodegradability, biocompatibility, availability at low cost and ease of processing, because of these properties it has been widely used in pharmaceutical formulation, tissue engineering and in cell culture. In addition, gelatin can also be used for ocular applications, bio-adhesives, and bio-artificial grafts. These different applications have diverse physical, chemical and biological requirements and this has prompted research into the modification of gelatin and its derivatives. It differs from other hydrocolloids because most of them are polysaccharides, whereas gelatin is a digestible protein containing all the essential amino acids. In this chapter, we discuss the uses of gelatin in various biomedical fields.

Keywords: gelatin, biomedical, tissue engineering, artificial grafts

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1. INTRODUCTION

Gelatin is a natural, biodegradable, biocompatible and multifunctional biopolymer. It is extracted mainly from cattle bones, hide, pork skin and fishes. Depending upon the method of collagen hydrolysis they are of two types “type A and type B”. Type A gelatin is obtained by acid hydrolysis of gelatin. Acid processing barely affects the amide groups of glutamine and asparagine, resulting in a higher isoelectric point (IEP), i.e., 7-9 (Patel et al. 2008). Type B gelatin derived by alkaline hydrolyzes of asparagine and glutamine to aspartate and glutamate, respectively. Thus it possesses a greater proportion of carboxyl groups, rendering it negatively charged and lowering its IEP (i.e., 4.5 - 6.0) (Ninan et al. 2011). As a protein, gelatin exhibits an amphoteric behavior due to the presence of both acidic and basic functional groups, as a result of existence of amino acid functional groups and terminal amino and carboxyl groups. It differs from other hydrocolloids because most of them are polysaccharide, whereas gelatin is a digestible protein containing all the essential amino acids except tryptophan (Mariod et al. 2013). It contains approximately 20 amino acids which are linked together in a partially ordered fashion. Four groups of amino acids are predominant in the gelatin molecule. In every 1000 residues of gelatin’s amino acid residues, 330 are glycine, 132 are proline, 112 are alanine, 93 are hydroxyproline and the rest are other residues (Schrieber et al. 2007). The triple helical structure of gelatin is due to Glycine X-Proline, where X represents the amino acids like lysine, arginine, methionine, and valine. Glycine, being dominant component, is the smallest amino acid as its lateral group is hydrogen. Pro and Hypro—with rigid lateral pyrrolidine rings—display steric hindrances (Hoque et al. 2015). A typical structure of gelatin shows Ala-Gly-Pro-Arg-Gly-Glu-4Hyp-Gly-Pro- arrangement (Figure 1). Moreover, chemical composition and distribution of particular amino acids may affect rigidity of gelatin chain. Each amino acid chain may have a molecular weight between 10,000 and several hundred thousands of Daltons, depending upon the raw material and conditions of the conversion of collagen into gelatin. The surface property of gelatin is a polyampholyte.

However, the gelatin is negatively charged at higher pH and positively charged at lower pH.

Gelatin is remarkably known for its various merits which makes it a versatile natural biopolymer like it is cheap, widely available, denatured product and it is much less antigenic than collagen. The gelatin chains contain abundant amino sequences that modulate cell adhesion, thereby improving the final biological behavior over polymers that lack these cell-recognition sites (Wang et al. 2012). The diverse and accessible functional groups of gelatin allow for chemical modifications, such as coupling with cross-linkers and targeting-ligands. It also provides intermediate structural support when blending with other material constituents (Tang et al. 2012). At temperature > 35 - 40°C gelatin-water mixture exists as a sol (Tanaka et al. 2003). At further lower temperature the intramolecular hydrogen bonding induces a transition from sol to a structured three-dimensional gel, at concentration higher than approximately 1% (Gao et al. 2014). Lower concentration does not have sufficient molecules to support an infinite three-dimensional gel network (Parker and Povey 2012).

Being a versatile natural polymer, gelatin is widely used in food, photographic, medical, cosmetic and pharmaceutical products. In the food products, it is utilized as a film former, the gelling agent providing texture and shape to food (Cheng et al. 2014; Hanani et al. 2014). In the medical field and pharmaceutical fields, gelatin is currently used as in tissue engineering (Su and Wang 2015) as a matrix for implants, device coatings and as a stabilizer in vaccines against measles, mumps, rubella, Japanese encephalitis, rabies, diphtheria and tetanus toxin (Burke et al. 1999; Fooxand Meital2015). It is also used in intravenous infusions, hard and soft capsules, plasma expanders, wound dressings, tissue bio-adhesives, hemostats, sealants and in drug delivery systems (Karimand Bhat 2009; Panduranga 1996; Pollack 1990; Saddler and Horsey 1987). Due to its innate properties it has gained new interests in drug delivery systems (Santoro et al. 2014) such as hydrogels (Cui et al. 2014), films (Li et al. 20140, microcapsules (Prataand Grosso 2015), nanoparticles, etc. (Abrams et al. 2006; Rajan and Raj 2013; Azimi et al. 2014; Khan 2014).

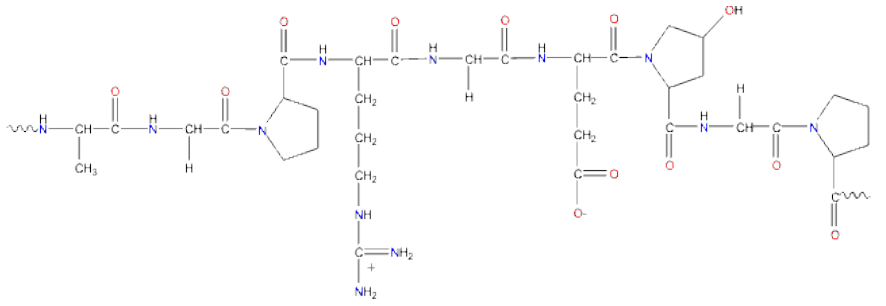

Figure 1. Structure of gelatin representing; Ala-Gly-Pro-Arg-Gly-Glu-4Hyp-Gly-Pro units.

2. APPLICATION OF GELATIN

Gelatin dissolves rapidly in the water at 37°C, non-immunogenic, and fully absorbable polymer. These properties have attracted the researchers to use gelatin in biomedical field. In this chapter we focused on the various applications of gelatin in the biomedical field.

2.1. Cardiovascular

Gelatin is an attractive biopolymer and has been used as a suitable scaffolding biomaterial for cardiovascular tissue engineering. Recent advances in the tissue engineering field have attracted significant attention in creating cardiac tissue concepts. Hydrogels, porous and fibrous frameworks are used in cardiac tissue engineering (Raneand Christman2011). For example, commercially available gelatin-based foams (e.g., Gelfoam®, water-insoluble gelatin sponge) have been planted with cells derived from fetal rat ventricular muscle to form functional cardiac grafts (Li et al. 1999). The results of this study show that the cells are able to grow and instinctively exhausted within the 3D microenvironment of the gelatin matrix, in both *in vitro* and *in vivo* (implantation) studies. Gelatin has been also mixed with other synthetic biomaterials such as polycaprolactone (PCL), polylactic acid (PLA), and poly (glycerol-sebacate) (PGS) for

creating frameworks with adjustable degradation rate and desired mechanical properties to control cellular organization and impersonator the grading of the native cardiac tissue (Li et al. 2000; Ozawa et al. 2004; Ifkovits et al. 2009; Kharaziha et al. 2013; Nerurkar et al. 2007; Tamayol et al. 2013). Since gelatin is an insulating biopolymer, conductive nanoparticles such as carbon nanotubes (CNTs) have been incorporated into photo cross-linkable GelMA hydrogel to enhance the electrical and mechanical properties of the tissue matrix and improve spontaneous beating of cardiomyocytes as compared to pure gelatin hydrogel.

By using photolithography a highly organized endothelial cord-like structures within GelMA hydrogel can be created (Nikkhah et al. 2012). It is also proven that the dimensions of the micropatterned features significantly affected proliferation, alignment, and cord formation of the encapsulated endothelial cells. In another study, co-culture of mesenchymal stem cells (MSCs) and endothelial progenitor cells (EPCs) inside Gel-MA (Methacrylated gelatin) hydrogel of different methacrylation degrees resulted in the extensive formation of biomimetic capillary networks (Chen et al. 2012). An electrospun scaffold made with the blend of gelatin, poly (lactic-co-glycolic acid) (PLGA) and elastin has also shown a great promise as suitable biomaterials for vascular tissue engineering (Han et al. 2010).

2.2. Drug Delivery

Gelatin has been extensively investigated as a drug delivery carrier due to its properties and history of safe use in a wide range of medical applications. Gelatin's properties can be modified and adjusted to maximize drug loading and efficiency of release for many classes of drugs. Incorporating bioactive molecules into appropriate carriers offers many advantages compared to conventional dosage forms. It can improve patient compliance and convenience by reducing possible toxic side effects of the drug. The release profile from gelatin carriers were shown to be optimized by changing the gelatin source, its molecular weight and the degree of its crosslinking. The amount of loaded drug and the type of interaction between

the drug and the carrier depending on the chemical structure of the drug and the carrier and the conditions of the drug-loading procedure. Gelatin microparticles and nanoparticles have been widely used for encapsulating many bioactive molecules. Microparticles have a relatively large surface area and can, therefore, serve as vehicles for cell strengthening and in distribution of large bioactive molecules to the desired site. Nanoparticles have a higher intracellular uptake and are better suited for intravenous or drug delivery in different areas in the body. Due to their unique design, liposomes have the ability to incorporate both hydrophilic and hydrophobic drugs, protect them from degradation, target them to the desired site and reduce the toxicity or side effects of those molecules. Embedding liposomes into a gelatin-based system resulted in an improvement in their stability and viscosity and in the half-life of the loaded drug and the liposome. As a drug carrier, gelatin fibers contain a high surface area to volume ratio, high porosity, and controllable pore size and can, therefore, accelerate the solubility of the drug in the aqueous solution and enhance the drug's efficiency. Gelatin hydrogels can trap molecules within the gaps between the polymer crosslinks. In the body, due to direct contact with water, they swell and the gaps between the polymer crosslinks increase, allowing the drugs to diffuse into the bloodstream. However, work is continually being carried out in order to improve gelatin release technology by modification of gelatin to allow the release of a wider variety of biomolecules from gelatin carriers for a broad range of applications (Foox and Zilberman 2015).

2.3. Bone Tissue Engineering

Bone is a hard, solid connective tissue that provides structure and protection to the body. To support external loading and absorb shocks, bone has a unique structure and chemical composition. Bone formation is a highly complex and dynamic process, (Hoque et al. 2015) which initially starts with recruitment of osteoprogenitor cells. The bone structure is composed of two layers of different density of bones. The outer layer is compact bone and the inner layer being spongy bone. Bone is always undergoing dynamic

remodeling carried out by two different cell types, the osteoblast for building bone and the osteoclast for digesting bone (Bose et al. 2012). Bone defects are common diseases and the number of patients suffering from this condition keeps increasing. Scaffolds utilizing natural and synthetic polymers combined with bone cells are seen as a promising approach to overcome the limitation of the conventional treatment for bone defects. A study shows that (Pereira et al. 2014) the osteogenic differentiation and proliferation of human adipose-derived stem cells (hASCs) on the mineralized PCL-GE (Polycaprolactone- Gelatin) scaffolds are considered to be of great importance in bone tissue engineering. In another study, (Wen et al. 2013) found that the umbilical cord-derived mesenchymal stem cells (hUC-MSCs) exhibited bone regeneration potential with strong expression of specific osteogenic markers *in vitro*. Moreover, the hUC-MSCs also displayed faster proliferation which provides a larger number of cells in short time period to meet the needs of bone tissue engineering. In other words gelatin-based scaffolds and microspheres were meant for sequential release of growth factors to initiate bone regeneration and improve vascularization at the injury site (Kempen et al. 2009; Patel et al. 2008). Alternatively, others have proposed the use of gelatin hydrogels for ex vivo gene transfer aiding bone regeneration (Kim et al. 2004). Beyond these applications, gelatin-based scaffolds have been used to decrease bacterial bone infections through the sustained release of antibiotics and antimicrobial agents post-fracture or implantation (Kuijpers et al. 1998; Di Silvio and Bonfield, 1999; Yaffe et al. 2003).

2.4. Cosmetics

Skin is the largest tissue covering the body and provides physical and chemical protection of the body from harmful sources such as heat and microbial organisms (Li 2007). The skin has two layers; the epidermis or outer layer, which is constantly regenerated, and the dermis on the inner layer that provides mechanical support for the dermis (Hench and Jones 2005). Gelatin, which is a denatured derivative of collagen, has been shown

to be a promising biomaterial for creating skin grafts (Metcalfe and Ferguson 2006). For instance, gelatin has been extensively used alone (Lee et al. 2005; Perng et al. 2008; Powell and Boyce 2008) or in combination with other natural and synthetic biomaterials. Few studies showed, a good affinity of the human dermal fibroblast (HDF) on the pure gelatin scaffolds even after treated with GTA (Glutaraldehyde) (Zhang et al. 2006). However, initial inhibition of cell proliferation was observed, possibly due to the existence of residual GTA. The blend of gelatin with other natural polymer has been demonstrated in many studies to promote the cell growth and proliferation of the HDF. It is found that the blends of gelatin with natural polymers exhibit better support for cell attachment, adhesion, and proliferation (Vatankhah et al. 2014). On the other side, the higher concentration of gelatin in the blend is unfavorable for growth of fibroblasts. It was found that high concentration of gelatin reduced the scaffold porosity which eventually unfavorable for cell growth (Enrione et al. 2013). To improve on the cell growth, have impregnated collagen-gelatin scaffold with basic fibroblast growth factor (bFGF) to accelerate skin regeneration (Ayvazyan et al. 2011). However, blends of gelatin-natural polymer display poor mechanical properties, especially under wet conditions. Whereas, the blend of gelatin and synthetic polymers were found to enhance the biomechanical properties of the scaffold. When human keratinocytes seeded on gelatin-PCL (polycaprolactone) scaffolds showed good biocompatibility and found to accelerate the wound closure progress (Morimoto et al. 2013). Collagen type I when incorporated on the surface of gelatin-PCL scaffold, the cell adherence, proliferation, and migration of the fibroblast was greater (Duan et al. 2013). Another polymer that is frequently blended with gelatin is a PHB (Poly (3-hydroxybutyric acid) a hydrophobic polymer-supported the adhesion and proliferation of HDFs and keratinocytes with a prolonged half-life *in vivo* (Gautam et al. 2014; Nagiah et al. 2013).

2.5. Wound Dressings

Wound care materials should provide a warm and moist environment for a rapid healing process; in addition, they should prevent the proliferation of

bacteria around the wound area (Winter 1962; Barnett and Irving 1991; Choi et al. 1999). Consequently, wound dressing hydrogels with biodegradability, good fluid absorbance, transparency, and optimal water vapor permeability are preferred over the preformed dressings (e.g., commercial dressings in the forms of membranes and sheets) for the wound healing process (Jaipan et al. 2017). Oxidized alginate- and gelatin-based hydrogel when used for wound dressing application via *in vivo* study in a rat model shows promising results with relatively low water vapor transmission rate compared with commercially available wound dressing products and good water absorptivity. The improved water retention facilitated the development of a moist environment that is conducive to wound healing; the alginate- and gelatin-based hydrogel was shown to enhance cell migration and re-epithelialization (Balakrishnan et al. 2005). Dextran dialdehyde cross-linked gelatin hydrogel is also used for wound dressing material (Draye et al. 1998). Gelatin-based hydrogel sheets with high antibacterial efficacy have also been fabricated from gelatin, honey, and chitosan (Wang et al. 2012). *In vitro* and *in vivo* studies demonstrated that these sheets did not exhibit toxic and irritant side effects while their bacterial resistance was superior to chitosan, honey, and gelatin when used separately (Wang et al. 2012).

2.6. Ocular Tissue Engineering

Gelatin-based materials have been most successful in ocular tissue engineering as cell sheet carriers, with effective delivery of both corneal endothelial sheets to the posterior cornea (Lai et al. 20130, and also RPE (Retinal pigment epithelium) sheets to the sub-retinal space (Silverman and Hughes1989). Gelatin offers an excellent, low-cost starting substrate. Crosslinked gelatin scaffolds make up a small but important part of the ocular tissue engineering. If crosslinked using appropriate methods it could provide lower antigenic and immunogenic risk than its parent material. Gelatin and its derivatives have been used as potential scaffolds for corneal epithelium (Wang et al. 2012), corneal endothelium (de la Mata et al. 2013) and retinal pigment epithelium (Lai 2013), as a bio-artificial corneal stroma

(Lai 2013) and as a potential bio-adhesive in treatment of retinal detachment (Yamamoto et al. 2013). The range of crosslinking options used to strengthen gelatin scaffolds in this field. There is good evidence to suggest that cross-linkers may be preferable in terms of both cell compatibility and biocompatibility (Lai and Li 2010). Whilst there may be uses for glutaraldehyde to crosslink matrices, such as fragile electrospun matrices which are short-lived in aqueous solutions (Sisson et al. 2009), the risk of cell toxicity of excipients could be a potential issue. Gelatin methacrylamide offers a gel-based system with tunable matrix stiffness, which can be controlled without significantly changing the chemical composition, this material would be an effective tool in determining the optimum material properties for application in ocular tissue engineering. The utility of dehydrated gelatin discs in ocular tissue engineering has been dominated by application as a cell sheet carrier in the delivery of either endothelial cell sheets to the posterior cornea (Hsu et al. 2013), or retinal pigment epithelial cells to the sub-retinal space (Lai et al. 2013; Rose et al. 2014). The application of photo cross-linkable gelatin in corneal stromal tissue engineering is also foreseen.

CONCLUSION

Among the natural polymeric materials, gelatin offers great practical potential as a composite material in the biomedical field. The resulting gelatin-based materials from various processing techniques exhibit excellent biocompatibility, biodegradability, and porous structure. Gelatin has been developed in different forms including films/foams, porous scaffolds, and hydrogels. So far, there has been significant progress in tuning the physical and chemical properties of gelatin through changing the crosslinking process and blending it with other natural and synthetic biomaterials for specific applications. Gelatin blends with other polymers always produce high efficacy matrices with improved biomechanical and bio-affinity of the scaffolds.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 4

POLYLACTIDE (PLA) BASED NANOCOMPOSITES FOR APPLICATIONS IN ANTIBACTERIAL/MICROBIAL AND BIOMEDICAL ENGINEERING

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ABSTRACT

For the last few decades, there has been growing interest in bio-based polymers and nanocomposites open an opportunity for the use of new, high-performance material. The use of biodegradable polymers and nanocomposites are of great importance currently in many applications, Polylactide (PLA) represents the best polymeric substitutes in the framework of environmentally friendly and sustainable processes and products for several petropolymers due to its renewability, bio-compatibility, ease of surface chemistry modification, biodegradability, good thermomechanical and optical properties. Having the above properties polylactide (PLA) nanocomposite shows immense potential in food packaging, antimicrobial as well as in pharmacology and biomedical engineering areas.

Keywords: polylactide (PLA), nanocomposites, food packaging, biomedicine

INTRODUCTION

Polylactide (PLA) is a thermoplastic that can be derived from renewable sources and degrades to nontoxic compounds in landfills (Martin and Averous 2001; Tsuji and Ikada 1998). Polylactide (PLA) has been the leader in all biopolymers due to its outstanding mechanical properties, biodegradability, renewability, and relatively low cost and also justify environmental concerns of greenhouse gas emissions, environmental pollution and the depletion of fossil resource (Auras, Harte, and Selke 2004; Kümmerer 2007; Jenck, Agterberg, and Droescher 2004). It is a polymer of monomer lactic acid, which may be easily produced by carbohydrate feedstock's fermentation. Hence, PLA provides more disposal options and its production is less environmentally burdensome in comparison to other traditional petroleum-based plastics (Doi and Steinbüchel 2002; Lunt 1998). Low molecular weight PLA was firstly prepared by *Pelouze* in 1845 by the action of condensation of l-lactic acid followed by removing of water continuously (Carothers, Dorough, and Natta 1932). To substitute the conventional petroleum-based plastics, Polylactic acid (PLA) has been explored recently by researchers or polymer scientists as potential biopolymer (Sinha Ray, Maiti, et al. 2002; Sinha Ray et al. 2003; Ray and Okamoto 2003). PLA, in comparison to some other polymers, is stiff and brittle with low impact strength and low deformation at break (Jacobsen et al. 1999). In recent, PLA has grabbed attention as of biodegradable polymers, though, as packaging material, the use of PLA is still a barrier due to its high cost and low performance as compared to other commodity polymers. The most important limitation is its low gas barrier properties for the application of PLA in food packaging. For applications in various fields, PLA suffers some other limitations like heat distortion temperature, low thermal resistance, and rate of crystallization, while some other precise properties are essential by different end-use sectors such as antistatic to

conductive electrical characteristics, flame retardancy, antibacterial, anti-UV or barrier properties, etc.

Polymer nanocomposites have grabbed a lot of attention from the last few years. These are low cost and high-performance materials for applications in various fields from tissue engineering to automotive to food packaging have become enchanting to researchers around the world (Vaia and Giannelis 2001; Alexandre and Dubois 2000; Giannelis 1996). Nanocomposites technology has the great potential to enhance polymer properties and inflate the applications of PLA, therefore, by adding nanofillers in PLA represents an interesting way to outspread and to enhance the properties of PLA (Raquez et al. 2013; Thellen et al. 2005; Rhim, Hong, and Ha 2009; Sinclair 1996). A number of researchers have been worked on PLA-based nanocomposites with layered silicates so as to mark highly exfoliated structures. *Bordes* et al. (Bordes, Pollet, and Avérous 2009) reported routes for the synthesis of PLA/layered silicate nanocomposites which was based on solvent intercalation, melt-intercalation and in situ intercalation.

METHODS

Preparation and Properties of Polylactide (PLA) Nanocomposites

Sinha Ray and Maiti (2002) synthesized polylactide (PLA)/layered silicate nanocomposites by simple melt extrusion of PLA with organically modified montmorillonite. These intercalated nanocomposites revealed outstanding enhancement of materials properties in both melt and solid states in comparison to PLA matrices without clay. Cabedo (2006) reported nanocomposites of amorphous PLA and chemically modified kaolinite and noticed good interaction within polymer and clay led to an increase in oxygen barrier properties of about 50%. They also studied the addition of plasticizers to conquer the inherent brittleness of PLA. Schmidt, Shah, and Giannelis (2002) developed many poly(l-lactic acid) (PLA) nanocomposites

which were based on different layered inorganics. These nanocomposites exhibited enhanced mechanical properties with higher moduli in compare to pure PLA. The increment was above T_g, by which work temperature was enhanced and this enhancement did not hinder biodegradation. In nanocomposites, the rate of biodegradation was enhanced six to ten times and it was cleared by marine respirometry and crystallinity measurements in solution pretending a physiological environment. PLA/PBAT bio-nano composites were prepared by *Moustafa* and coworkers for their application in antimicrobial natural rosin for green packaging. They used green modification method of organoclay, non-toxic reinforcing material makes the material to maintain its green character. The attained results revealed the outstanding possibility of using expanded OC modified PLA/PBAT polymer blends in which green material antimicrobial natural rosin was added, for their applications in food packaging and biomembranes (Moustafa et al. 2017).

Table 1. Comparison of material properties between neat PLA and PLACN4 reprinted with permission from Nano Letters, 2002, 2 (10), pp 1093–1096. Copyright (2002) American Chemical Society

Material properties	**Neat PLA**	**PLACN4**
Storage modulus/GPa at 25°C	1.63	2.32
Flexural modulus/GPa at 25°C	4.8	5.5
Flexural strength/MPa at 25°C	86	134
Distortion at break/%	1.9	3.1
HDT/°C	76.2	94
O_2 gas permeability coefficient ($mL.mm.m^{-2}.day^{-1}.MPa^{-1}$)	200	177

Ray and coworkers developed polylactide (PLA)-layered silicate nanocomposite and studied material properties and biodegradability. They found that material properties were increased after nanocomposite formation in comparison to neat PLA, Table 1 (Sinha Ray, Yamada, et al. 2002). D. R. Paul and Robeson (2008) reported that the addition of montmorillonite increased the biodegradation of PLA under compost. In these conditions, PLA firstly fragmented and followed by a biodegradation process, when PLA underwent fragmented to about 10,000 g/mol.

Sabet and Katbab (2009) prepared PLA based nanocomposites with improved biodegradability and abridged oxygen permeability via melt hybridization of poly (lactic acid) (PLA) and organomodified clay which showed a correlation between the structure of nanocomposites and rate of biodegradation.

Preparation of Poly(L-lactide)/layered aluminosilicate nanocomposites in the presence of two organo-modified montmorillonites by ring-opening polymerization was reported by Paul and coworkers (M. A. Paul et al. 2003). They suggested that the obtained exfoliated nanocomposites having enhanced thermal stability were attained by directly grafting of polymer chains on the surface of clay via hydroxyl-functionalized ammonium cations or these nanocomposites with high molecular weight were obtained via solid-state polymerization (Katiyar and Nanavati 2011). As sepiolite/PLA nanocomposites are less studied, the PLA nanocomposites melt-elaboration and characterization in the presence of Cloisite 30B and sepiolite was studied by Fukushima and coworkers (Fukushima, Tabuani, and Camino 2009).

Polylactide (PLA) nanocomposites were prepared by solution and melt mixing in the presence of carbon nanotubes (CNTs) for the studies of crystallization kinetics and morphology. Figure 1, represents the DSC cooling traces for nanocomposites cooled from the melt at various rates. Neat PLA showed very slow crystallization kinetics while with increasing CNT content faster crystallization kinetics are attained (Barrau et al. 2011).

Poly(lactic acid) (PLA) with organically modified montmorillonite (oMMT) in the presence of triallyl cyanurate (TAC), have been cross-linked by high-energy electrons in order to prepare its nanocomposites. TEM of PLA nanocomposites, Figure 2, revealed the internal structure of composites, like the dispersion position of the nanofiller in the matrix (Wang et al. 2012). Zheng (2009) prepared biocompatible (PDLLA)/magnetite (Fe_3O_4) nanocomposites by chemical co-precipitation and analysis of these were done by glass transition temperature (Tg), micro-surface morphology, mechanical properties, and functional groups change. Their shape memory effect was also reported in their studies.

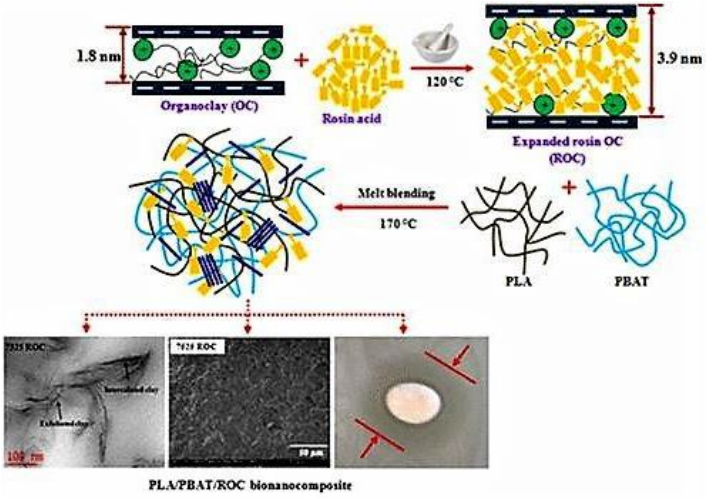

Figure 1. Synthetic scheme of PLA/PBAT/ROC bionanocomposite. Reprinted with permission from *ACS Appl. Mater. Interfaces, 2017, 9 (23), pp 20132–20141*. Copyright (2017) American Chemical Society.

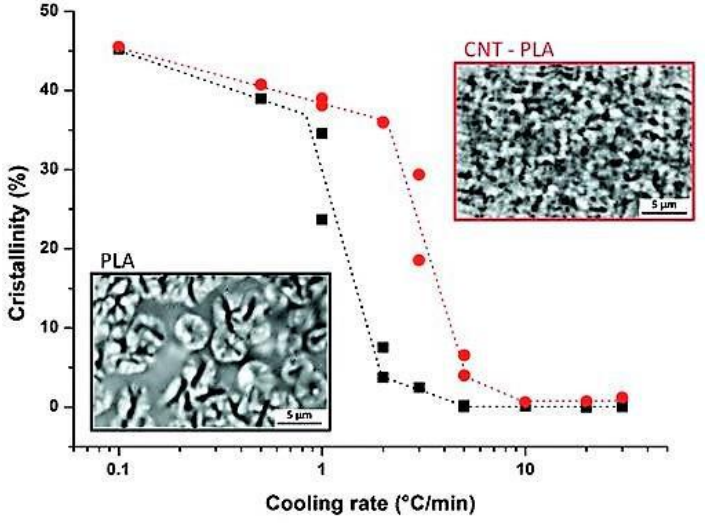

Figure 2. PLA crystal content versus cooling rate for NT0 (black squares), NT01 (green triangles), and NT1 (red circles). Reprinted with permission from *Macromolecules*, 2011, 44 (16), pp 6496–6502. Copyright (2011) American Chemical Society.

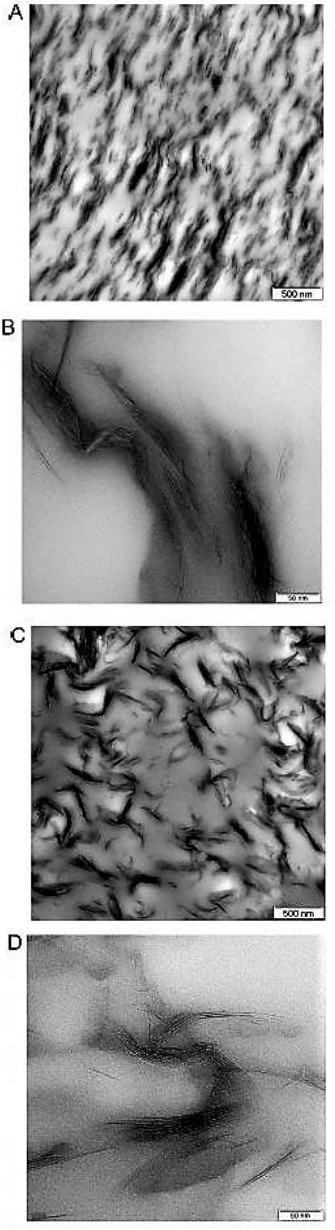

Figure 3. TEM patterns of PLA nanocomposites showing the nature of the dispersion of nanoclay in the matrix: (A, B) PLA-MMT-TAC 0kGy and (C, D) PLA-MMT-TAC 70kGy. Reprinted with permission from *Langmuir, 2012, 28 (34), pp 12601–12608*. Copyright (2012) American Chemical Society.

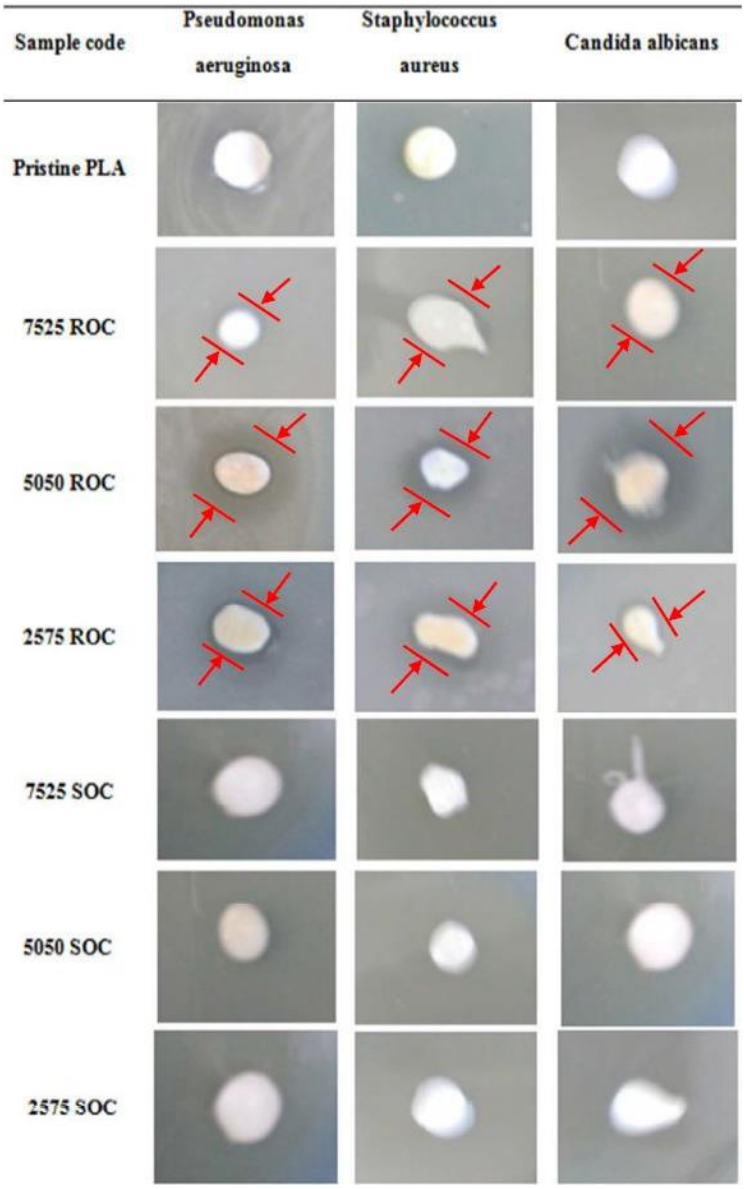

Figure 4. Antimicrobial activity for pristine PLA and its blends with different ratios of PBAT containing 2.5 w% of ROC or St. Acid against Pseudomonas Aeruginosa, Staphylococcus aureus, and Candida Albicans. Reprinted with permission from *ACS Appl. Mater. Interfaces, 2017, 9 (23), pp 20132–20141*. Copyright (2017) American Chemical Society.

Applications

As a biodegradable polymer, PLA has numerous applications in the biomedical field because of its biocompatibility features as well as good thermal plasticity, mechanical properties and is eagerly fabricated made it a promising polymer for several end-use application (Ray et al. 2003).

Biomedical

Kim, Lee, and Knowles (2006) developed PLA based nanocomposites in which in the suspension of biopolymer poly(lactic acid) (PLA) bioceramic hydroxyapatite (HA) was kept with the aim to insert a surfactant hydroxystearic acid (HSA) between the hydrophobic chloroform-dissolved PLA and hydrophilic HA powder. These nanocomposites were found useful in tissue engineering applications, mainly as three-dimensional substrates for bone growth. Nanocomposites of PLA was prepared by accumulating anticancer drug daunorubicin on PLA nanofibers and TiO_2 nanoparticles combination. Studies suggested that the above drug molecule is easily assembled in nanocomposites surface and can enable the drug infiltration and buildup on the target leukemia K562 cells. These nanocomposites having ease of surface chemistry modification, good biocompatibility, and very high surface area makes it a suitable candidate for biomedical engineering areas and pharmacology (Chen et al. 2007). Boccaccini (2010) reviewed various nanocomposites including poly(lactic acid) and suggested their mechanical, physicochemical and biological properties of introducing nanoscale bioactive in that type of biodegradable nanocomposites and revealed the chances of these materials in biomedical applications. Nanocomposites of polylactic acid/starch/poly ε-caprolactone (PLASCL20) were prepared via melt blending by mixing abovesaid with nanohydroxyapatite (nHA). The addition of 3% nHA in these nanocomposites enhanced the hydrophilicity, antibacterial activity, hydrolytic degradation, and the drug release as compare to PLASCL20. These were found suitable as antibacterial contenders for several medical applications along with the least side effects because of the controlled release of triclosan (Davachi et al. 2017).

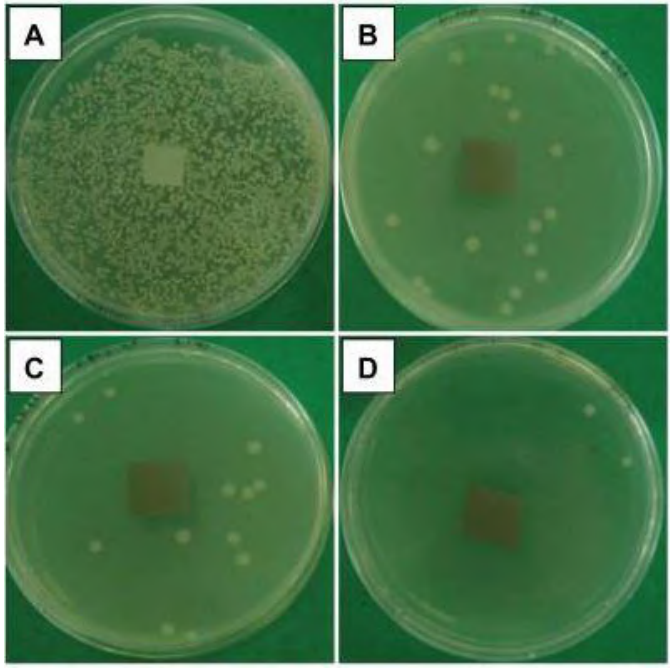

Figure 5. Comparison of inhibition zone test for Vibrio parahaemolyticus between PLA (A), Ag/PLA-NC content 8 (B), 16 (C), and 32 (D) wt% respectively.

The development of silver/poly (lactic acid) nanocomposite (Ag/PLA-NC) films was done by *Shameli* and his coworkers. They investigated that silver nanoparticles were synthesized via chemical reduction method into biodegradable PLA in diphase solvent in which sodium borohydride was used as a reducing agent. Silver nitrate acted as a polymeric matrix and sodium borohydride acted as a precursor in the PLA nanocomposite preparation. Ag/PLA-NC films revealed antibacterial activity, Figure 5, against Gram-positive bacteria (Staphylococcus aureus) and Gram-negative bacteria (Escherichia coli and Vibrio parahaemolyticus) by diffusion method using Muller–Hinton agar and the results revealed that these films can be used as an antibacterial scaffold for medical application and tissue engineering (Shameli et al. 2010). Nieddu (2009) reported PLA nanocomposites with different layered silicates nanoclays like fluorohectorites and montmorillonites with or without organic modifiers for their application in biodegradation in blood plasma. Development of sol-gel

bioactive glass/poly(l-lactide) nanocomposite scaffolds were reported by *El-Kady* and coworkers. In vitro bioactivity studies of these were found potentially applicable in bone engineering (El-Kady, Ali, and Farag 2010).

Others

Nanocomposite composed by PLA and montmorillonite layered silicate may lead to barrier properties suitable for food packaging applications (Thellen et al. 2005). In the chain, Rhim, Park, and Ha (2013) reported the applications of PLA nanocomposites in food packaging as these nanocomposites to have the potential of improvement of packaging performance as well as their biodegradability, mechanical, thermal and antimicrobial properties are perfect for the food packaging. PLA/Cloisite 30B composite film films were prepared for the improvement in their tensile strength, water vapor barrier, and antimicrobial properties. Tensile strength, elongation at break and water vapor permeability of nanocomposites were found $3.0 \pm 0.1\%$ and 1.8×10^{-11} gm/m^2 s Pa respectively and bacteriostatic function against *Listeria monocytogenes* (Rhim, Hong, and Ha 2009). The nanocomposite of PLA and montmorillonite-layered silicate was found useful in food packaging material due to its good barrier properties (Shibata et al. 2006). Sinha Ray and coworkers reviewed recent developments and properties of nanocomposites including PLA (Ray and Bousmina 2005). Studies of photodegradation of PLA-TiO_2 nanocomposites under UV light was done by *Nakayama* and coworkers and suggested that nanocomposites photo degradability can be efficiently promoted and their application in food packaging (Nakayama and Hayashi 2007).

CONCLUSION

The evolution of layered silicate-based PLA nanocomposites fruitfully created a sustainable material with improved thermal, physical, and chemical properties, to be an alternative to petroleum-based materials. Primarily, most of its applications were limited to short-time uses like the

packaging but now it is expanded to the biomedical sector due to its biodegradable property. Fascinatingly, due to the reduction of petroleum resources, PLA is now perceiving more and more attention as a valuable sourced polymer alternative in longstanding applications like electronics and automotive. Hence, the present chapter highlights the main developments and researches in PLA-based nanocomposites during this last decade.

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Chapter 5

POLYSACCHARIDES BASED NANOCOMPOSITES FOR DRUG DELIVERY SYSTEM

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ABSTRACT

The design and synthesis of biomaterials with a novel combination is expected to expand the scope of drug-delivery systems in the future. This chapter will focus on the chemical nature of biomaterials as well as the methods used to characterize them with regard to drug delivery. Recent developments in biomaterials capable of intracellular delivery are surveyed to highlight the frontier areas of drug delivery.

Keywords: polysaccharides, drug release system, nanomaterial

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1. INTRODUCTION OF POLYSACCHARIDES

Saccharides are generally recognized as carbohydrates. The most simple carbohydrates are *monosaccharide*, which contains a small chain of aldehydes and ketones having hydroxyl groups that have formula $(CH_2O)_n$ where n is three or more monosaccharides are glucose, fructose, and glyceraldehyde (IUPAC 1997). Monosaccharides are the structure blocks of disaccharides that contain a chain of sucrose and lactose. An oligosaccharide is having a small number (3 to 9) sugar or (mono-saccharides). *Oligosaccharides* can have many features, they are normally found on the plasma membrane of animal cells.

Polysaccharides contain more than ten monosaccharide units. Polysaccharides have a general molecular formula of $C_x(H_2O)_y$ where x is usually a large number between 200 and 2500. These repeating units in the polymer backbone are often six-carbon monosaccharides. *Polysaccharides* are having polymeric carbohydrate structure, formed by repeating units of monosaccharides and disaccharides which joined together by glycosidic. They have a structure of monosaccharide from linear to highly branch.

Polysaccharides are an important branch of biological polymers. The function of polysaccharides in living creatures is usually either structure or storage polysaccharides.

- *Storage polysaccharides:* this type of polysaccharide contains starch and glycogen in plants and found in the form of both amylose and the branched amylopectin. In case of animals, found the structurally similar glucose polymer is the more densely branched glycogen, which known as animal starch. Glycogen properties permitted it to be metabolized more quickly, which outfits the active lives of moving animals. Starch and glycogen polysaccharides are called storage polysaccharides because they are stored in the muscles and liver, are converted to energy body functions. Starch is obtained from plants whereas glycogen is obtained from animals.
- *Structural polysaccharides*: this type of polysaccharide contains cellulose and chitin. Cellulose is said to be the most abundant

organic molecule on earth and is used in the cell walls of plants and other organisms (IUPAC 1997). It has wide applications such as paper and textile industries and is also used for the production of rayon, celluloid, cellulose acetate, and nitrocellulose. Chitin has the same structural formula but has nitrogen-containing side branches, that why it increases strength. Chitin found in arthropod exoskeletons and cell walls of fungi. It also has multiple uses, including surgical threads. Callose or laminarin, chrysolaminarin, xylan, arabinoxylan, mannan, fucoidan, and galactomannan are also found in polysaccharides.

Polysaccharides are generally heterogeneous, covering minor modifications of the repeating unit. Depend on the structure; these macromolecules can have different properties from their monosaccharide arrangement. They may be amorphous or even insoluble in water (Metthews 1999). When polysaccharide is having the same type of monosaccharides, this type of polysaccharide is called *homopolysaccharide* or *homoglycan*, but when a different type of monosaccharide is present they are called *heteropolysaccharides* or *heteroglycans* (Campbell 1996; Varki 1999).

Nutrition polysaccharides having common sources of energy. Some micro-organisms can basically degrade starch into glucose but cellulose or other polysaccharides like chitin and arabinoxylans cannot metabolize easily. These polysaccharides can be metabolized by bacteria and protists. These multi-faceted polysaccharides are not digestible, they provide important dietary elements for humans. Depend on these properties it's also called dietary fiber, these carbohydrates type polysaccharides enhance digestion among other benefits (Martin and David 2005). Soluble fiber binds to bile acids in the small intestine, restricted them enter the body, that why turn lowers cholesterol levels in the blood (Weickert and Pfeiffer 2008). After eating, soluble fiber also decreases the absorption of sugar and normalizes blood lipid levels, once fermented in the colon, and produces short-chain fatty acids as byproducts with different physiological activities. Although insoluble fiber is allied with reduced diabetes risk (Scientific Opinion 2010).

Dietary fiber is most important for the diet, with a regulatory establishment in many developed countries (Anderson et al. 2009; Jones and Varady 2015). Dietary fibers are a family of biopolymers, nucleic acids, proteins, and polysaccharides (Weickert and Pfeiffer 2008). Mostly polysaccharides are found easily, expensively recovered natural and produced as energy storage or structural biopolymers by microbes, plants, and animals (Scientific Opinion 2010). Polysaccharides have number of advantages over nucleic acids and proteins for applications in materials science. Polysaccharides are generally more stable than nucleic acids and proteins and are usually not irreversibly denatured on heating (Scientific Opinion 2010).

2. FUNCTIONS OF POLYSACCHARIDES

2.1. Homopolysaccharides

- **Starch:** starch is known as storage polysaccharide and found in plant cells shown in Figure 1. It's having two forms, first is amylose is the helical form of starch comprised only of alpha-1,4 linkages and second is amylopectin that has a structure like glycogen except that the branched alpha-1,6 linkage is present on only about one in 30 monomers.

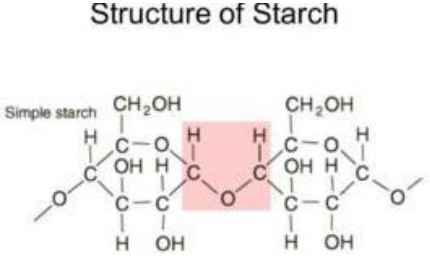

Figure 1. Structure of starch.

- **Glycogen:** Glycogen is also known as storage polysaccharides and it's found in animals (Figure 2). It is composed of alpha-1,4-

glycosidic bonds with branched alpha-1,6 bonds present at about every tenth monomer. It is mainly produced by the liver and muscles, but it can also be made during a process called glycogenesis.

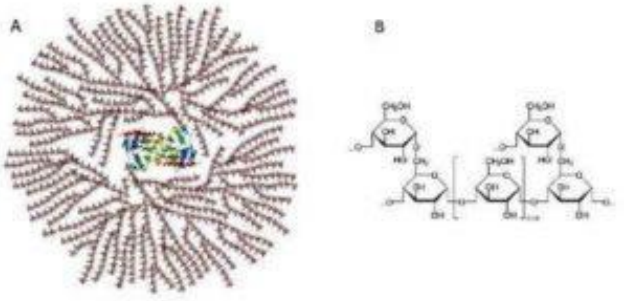

Figure 2. Structure of glycogen.

- **Cellulose:** Cellulose is a structural polysaccharide that is found in the cell wall of plants and when consumed, it acts as a dietary fiber. Cellulose is known as at most plentiful organic molecule on earth. Wood paper and cotton are common forms of cellulose.

2.2. Heteropolysaccharide

Heteropolysaccharides are found in different structural and functional roles in the human body.

- **Dermatan sulfate:** Dermatan sulfate is originated mainly in the skin, and also present in vessels, heart, lungs. It may be related to coagulation and vascular diseases and different conditions.
- **Hyaluronic Acid:** Hyaluronic acid acts as a lubricant and its presence in the synovial fluid of joints.
- **Heparin:** Heparin presents as an anticoagulant in the blood.

- **Chondroitin Sulfate:** Chondroitin sulfate contributes to tensile strength and elasticity of different parts such as walls of the aorta, cartilages, ligament, and tendons.
- **Keratan sulfate:** Keratan sulfate present in the cornea, bone, cartilage and a variety of other body parts such as hair and nails.

In this way, different type of polysaccharides that are present in the human body is glucose-amino-glycans or mucopolysaccharides that are created by the endoplasmic reticulum. Polysaccharides from important material such as connective tissues, collagen, and elastin.

3. DRUG DELIVERY SYSTEM

The drug delivery system is medium for transporting a pharmaceutical compound (drug) in the particular part of body as desirable to safely release its needed target site with therapeutic effect (Jones and Varady 2015). Drug delivery technologies adapted drug release profile, distribution, absorption, and elimination for the advantage of refining product safety, and efficacy, as well as patient compliance and convenience. Drug release is from diffusion, degradation, swelling, and affinity-based mechanisms. In present time polysaccharides nanoparticle has most attention as a potential drug release system, it's applicable for controlled release of drugs in target site (Aminabhavi et al. 2001). Some of the polysaccharides such as chitosan and deacylated product of chitin have shown best drug release properties. It is insoluble at natural and alkaline pH values but forms salt with inorganic and organic compounds. Upon dissolution the amino groups of chitosan get protonated then polymer became positive charged (Neil 2010). Peptides, antibody, protein, gene and vaccine-based drugs, may not be transported by above routes because due to molecular size and charge issues they cannot be absorbed into the systemic circulation efficiently for therapeutically effective. In this way, many proteins and peptide drugs have to be transported by injection or a nano-carrier technique (Wang and von Recum 2011).

The drug release system can be made by slowly degradable, stimuli reactive (temperature and pH-sensitive) by conjugating them. The targeted drug release system is the ability to direct interest with the drug-loaded system. Two major mechanisms addressing the desired site for drug release (Reddy 2010). Colloidal drug release systems like as micellar solutions, liquid crystal dispersion, Vesicle and nanoparticle dispersion obtain a small particle in the range of 1-400 nm show ideal drug delivery system. This system also modified and achieved goal for drug release systems with optimized drug loading and release properties, long shelf-life and low toxicity (Mueller 2004). Present research in the field of drug delivery includes the development of different types of drug delivery, such as targeted delivery in which the drug is only active in the target area of the body such as in cancerous tissues (Mueller 2004). Sustained drug release, in which the drug is released over a period of time in a controlled way, and methods to enhanced survival of oral agents which must pass through the acidic environment of a stomach (Bertrand and Leroux 2005). Different types of sustained-release formulations were investigated such as include liposomes, drug-loaded biodegradable microspheres, and drug-polymer conjugates and hydrogel (Staff 2015).

4. CLASSIFICATION OF DRUG DELIVERY SYSTEM

Different types of drug delivery systems were investigated, which are following.

- Magnetic drug delivery
- Thin-film drug delivery
- Biodegradable polymer-based drug delivery system
- Bovine submaxillary mucin coatings
- Acoustic targeted drug delivery
- Self-micro emulsifying drug delivery system
- Neural drug delivery systems

5. POLYSACCHARIDES BASED DRUG DELIVERY SYSTEM

The field of drug delivery has given a solution to the limited efficacy and high toxicity of many drugs. Nano-sized drug carriers are popular because their size allows for selective accumulation in the diseased area. Polysaccharides are non-toxic and biodegradable natural polymers that can serve as the basis for these nano-sized carriers. Polysaccharide with strong hydrophilicity that may reduce uptake by the reticuloendothelial system and prolong drug circulation.

5.1. Starch-Based Nanoparticle for Drug Delivery System

Starch is a naturally occurring polymeric material, it's extracted from seeds, tubers or roots. Starch shows the chain structure of glucose which linkage by glycoside. It has two forms are amylase which is linear and other is amylopectin's which have branched. In the present time, starch-based hydrogel represents best in drug delivery, tissue engineering, and other biomedical applications (Sa-Lima et al. 2010) developed injectable hydrogels of starch and encapsulated the starch-based gels derived stromal cells for the regeneration of articular cartilage. Chitosan β-glycerophosphate starch hydrogels can be investigated use of chondrogenic and differentiation of ADSC for cartilage regeneration. Hydrogels of starch have found their use in wound dressing (Pal et al. 2006). Investigated transparent starch-based hydrogel membranes, and it's prepared by cross-linking of polyvinyl alcohol with heat-treated corn starch suspension. Nanoparticles intercalated hydrogel matrix shows the unique physicochemical characteristic properties of hydrogels such as thermal, mechanical, barrier, optical, sound, electric simulations, etc. (Schexnailder and Schmidt 009). The aggregation properties are shown by nanoparticles, which are neither stabilized nor charged. Charged nanoparticles may occur exfoliation in water, due to the colloidal interactions of silicates and stabilize the gel formed. Literature review and some new publications covers the synthesis, characterization, and applications of hydrogels of polymer nano-composite covering

magnetic and inorganic nanoparticles (Razmjou et al. 2013, Hou et al. 2008, Takahashi et al. 2005) has shown that a modified polyethylene dioxide–laponite system can be investigated for a drug delivery system at physiological situations. A broader variety of applications is mentioned for starch made from nanoparticulate bentonites (natural layered silicate) and PEO polymer. Metal nanoparticles dispersed within hydrogels of polymer nanocomposites can enhance anti-microbial properties and electrical conductance (Murali et al. 2007, Kozlovskaya et al. 2008). Gaharwar (2011) were investigated Polymer–magnetic nanocomposites, with particles in the polymer matrix dispersed within cross-linking polymer chains (Gaharwar et al. 2001). PEG and silicate nanoparticles synthesized nanocomposite hydrogel. Recent research demonstrated the potential of silicate-PEG nanocomposite hydrogels in craniofacial, orthopedic and dental applications. Viscosity measurements for the function of shear rates represented in Figure 3.

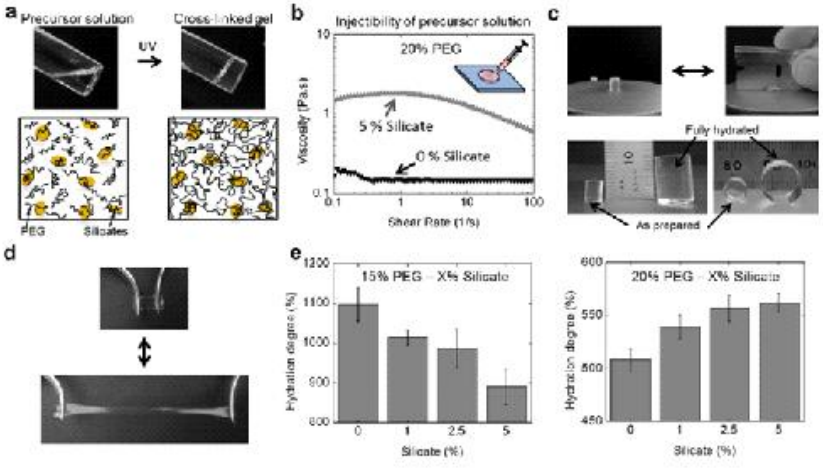

Figure 3. Transparent PEG–silicate nanocomposite hydrogels.

Synthesized nanocomposite observed the result that nanocomposites were used for sustaining the extreme mechanical deformation. The swelling characteristics of the nanocomposites were affected by the ratio of silicate nanocomposites. Many other aspects of polymer nanocomposites are

currently being investigated, such as the effects of nano-filler on chain dynamics, and it depends on the final properties and degree of dispersion. Ideal hydrogels have been synthesized by direct dissolution of chitin at low temperatures. A clear transparent solution in a mixture of 8wt%NaOH/4wt% urea aqueous solution by freeze/thawing method to prepare transparently (Chang et al. 2011). The chitin hydrogels may find wide use in bio-applications, as a result of the more stable structure and better compatibility of chitin than its derivatives (Chang et al. 2011). Hydrogel nanocomposites are also being investigated as pressure-sensitive adhesives for skin contact applications. Monodisperse polystyrene nanoparticle used as a filler on the network formation, rheological properties and adhesion performance of hydrogel nanocomposites (Bait et al. 2011). Organically modified phyllosilicate form organoclay, which derived from the naturally occurring clay mineral. Polydimethylsiloxane (PDMS) intercalated organoclay shows the results in the formation of pressure-sensitive adhesives. Shaikh (2007) obtained the partially exfoliated nanocomposites of PDMS. It was shown that different ratios of the organo-silicate additive to the polymer matrix, nanocomposites enhanced the drug release kinetics and the adhesive properties of the matrix (Shaikh et al. 2007). Present emphasis is to develop transdermal formulations, which are based on natural polymer matrix and for better release technologies in, which the dispersion of the drug is uniform within the transdermal layer (Brown et al. 2006; Naik et al. 2000).

5.2. Cellulose Based Drug Delivery System

Cellulose is mostly known as naturally occurring polysaccharides and its derivatives have been broadly used in the pharmaceutical field as drug delivery. Hydroxyl propyl cellulose was synthesized and modifying by some of the cellulose hydroxyl groups with propylene oxide to enhance the cellulose solubility and control drug release (Kamel et al. 2008). Which improves the oral delivery of hydrophobic drugs, which often have less bioavailability after administration, Winnik (2003) Modified hydroxyl propyl cellulose with hydrophobic hexadecyl or octadecyl groups through

polyoxyethylene linker of variable length (Francis et al. 2003). Five hydrophobic molecules were attached to one hydroxyl propyl cellulose chain, the critical micelle concentration was 65–135 mg/L while with ten hydrophobic chains, the critical micelle concentration dropped to 15–22 mg/L. Less water-soluble immunosuppressant (Cyclosporin A), was used as ideal drug. The maximum loading was 0.025 mg CyA/mg micelle was observed with lower hydrophobic modification, while, as anticipated, with higher modification and loading capacity increased to 0.067 mg CyA/mg micelle. PEO-C16 provided an improved solubilizing environment for CyA relative to PEO-C18 with the same quantity of hydrophobic moieties. The polymeric micelles size dropped from 78–90 nm to 44–74 nm by the encapsulation of CyA. Presumably, the encapsulation of CyA enhances the hydrophobic interactions in the core and produces more compact particles. In vitro-studies showed HPC-PEO-C16 micellar system had high affinity to mucus and could enhance the permeability of entrapped therapeutics across intestine epithelial-Caco-2 cells (Xiong et al. 2012; Chayed et al. 2003; Francis et al. 2005; Enomoto-Rogers et al.2011; Clagett et al. 1998; Francis et al. 2003; Francis et al. 2005; Yuan et al. 2006; Xu et al. 2006; Houga et al. 2009; Daoud-Mahammed et al. 2009). These studies demonstrated the great potential of cellulose-based micelles for improved oral delivery of hydrophobic drugs. A literature review has focused on the design and synthesis of cellulose-based micelles; such systems include HPC-polycaprolactone (Discher and Ahmed. 2006) and cellulose-C15-pyrene micelle. Micelles prepared from cellulose-C15-pyrene with longer cellulose chains and smaller in size relative to those prepared from short-chain cellulose and shows multilayer micelle (Chen et al. 2006). *Galkina* et al. synthesized TiO2 modified nanocomposite based on cellulose nanofibers and loaded three types of medicines, diclofenac sodium, penicillamine-D, and phosphomycin. Diclofenac released was observed fast and highest about 90% within 70 minutes (Enomoto-Rogers et al. 2011).

Many researchers are also developing as promising polysaccharides carriers for drug delivery systems with the present improvement and breakthrough of the nanocellulose modification techniques, at present time nano cellulose are drawing wonderful attentions in drug delivery systems

and continue to grow positive result (Galkina et al. 2015; Peng et al. 2011; Habibi et al. 2010). Das (2012) synthesized cellulose nano-whiskers for a novel drug delivery system (Das et al. 2012). That was adapted for the controlled delivery of enzymes, proteins and amine-containing drugs with the selection of desired linker molecules. Representing the processes exist between sources of bacterial cellulose and its drug delivery system in Figure 4.

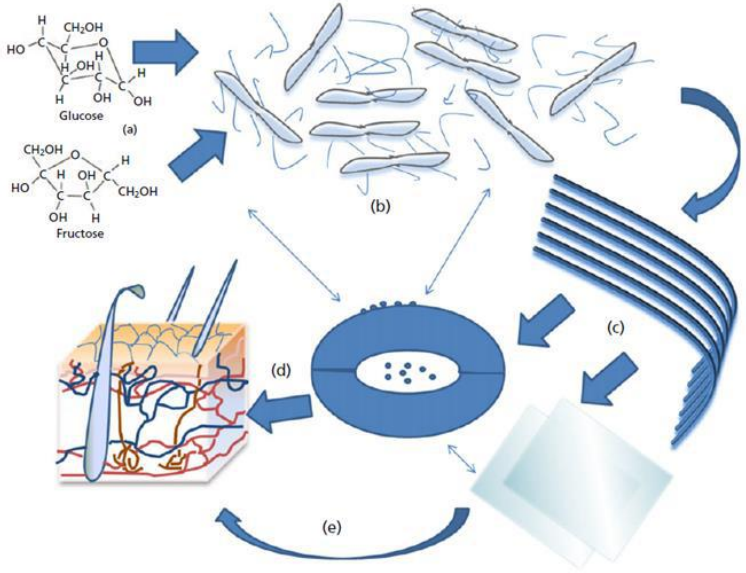

Figure 4. Representation of processes ranging between sources of bacterial cellulose and its drug delivery system.

5.3. Chitosan Based Drug Delivery System

In current times chitosan and its derivatives have been most broadly investigated composites for drug delivery due to valuable properties. Many researchers have focused on chitosan-based drug delivery systems (Figure 5) for improvement of hydrophobic drug delivery. Most of these systems were developed by chitosan and its derivative with hydrophobic moieties such as stearic acid (Xie et al. 2006; Du et al. 2011; Hu et al. 2009; Hu et al.

2008; Hu et al. 2012), deoxycholic acid (Hu et al. 2012; Jin et al. 2012; Lee et al. 2012; Wang et al.2012), glycyrrhetinic acid (Tian et al. 2012), polycaprolactone (Zhang et al. 2011; Chen et al. 2011). Modified chitosan can lead to the formation of self-assemble spherical nano and macro composites with a range of 20–500 nm in aqueous solution. Modification percentage of higher hydrophobic moieties usually gives rise to a smaller composite diameter due to stronger hydrophobic interactions. Several anti-tumor therapeutics such as paclitaxel (Sahu et al. 2011; Mo et al. 2011; Lian et al. 2011), doxorubicin (Huo et al. 2012; Jin et al. 2012; Du et al. 2011; Du et al. 2011; Srinophakun and Boonmee. 2012; Du et al. 2012), and camptothec in Du (2012), have been used as ideal drugs which encapsulated by chitosan modified composite. The chitosan modified nano and micro composite enhanced the solubility of the hydrophobic drugs and these composites showed controlled or sustained release of the hydrophobic drugs. A higher degree of substitution usually specified slower drug release despite insignificant changes in the loading efficiency. The therapeutic-loaded nano and micro composites showed significantly higher toxicity to tumor cells for in vitro compared to free drugs due to improved drug internalization. Chitosan-based composites have been used to improve oral drug delivery due to muco and bioadhesive nature of chitosan. Chitosan-based composites were established to inhibit the activity of P-glycoprotein 1 ATPase (Jiang et al.2011). Chitosan has opened the tight junctions between cells, in this reason it has greater drug absorption capacity. The chitosan-based composites were characterized by low CMCs, for high stability (Sonaje et al.2011) and resistance to the harsh environment of the gastrointestinal tract. N-octyl-O-sulfate chitosan can improve the oral bioavailability of PTX (Srinophakun and Boonmee .2012).

Chitosan-based materials were established to be a relatively safe vehicle of a drug for oral formulation (Lin et al. 2011). Chitosan-based drug release systems have also been examined for applications in antivirus (Sonaje et al. 2011), anti-thrombogenicity (Lin et al. 2011), and anti-platelet aggregation release (Jiang et al. 2011).

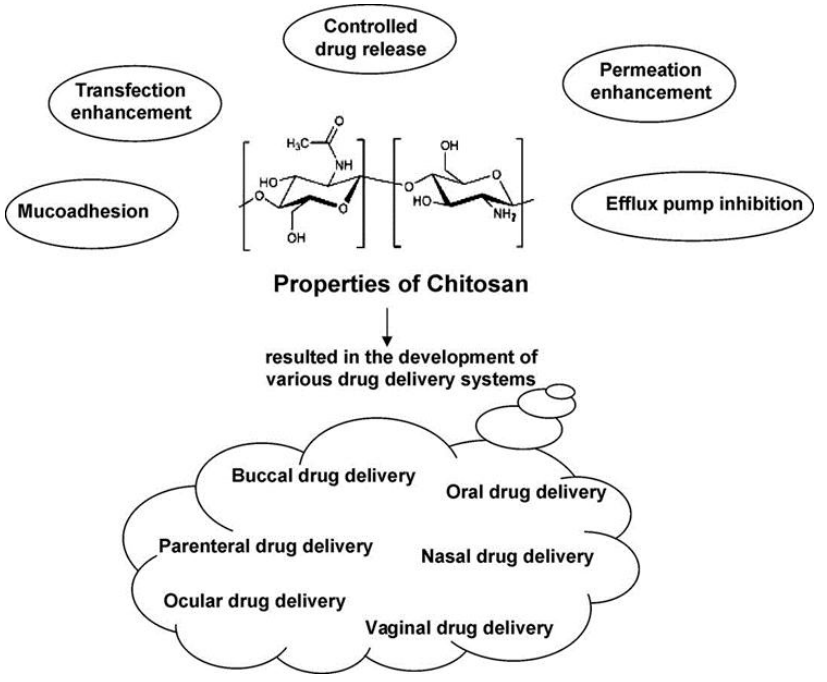

Figure 5. Chitosan-based drug delivery systems.

CONCLUSION

Polysaccharides based drug delivery systems have shown potential improvement of drug and protein delivery by enhanced solubility, stability, and controllable drug release properties. Polysaccharide-based drug release system was also shown prolonged circulation and favorable pharmacokinetics in several models, indicating the potential for translation to clinical research. Polysaccharide-based drug delivery system forms a clear trend towards more complex and controllable systems, which will possess higher targeting and specificity to further improve therapeutic efficacy and reduce undesired side effects. Polysaccharide possesses some very extraordinary properties which make it a very useful biomaterial for drug delivery includes its biocompatibility, absorbability on biological membranes, no antigenicity, low toxicity, synergism with other bioactive

compounds, etc. This advantage will value the future development of biomaterial for drug delivery.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 6

POLYVINYL ALCOHOL (PVA) BASED NANOCOMPOSITES FOR BIOMEDICAL AND TISSUE ENGINEERING APPLICATIONS

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ABSTRACT

PVA is a synthetic polymer that has been widely used for the last 30 years in the medical, clinically, non-clinically and other fields. In the field of nanocomposites, current research and development are much focused on polymer matrix-based nanocomposites. The aim of the chapter is to explore the synthesis, properties and biomedical applications of polyvinyl alcohol (PVA) based nanocomposites. Such nanocomposites have outstanding thermal stability, mechanical properties, noncarcinogenicity, non-toxicity, biocompatibility, and flexibility. These properties of PVA based nanocomposites makes them a suitable candidate for medicinal and biomedical applications such as drug delivery, wound dressings, soft

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biomaterial implants and bone tissue engineering. Special focus is given to the biomedical applications of PVA based nanocomposites.

Keywords: polyvinyl alcohol, properties, biocompatibility, biomedical application

INTRODUCTION

Polyvinyl alcohol (PVA) is a synthetic polymer that has been essentially derived from the saponification process of polyvinyl acetate through hydrolysis (Pal, Banthia, and Majumdar 2007; Hill and Le 2001), has been used throughout the first half of the 20th century worldwide. In water, it is a solubilized crystalline structure polymer that is easily degradable by biological organisms having a wide range of applications in commercial, industrial, medical and food areas. Along with these applications, it has been also used in producing end products like food packaging materials, resins, lacquers, surgical threads, etc. PVA is also used as a blending with other polymers having hydrophilic properties (Lee et al., 2004; C. Zhang et al., 2005; Mansur, Oréfice, and Mansur 2004; Xu et al., 2009; Salavagione, Gomez, and Martinez 2009; Hyon, Cha, and Ikada 1989; Mansur et al., 2008; BUNN 1948). It has been also used in many industrial applications for enhancing mechanical strength due to its compatible and hydrophilic nature (Limpan et al., 2012; M. Liu et al., 2007; DeMerlis and Schoneker 2003; Razzak and Darwis 2001) along with its use in nanofillers and crosslinked product (Qiu and Netravali 2013, 2012).

Polymer nanocomposites, ceramic nanocomposites, and metal nanocomposites are the main groups of nanocomposites. Current studies revealed that polymer nanocomposites can be used in several medical areas along with aerospace, packaging, construction, optoelectronic devices, etc. Nanomedicine is the field of diagnosing, curing, treating, preventing diseases as well as dealing with an excruciating injury, alleviating pain and protecting human health with the help of molecular tools and health of the human body (Feldman 2016; Tiwari et al., 2012). A wide variety of nanocomposites based on PVA have been prepared by taking it as a matrix

or nano reinforcement like layered silicate. The method of synthesis of these nanocomposites is generally in situ polymerization or solution casting. The first nanocomposite of PVA with a complete range of MMT loading was PVA/MMT nanocomposites. PVA nanocomposites, alpha-chitin whisker reinforced, were prepared with or without heat treatment (X. Zhang et al., 2003; Liang et al., 2009; Roohani et al., 2008; Strawhecker and Manias 2000).

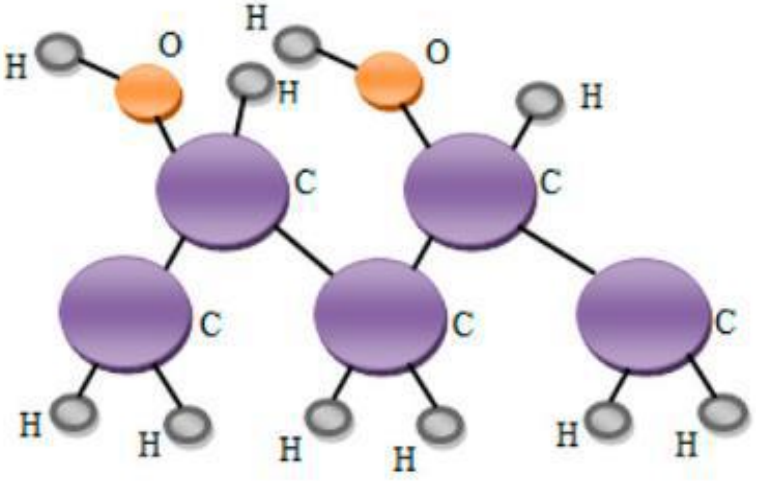

Figure 1. Structure of polyvinyl alcohol (PVA).

METHODS

1. Synthesis of PVA Based Nanocomposites

Ferrite-polymer nanocomposite based on PVA was synthesized by Sindhu (2006) by direct mixing of the PVA and ferrite, followed by sonication. Polyvinyl alcohol (PVA) nanocomposite hydrogels were synthesized by different loading of hydrophilic natural Na-montmorillonite nano clay. Dehydration tests of these nanocomposites were performed and found the direct dependency of these on the dehydration temperature (M

Sirousazar et al., 2011). Nanocomposites of polyvinyl alcohol (PVA) with starch-containing some montmorillonite were prepared by (Spiridon et al., 2008). The enzymatic degradation studies of the above nanocomposites were performed on the basis of determinations of mass loss and the reducing sugars.

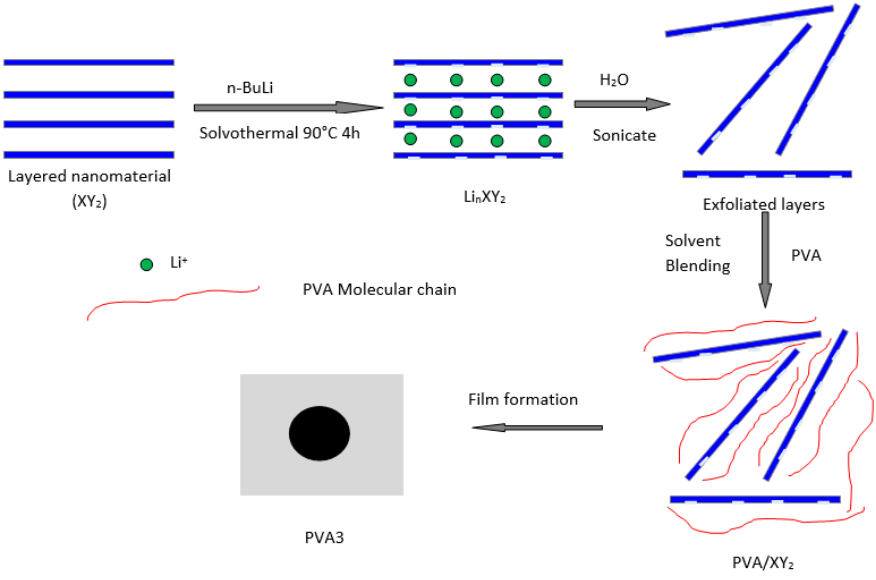

Figure 2. General preparation process of PVA nanocomposites.

2. Properties of PVA Nanocomposites

Recently, K. Zhou (2012) reported that the addition of 1−5 wt. % exfoliated molybdenum disulfide nanosheets in polyvinyl alcohol (PVA), resulted in a nanocomposite with ≈28% enhanced storage modulus with ≈24% increment in the tensile strength. Molybdenum disulfide (MoS_2)/polyvinyl alcohol (PVA) nanocomposites are prepared by Zhou and coworkers (K. Zhou et al., 2012a) via solvent blending method and found the enhancement in the mechanical properties, fire resistance properties and thermal properties which revealed the good dispersion of MoS_2 in PVA and strong interactions between them. Nanocomposites obtained from polyvinyl

alcohol (PVA) and cellulose whiskers (CWs) revealed outstanding improvement in mechanical properties (Jalal Uddin, Araki, and Gotoh 2011)

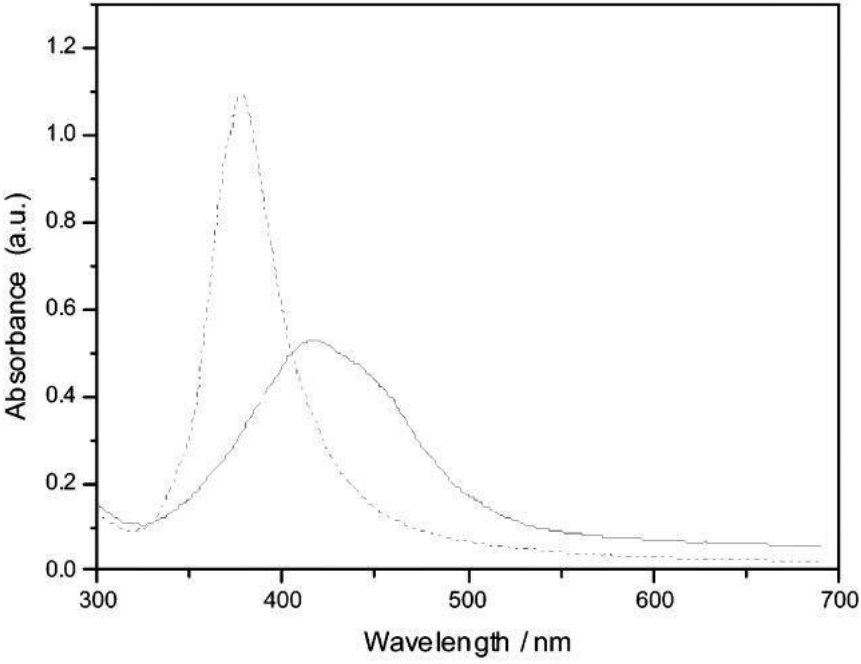

Figure 3. Absorption spectra of as-prepared silver colloid (dashed line) in water and PVA-Ag nanocomposite film (solid line) with 0.33 wt % of Ag, Reprinted with permission from Chem. Mater., 2003, 15 (26), pp 5019–5024, Copyright (2003) American Chemical Society."

Mbhele (2003) prepared PVA-Ag nanocomposites, optical studies suggested that a broad surface plasmon absorption band was found at 420 nm wavelength in PVA-Ag nanocomposite films while in pure form it was found at 380 nm revealed Ag nanoparticles embedded in PVA matrixes. The water vapor permeability of poly(vinyl alcohol)/Na^+ montmorillonite nanocomposites was measured, figure 4, and found that the improvement in the water permeability instigates from the boosted modulus of the PVA matrix in the nanocomposites (Strawhecker and Manias 2000).

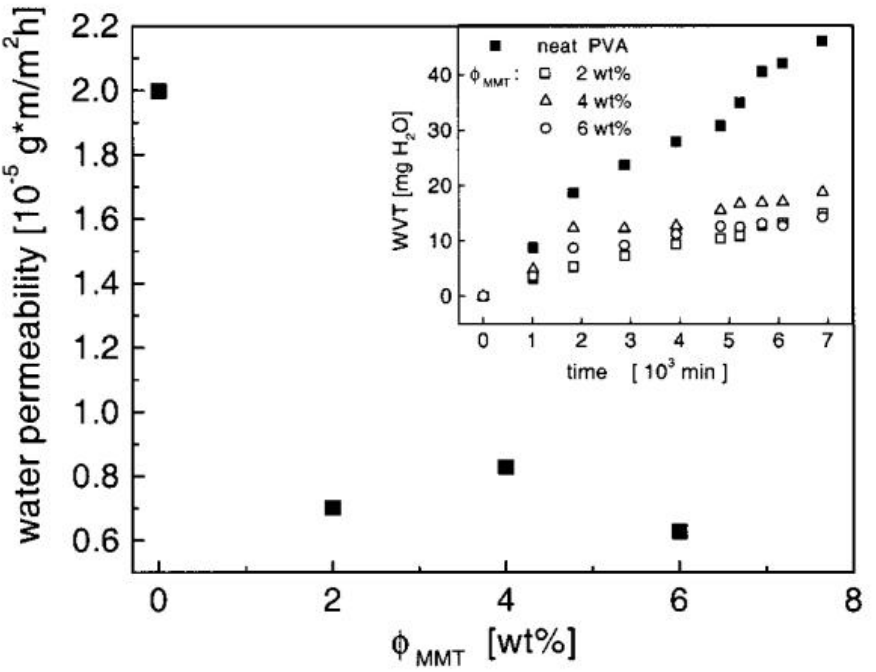

Figure 4. Water vapor permeability for the neat PVA and several PVA/MMT nanocomposites. The inset shows the water vapor transmission raw data collected for each composition, which were used to calculate the water permeabilities. Reprinted with permission from Chem. Mater., 2000, 12 (10), pp. 2943–2949 Copyright (2000) American Chemical Society.

GO/PVA composite hydrogel with enhanced mechanical properties via solution mixing and freezing/thawing was prepared (J. Liu et al., 2012) and unveiled that in PVA chains strong physical cross-linking effect was observed due to hydrogen bonding.

3. Applications

PVA has been used for its compatibility in biomedical applications (Paradossi et al., 2003). Nanocomposites of PVA are used in various biomedical fields like manufacturing of artificial heart surgery contact lenses, wound dressings and drug delivery systems as it has highly favorable

properties like biocompatibility, non-carcinogenic, nontoxicity, bioadhesive properties, and swelling characteristics. Polyvinyl alcohol (PVA) reinforced with multi-walled carbon nanotubes and glutaraldehyde is excellent to be used as biomedical applications in an alternative of traditional materials (Mohammad Mahdi Dadfar, Kavoosi, and Mohammad Ali Dadfar 2014).

DRUG DELIVERY SYSTEM AND CANCER DIAGNOSIS

Polyvinyl alcohol and SPION nanocomposites were found useful in drug delivery of popular drug ciprofloxacin [30]. Li, Wang, and Wu (1998) prepared poly(vinyl alcohol) (PVA) hydrogel nanoparticles by the technology of water-in-oil emulsion plus the process of cyclic freezing-thawing for their use in protein (Bovine Serum Albumin)/peptide drug delivery and release of BSA followed diffusion-controlled mechanism. Polyvinyl alcohol (PVA)/halloysite (HNTs) bionanocomposite films were fabricated by solution casting and crosslinking of glutaraldehyde (GA). They exhibited applications in drug delivery systems as well as bone tissue engineering (W. Y. Zhou et al., 2010). PVA-coated indomethacin-loaded PLGA nanocomposites were prepared with an about 100 nm diameter size by emulsification and the solvent evaporation method for their application in iontophoretic transdermal drug delivery (Tomoda et al., 2014). Kalia (2014) reviewed super magnetic iron oxide nanoparticles with PVA in magnetic resonance imaging (MRI) of cancer cells for cancer diagnosis and chemotherapy.

TISSUE ENGINEERING

Nowadays, bone tissue engineering has become one of the auspicious areas because it has the potential to repair diseased/damaged bone tissue by joining osteogenic cells, osteoconductive scaffolds and osteoinductive biological signals organized in an arranged way for bone tissue regeneration (Hou et al., 2007; Bártolo et al., 2009). In order to applications in tissue

engineering, Sionkowska and Kozłowska (2010) suggested that nanocomposites processed from collagen type I and PVA showed morphological characteristics for potential use as bone TE soft scaffolds. Polyvinyl alcohol (PVA)/ waterborne polyurethane (WPU)/ TEMPO-oxidized cellulose nanofibers (TOCNs) nanocomposite were prepared (Dai et al., 2014) and they were non-toxic, hydrophilic and biocompatible so could be used for filtration materials, tissue scaffolding and medical fields as wound dressing materials. *Yoshii* and coworkers prepared polyvinyl alcohol (PVA) hydrogel by electron beam irradiation and acetalization of PVA. Heat resistance of these was checked by mechanical properties. Its application as a wound dressing was assessed by attributing to a wound or burn of the back skin of marmots and found homogeneous adhesion to the infected parts along with easy removal with no damage to rehabilitated skin as well as a little rapid rate of regeneration of the injured skin (Yoshii et al., 1995). In the series fabrication of polyvinyl alcohol (PVA) scaffold for bone tissue engineering via selective laser sintering was done by *Shuai and coworkers* (Shuai et al., 2013). They suggested that the porosity of the above was found 67.9 ± 2.7% which was suitable for the prerequisite of micro-pores of the bone scaffolds as tissue engineering (TE). For wound dressing on animals, nanocomposites of polyvinyl alcohol (PVA) with organically-modified montmorillonite as nano clay was prepared by the freezing-thawing cyclic method. In vivo studies of these were performed which unveiled an enhanced healing process in wounds as compare to sterile gauze and in vitro studies helped to determine cytotoxicity and biocompatibility of synthesized nanocomposites. In studies, these were found non-toxic and biocompatible for their use in wound dressing in practical wound management (Mohammad Sirousazar, Kokabi, and Hassan 2011). Preparation of nanocomposites of polyvinyl alcohol- chitosan (PVA-CS) and graphene oxide (GO) was done by casting their stable aqueous mixture. These new nanocomposites revealed enhanced thermal stability as well as they were found mechanically strong. Their cell viability and cytotoxicity studies unveiled that MC3T3-E1 mouse osteoblastic cells can attach and fabricated on PVA-CS/GO nanocomposite films and makes them a suitable candidate for tissue engineering (Pandele et al., 2014). Nanocomposites of

PVA and chitosan prepared by gamma radiations revealed good biodegradability, biocompatibility, and hemostatic properties and due to this, they can be used in wound dressing (El Salmawi 2007).

OTHER BIOMEDICAL APPLICATIONS

Polyvinyl alcohol (PVA) functionalized cobalt ferrite nanocomposites were successfully prepared by the combustion method and surface modified by (Salunkhe et al., 2013) for biomedical applications. These were characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), Fourier transforms infrared (FTIR) spectroscopy, dynamic light scattering (DLS) and thermogravimetric analysis (TGA) and revealed decrement of contact angle suggested the conversion of hydrophobic nature to hydrophilic. In vitro cytotoxicity results revealed less cytotoxicity of these on mouse fibroblast L929 cell line. A novel nanocomposite polyvinyl alcohol/polyaniline/ Ag (PVA/PANI/Ag) was developed by exposure of Ag nanoparticles on the PVA/PANI composite. These nanocomposites showed outstanding antibacterial activity against Gram-positive bacteria *Staphylococcus aureus* and Gram-negative *Escherichia coli* with the help of a paper disk diffusion method (Ghaffari-Moghaddam and Eslahi 2014). Nanoparticles of $Zn_{0.5}Co_{0.5}Al_{0.5}Fe_{1.46}La_{0.04}O_4$ remove dye up to 76% while the $Zn_{0.5}Co_{0.5}Al_{0.5}Fe_{1.46}La_{0.04}O_4$/PVA nanocomposites removed the dye up to 90% suggested its potential application in industrial wastewater purifying and recycling (Ahmed et al., 2013).

CONCLUSION

Over the past few decades, polymeric nanocomposites are in high demand due to its unique properties that can be attained with these materials. These nanocomposites revealed a wide and versatile range of properties and other beneficial characteristics at adequate cost and biodegradation rate, thus can be applied in a broad range of applications. The alternative polymeric

medical devices are popular and have also increased substantially around the world. As a host for different kinds of nanofiller in these nanocomposites, poly(vinyl alcohol) (PVA) plays an important role as it is a water-soluble polymer. The introduction of nanosized particles into the PVA enhanced its properties and makes it an outstanding tool for biomedical uses. This chapter provides an overview of recent advances in polyvinyl alcohol (PVA) based nanocomposites and its applications in different medical fields such as drug delivery, wound healing, bone replacement, tissue engineering, and others.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 7

BIOPOLYMERS AND THEIR ROLE IN BIOMEDICINE

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ABSTRACT

Biopolymers are obtained from biowastes or natural origin from various sources used for various industrial applications such as wastewater treatment, photocatalysis, and biomedical applications. Various types of biopolymers are available for biomedical applications due to their inherent properties like antimicrobial activity, biocompatibility, biodegradability. Biopolymers play a vital role in the medical field due to presence of the various functional groups. These functional groups are easy to modify for various applications such as drug delivery, wound healing, and tissue engineering.

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Keywords: biopolymer, classification PLA, chitosan

INTRODUCTION

Biopolymers derived from natural resources are renewable, biodegradable and non-toxic in nature. These polymers are also produced from biological diversity such as plants, animals, and microorganisms. These biopolymers are also synthesized chemically from biological materials such as sugars, starch, natural fats, etc. The use of polymers in medical applications has been used from ancient times. These polymers offered a good design for the materials to make it more biocompatible. In recent years the biological functions of polysaccharides attain a great biomedical application. There are a number of applications of the biopolymers including the food additives, clothing fabrics, water treatment chemicals, packaging of medical materials. There are basically three types of biopolymers which include polysaccharides, proteins, and polynucleotides. The use of the biopolymers in the development of therapeutic devices such as three dimensional porous structures as scaffolds for tissue engineering, controlled release drug delivery and applications like suturing, fixation or adhesion which are developed from the biopolymers whose degradation products are not immunogenic (Niaounakis . 2015, Onar.2014, Reddy et al. 2015). The biopolymers are basically alternative to petroleum-based polymers and their properties depend on the polymer structure.

CLASSIFICATION OF BIOPOLYMERS

The three main groups of the biopolymers are classified in Table 1 on the basis of their origin.

BIOPOLYMERS FOR BIOLOGICAL APPLICATION

Polylactic Acid (PLA)

It is a biopolymer that can be produced from natural sources such as corn starch, potatoes. It can be made into consumer items as diverse as disposable plates and cups, packaging and clothing and some properties of PLA are similar to that of synthetic polymers (Mukherjee et al. 2011). The monomers used for polymerization of lactides are synthesized from glycolic acid, DL lactic acid. PLA (Polylactic acid) comes from fermented plant starch (mostly from corn) and is often referred to as corn starch plastic. It is becoming popular very quickly because corn-based plastic is a more environmentally-friendly alternative to traditional plastics, which are petroleum-based. There are two methods for manufacturing polylactic acid (PLA) from lactic acid: the first method uses the cyclic lactic acid dimer called lactide as an intermediate stage; the second method is direct polymerization of lactic acid. Polylactic acid is formed from the corn which is first fermented to the lactic acid, the lactic acid is then polymerized to make polylactic acid. It is the first bio-plastic which is still used today, these bio-plastics make many contributions to the reduction of CO_2 in the environment and these are also biodegradable substances by which it protects the environment. The bio-plastic materials are used in automobile interiors, for packaging of food items, for agriculture sheeting and other household appliances (Auras et al., 2010, Benninga 1990, Xiao et al. 2012).

Advantages of Corn

(a) Comes from corn, which is a renewable resource
(b) Does not contain toxins
(c) Producing this kind of plastic creates much less greenhouse gas emissions than conventional plastic production.
(d) Less energy is needed to produce corn-based plastic than to produce conventional plastics.

(e) Polylactic acid is more competitive than conventional plastic in terms of cost.
(f) Polylactic acid is safer since there is no danger of explosions in its production.

Table 1. shows the classification of various biopolymers

Classification	Origin	Biopolymers
Polysaccharides	Plant/algal	Starch, Cellulose, Alginate, Carrageenan, Pectin, Konjac
	Animal Bacterial	Chitosan, Hyaluronic acid
	Fungal	Pullulan, Elsnan, Yeast, glucans
	Lipids/Surfactants	Acetoglycerides, waxes, surfactants, Emulsion, Elastin, Resin, Adhesives
Proteins		Wheat gluten, casein, serum albumin
Polyesters		Polyhydroxyalkanoates, polylactic acid
Specialty Polymers		Shellac, Poly-gamma glutamic acid, natural rubber, nylon from castor oil

Chitosan

Chitosan is a cationic polysaccharide (Figure 1) found in the exoskeleton of crustaceans which is produced by deacetylation of chitin by obtaining from the alkalizing process at high temperature. It is a biodegradable polymer, used in different forms and have various applications in industrial and biomedical areas. The important application of the chitosan is in the cell attachment and cell growth and skin regeneration (Balan et al. 2014) used a coating of chitosan and heparin and in order to increase the mechanical properties and acceleration of re-endothelization and the healing process [Meng et al. 2009]. Chen (2009) developed a polymeric stent that is made from chitosan-based films fixed by genipin due to its high oxygen permeability chitosan is used as a material for contact and intraocular lenses[Chen et al.2009].

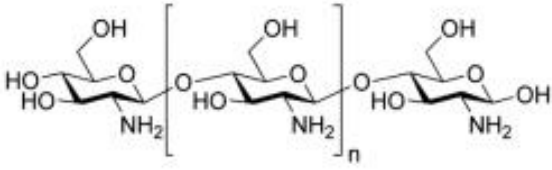

Figure 1. Chemical structure of chitosan (Ahmed et al. 2015, Ahmed et al. 2016).

Biological Properties of Chitosan

- Act as biocompatible (Biodegradable, safe and non-toxic)
- Haemostatic
- Spermicidal
- Antitumor
- Accelerate bone formation
- Central nervous system
- Fungistatic
- Anticholesteremic
- Immunoadjvant.

Application

- Tissue engineering
- Cosmetics
- Ophthalmology
- Artificial Skin
- Wound dressing
- Drug delivery.

Calcium Alginate Biopolymer

This biopolymer is water-soluble, gelatinous and cream-colored substance that can be made by the addition of calcium chloride to the aqueous sodium alginate and gives the artificial flavor and the colors create a tastier edible slime. Calcium alginate is also used in forming the artificial

seeds in plant tissue culture. The cell wall of the brown algae is composed of the alginate biopolymer in the sodium salt form of alginic acid (Figure 2).

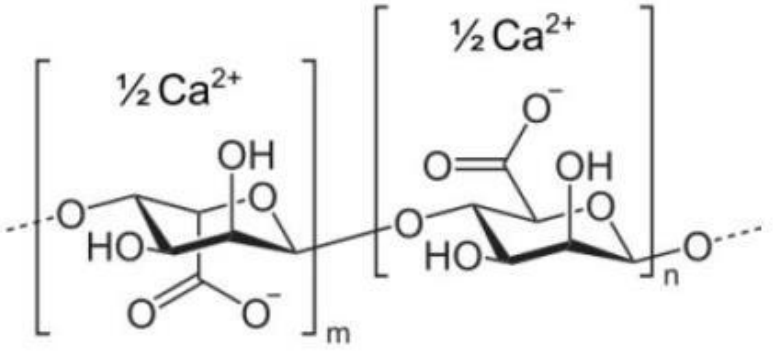

Figure 2. Chemical structure of calcium alginate (https://en.wikipedia.org/ wiki/ Calcium_alginate).

Applications of Calcium Alginate

a. For producing the insoluble artificial seeds.
b. For immobilizing enzymes
c. To produce an edible substance
d. Incorporated into wound healing

Collagen and Gelatin

Collagen protein is mostly found in connective tissues and beneath the skin. These proteins present in animals are generally hard and become soft when cooked and it breaks into gelatin which is called cooked collagen, which provides an effective way of absorbing the collagen-boosting amino acids. Gelatin and hydrolyzed collagen which is made from animal collagen and has same profile of amino acid. Some differences in their structure and properties are:

- Hydrolyzed collagen is broken down into smaller units of protein which are easy to digest.
- Hydrolyzed collagen dissolves in both hot and cold water but gelatin does not dissolve.
- Gels of Gelatin can be prepared, but hydrolyzed collagen gels cannot be prepared.

Functional Properties of Collagen and Gelatin

a. The gelling properties that are associated with collagen and gelatin include gel formation, texturing and water-binding capacity.
b. The properties related to the surface behavior (emulsion, foam formation, stabilization, adhesion, cohesion, and film-forming capacity) are possibilities of fish collagen as a functional material.

Biological Applications

- The collagen sheets are non-inflammatory and facilitate the migration of fibroblasts and microvascular cells.
- They have low antigenicity and have minimal biodegradation.
- They are non-toxic and helps in minimizing scarring.

CONCLUSION

Biopolymers are an important class of materials that have important applications. Of all these medical applications is an important one. The importance of new medical textiles biopolymers increased day by day due to its versatility, biocompatibility and non-cytotoxicity make these materials excellent for use. New types of polymers like polylactic acid, collagen, chitin, and such others have been used in today's technological period.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 8

LIGNIN: A WONDERFUL BIOPOLYMER

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ABSTRACT

Many years of cumulative research has been conducted on the usage of fiber-reinforced composites for biological, environmental and biomedical applications. For potential applications, full advantage must be taken of the material properties and the manufacturing techniques The three main areas have been addressed and discussed. First, a comprehensive and comparative survey of biocomposites from the existing literature obtained from various sources and their importance in various medical fields has been presented. Second, mechanical designs, manufacturing and exploring aspects of various fibrous polymer matrix composites are explained and described. The third area concern over examples of the design, development, and use of several medical devices and implants using polymer composites. However, being renewable, cheap, recyclable, and biodegradable, they have witnessed rapidly growing interested and attention in terms of industrial, biological, environmental and fundamental applications. So keep the whole in view, the present

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chapter focuses on fiber-based polymer lignin applied to biomedical and environmental applications and presents a comprehensive survey of lignin from the existing literature and its various biomedical and environmental applications. This chapter is the first of its kind to present all the contents together related to lignin that are generally limited to their fundamentals, different methods of synthesis and applications. Lignin is a class of complex organic polymers that form important and vast structural materials in the support tissues of vascular plants and some algae. Lignins are particularly important in the formation of cell walls especially in wood and bark because they lend rigidity and support and do not rot easily. Chemically, lignin is a cross-linked polymer with molecular masses in excess of 10,000 u. It is relatively hydrophobic and rich in aromatic subunits. The degree of polymerization is difficult to measure since the material is heterogeneous in nature. Different types of lignin have been described depending on the means of isolation and structure.

Keywords: biocomposites, biomedical, lignin, biodegradable, polymer

1. INTRODUCTION

Wood is composed of many chemical components, primarily extractives, carbohydrates, and lignin, which are distributed non-uniformly as the result of the anatomical structure of plants and trees. The term lignin is derived from the Latin word Lignum which means wood (De Candolle et al. 1821). Lignin is a complex organic polymer that forms a significant structural material in the support tissues of vascular plants and is one of the most abundant organic polymers on Earth after cellulose. The cellulose walls of the wood become impregnated with lignin. It greatly increases the strength and hardness of the cell and imparts necessary rigidity to the tree. This is essential to woody plants in order that they stand erect (Rouhi et al. 2001). Out of all polymers found in plant cell walls, lignin is the only one that is not composed of carbohydrate (sugar) monomers. In recent years, because of the application of modern methods and availability of techniques and instruments for chemical analysis, the lignin field has developed dramatically. Natural lignin is an amorphous, irregular, random and three-dimensional network of cross-linked co-polymer that containing both

aromatic and aliphatic entities (Norstrom 2012). Since the knowledge of lignin has evolved over one hundred years and the importance of lignin has been widely recognized since the early 1900s (Glasser et al. 2000). But however, our understanding of lignin is still limited due to its complex structure. Lignins are highly functionalized biomacromolecules possessing primarily alkyl-aryl ether linkages, aliphatic and aromatic hydroxyl groups and low polydispersity, which offer the potential for higher value-added applications in renewable polymeric materials development. About two-thirds of the lignin bonds are of ether type and about one-third is carbon-carbon linkages but the most common linkage is the ß-o-4′ linkage which is susceptible to pulping and bleaching and biodegrading reactions whereas the covalent carbon-carbon bonds are more stable (Sjortrom 1993). That is why it is undesirable in most chemical papermaking fibers and is removed by pulping and bleaching processes easily.

1.1. Source

Lignin is a natural resin that fills spaces between plant cells and strengthens cell walls by covering cellulose micro-fibrils. So, it is the main component of plant biomass including cellulose and hemicelluloses. Hence, it can be derived from various sources such as cereal straws, bamboo, bagasse, and wood. In terms of weight, the lignin content in wood is the highest (20 – 35%) while only 3 – 25% in other sources (Smolarski 2012).

1.2. Composition and Structure

Lignin is an amorphous, random and three-dimensional network of cross-linked copolymer of long chains of different types of phenyl propane monomers (lignols) which are considered to be essential lignin precursors (Figure 1). The three main building blocks of lignin preparation are derived from phenylpropane: 4-hydroxy-3-methoxyphenylpropane, 3,5-dimethoxy-4-hydroxyphenylpropane, and 4-hydroxypropane.

These three basic structural monomers include p-phenyl monomer (H type) derived from coumaryl alcohol, guaiacyl monomer (G type) derived from coniferyl alcohol, and syringyl monomer (S type) derived from sinapyl alcohol. The structure of lignin is highly complicated composed of phenylpropane units linked to each other by the irregular coupling of C–C and C–O (Qiu et al. 2006). Ether bonds in lignin include phenol-ether bonds, alkyl-ether bonds, dialkyl, and diaryl ether bonds, and so on. Lignin in softwood and hardwood mainly contains aryl glycerol-β-aryl-(β-O-4) ether bonds. In the C–C bonds of lignin, the dominant coupling type is β-5, β-β linkage, followed by β-1, β-2, 5–5, and so on (Tao et al. 2003)**.** Because the types and positions of functional groups lignins are different with different chemical characteristics.

The polymerization of lignin macromolecules by phenylpropane units is dehydro-oligomerization. The German eminent scientist Freudenberg produced first synthetic lignin by coniferyl alcohol and laccase under aerobic conditions. Later, peroxidase (POD) was found to catalyze this polymerization reaction effectively. In this process, redox shuttles of Mn_3C-Mn_2C played an important role in lignin biosynthesis. There have been several different hypotheses to explain lignification- one is a random coupling model, which proposed that lignol molecules are gradually connected to the lignin polymer by oxidative coupling. The random coupling hypothesis is reasonable because it explains the plasticity of lignin biosynthesis in mutants and transgenesis research. Another hypothesis involves the dirigent-like protein model, which considered that the lignified process is strictly under the manipulation of dirigent-like protein by controlling the formation of particular chemical bonds of the lignin molecules. The hypothesis showed that the metabolism of lignin should be an orderly life process, which explains the large numbers of *O*-4 linkages in lignin molecules. The formation of sinapyl alcohol and coniferyl alcohol was a relatively independent process by which enzymes involved in sinapyl alcohol synthesis were associated with each other to form a multienzyme complex. The synthesis of coniferyl alcohol is conducted in the cytoplasm another way. The phenylalanine ammonia-lyase (PAL), caffeoyl CoA methyltransferase (CCOMT), CCR, and CAD distribute in the cytoplasm,

catalyzing the synthesis of coniferyl alcohol. Peroxidase is widespread in plants with multiformity. So, how it participates in lignin monomer polymerization needs further studies. So far, it remains uncertain whether the POD or laccase catalyzes the polymerization of lignin monomers in the plant or if they work synergistically (Jiang 2001).

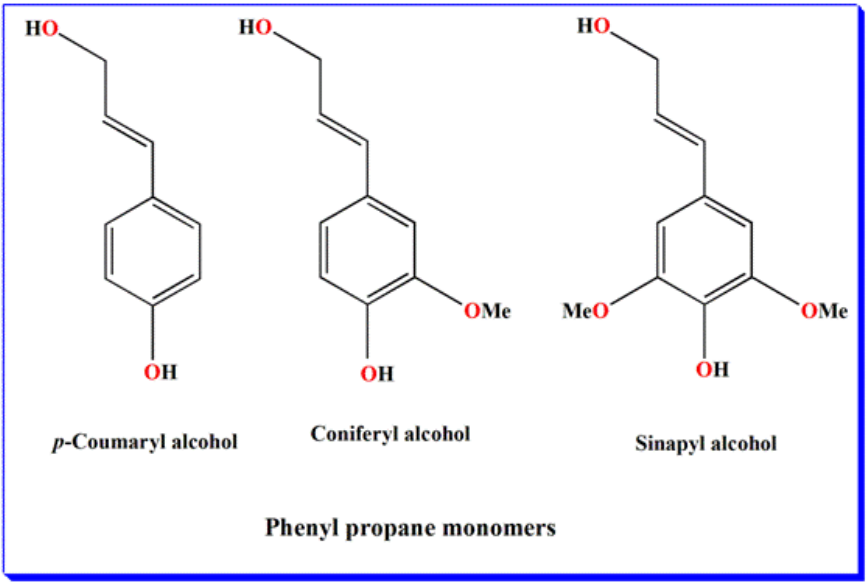

Figure 1. Phenyl propane monomers of lignin.

2. PROPERTIES

The physical, as well as chemical properties of lignin, are revealed as under:

2.1. Physical Properties

The physical properties of the lignin are given as below:

(a) *Molecular weight and polydispersity*
Under the effect of mechanical action, enzymes, or chemical reagents, the three-dimensional net structure of lignin is degraded into different size lignin fragments leads to its molecular weight polydispersity.

(b) *Solubility*
The presence of hydroxyls and many polar groups in the lignin resulting in strong intramolecular and intermolecular hydrogen bonds and making the intrinsic lignin insoluble in any solvent. But however, the presence of phenolic hydroxyl and carboxyl makes the lignin able to be dissolved in alkaline solution.

(c) *Thermal properties*
Lignin is an amorphous thermoplastic polymer. It has slight friability under high temperature and cannot form the film in a solution. It also has glassy transfer properties. The softening temperature of absolutely dried lignin ranges from 127 to 129°C, which remarkably decreased with increased water content, indicating that water acts as a plasticizer in lignin

(d) *Color*
Intrinsic lignin is a white or nearly colorless substance; the color of lignin we can see is the result of the separation and preparation process.

2.2. Chemical Properties

The chemical properties of lignin include nitration, halogenation and oxidation reactions on the phenyl ring of the lignin. It can also undergo benzyl alcohol, the aryl ether bond, and an alkyl ether bond and lignin-modified chromogenic reaction. The chemical reactions of the lignin structural unit are divided into two major categories:

(a) Chemical reactions due to side chain of the lignin
(b) Chemical reaction due to aromatic ring in the lignin structure

(c) Lignin chromogenic reaction

(a) Chemical Reactions Due to Side Chain of the Lignin

Reactions on the lignin side chains are associated with pulping and lignin modification due to nucleophilic reaction. The following reagents can conduct nucleophilic reactions with lignin:

(i) In alkaline medium, the effect of HO^-, HS^-, and S^{-2} nucleophilic reagents leads to the cleavage of the main ether bond, fragmentation and partial dissolution of macromolecule lignin. Hence, the phenol type structural unit is separated into phenolate anions and leads to the activation of *ortho*- and *para*- positions and thereby affects the stability of the CO bond and aryl ether bond is cleaved.
(ii) In a neutral medium, reaction with nucleophile HSO_3^- or SO_3^{2-} leads to breaking of the ether bond and brings and also degradation of lignin fragments.
(iii) In acidic medium, the lignin fragmentation reaction pulping process id carried out. SO_2 aqueous solution leads to the breakage of phenol-type and non-phenolic aryl ether bonds. The sulphonation of carbon may increase the lignin's hydrophilicity. Phenol-type and nonphenolic alkoxy ether bonds may also have a similar type of chemical reaction (Gao et al. 1996; Tao et al. 2003).

(b) Chemical Reaction Due to Aromatic Ring in the Lignin Structure

Chemical reactions of the aromatic ring of lignin are closely related to the lignin-bleaching process and have been divided into electrophilic and nucleophilic reactions:

(i) Electrophilic substitution reaction: Electrophilic reagents include chlorine, chlorine dioxide, oxygen molecule, ozone, nitro cation, nitroso cation, and so on. The electrophilic reagent replacement breaks the side chains of lignin and leads to the oxidative cleavage of "-aryl ether linkages. The aliphatic side chain is oxidized into a carboxylic acid and the aromatic ring is oxidized into the compound

of the o-quinone structure, which will finally be oxidized into dicarboxylic acid derivatives.

(ii) Nucleophilic reaction: Nucleophilic reagents that can react with the aromatic ring of lignin include hydroxide ions, hypochlorite ions, and hydrogen peroxide ions. These nucleophilic reagents can react with the chromophoric groups in the degraded lignin fragments, breaking the chromophoric structure to some extent.

(c) Lignin Chromogenic Reaction

The lignin can undergo the formation of a colored compound by the treatment of different types reagents revealed and discuss as under:

(i) ***Mäule chromogenic reaction:*** When the Hardwood lignin is treated with $KMnO_4$ and HCl and then ammonia, reddish-violet color is obtained. This is because of the syringyl ring of lignin which generates methoxy o-dihydroxybenzene under the treatment of KMnO4 and HCl. A purple methoxy-o-quinone is obtained after ammonia treatment.

(ii) ***Cross-Bevan reaction:*** Timber without extractives is treated with chlorine in the wet state; the lignin present will be converted into chlorinated lignin. After sulphonic acid and sodium sulfite treatment, the lignin of hardwood turns into red-purple (Jiang 2001).

3. CHEMICAL ANALYSIS OF LIGNIN

The conventional method for lignin quantitation in the pulp industry is the Klason lignin and acid-soluble lignin test, which is standardized according to TAPPI or NREL(Sluiter et al. 2008) procedure. According to the procedure, The cellulose is first recrystallized and partially depolymerized into oligomers by keeping the sample in 72% sulfuric acid at 30 C for 1 h.

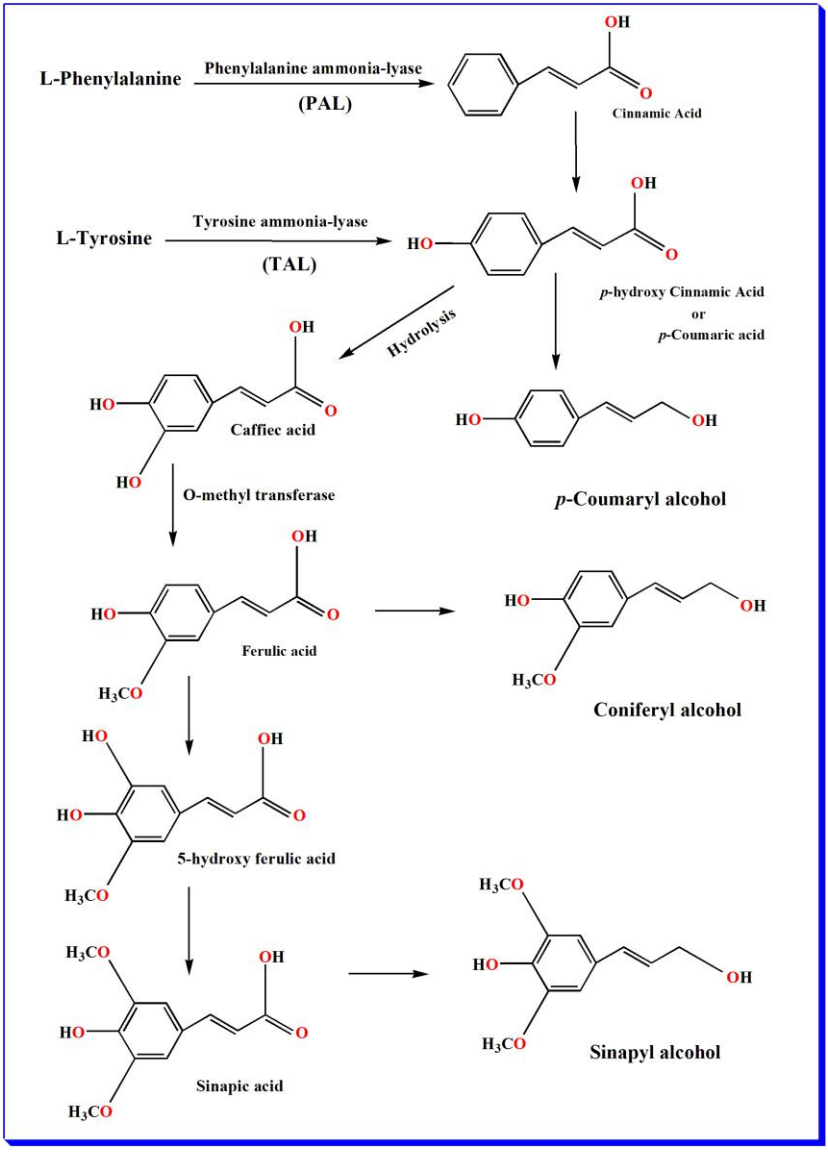

Figure 2. General biosynthesis pathway of monomers of lignin.

Then, the acid is diluted to 4% by adding water, and the depolymerization is completed by either boiling (100°C) for 4 h or pressure cooking at 2 bar (124°C) for 1 h. The acid is washed out and the sample dried. The residue

that remains is termed Klason lignin. A part of the lignin, acid-soluble lignin (ASL) dissolves in the acid. ASL is quantified by the intensity of its UV absorption peak at 280 nm. The method is suited for wood lignins, but not equally well for varied lignins from different sources. The carbohydrate composition may be also analyzed from the Klason liquors, although there may be sugar breakdown products (furfural and 5-hydroxymethylfurfural).

A solution of hydrochloric acid and phloroglucinol is used for the detection of lignin (Wiesner test). A brilliant red color develops, owing to the presence of coniferaldehyde groups in the lignin (John 1966).

Thermochemolysis (chemical break down of a substance under vacuum and at high temperature) with tetramethylammonium hydroxide (TMAH) has also been used to analyze the ratios of lignols with fungal decay as well the ratio of the carboxylic acid to aldehyde forms of the lignols. Increases in the lignol value indicate an oxidative cleavage reaction has occurred on the alkyl lignin side chain which has been shown to be a step in the decay of wood by many white-rot and some soft rot fungi.

Solid-state ^{13}C NMR has been used to observe at the concentrations of lignin as well as other major components in wood e.g., cellulose and its change with microbial decay. However, many intact lignins have a cross-linked with a very high molar-mass fraction that is difficult to dissolve even for functionalization.

4. BIOSYNTHESIS

Lignin biosynthesis is a very complex network that is divided into three processes: (i) biosynthesis of lignin monomers (Figure 2) (ii) transport and (iii) polymerization. After a series of steps involving methylation, deamination, hydroxylation, and reduction, lignin monomers are produced in cytoplasm and transported to the apoplast. Finally, lignin is generally polymerized with three main types of monolignols like p-coumaryl alcohol, coniferyl alcohol and sinapyl alcohol (Alejandro et al. 2012; Miao et al. 2010; Bonawitz et al. 2010; Liu et al. 2011). After transport, the lignin precursors are polymerized via free radical reaction. The formation of

radicals is catalyzed by oxidative enzymes, either H_2O_2-dependent peroxidases or O_2-dependent oxidases/laccases. These enzymes are secreted into the apoplast where they are either soluble or covalently or ionically bound to the cell wall (Blee et al. 2001).

The two amino acids L-Phenylalanine and L-Tyrosine which are widely present in plants are starting materials for the cinnamic acid pathway (Scheme Figure 2). Under the effects of various enzymes, the three monomers of lignin are finally synthesized after a set of chemical reactions, such as deamination, hydroxylation, methylation, reduction (Li et al. 2003; Geng et al. 2003), etc. Cinnamoyl CoA reductase (CCR) catalyzes the first step of the redox reaction of lignin biosynthesis, which may be the rate-limiting step, controlling lignin synthesis and the pathway from which carbon can go into lignin biosynthesis. Cinnamyl alcohol dehydrogenase (CAD) catalyzes the redox reaction of another step in the lignin synthesis process, which may control the reduction of coniferaldehyde. Sinapylalcohol dehydrogenase (SAD), ferulic acid 5-hydroxylase (F5H), and bispecific caffeic acid/5-hydroxyferulic acid O-methyltransferase (COMT) are immuno-localized in cells and tissues that have S lignin. CAD is located in tissues with precipitation of G lignin. It is speculated that the last step of redox reactions of different types of lignin may be passed through different synthetic pathways and catalyzed by different enzymes. C3H can catalyze coumaric acid to caffeic acid. Most research is inclined mainly to support the lignin biosynthesis and COMT can catalyze the methylation of caffeic acid, 5-hydroxyl coniferyl aldehyde, and 5-hydroxyl coniferyl alcohol into ferulic acid, sinapic acid, and sinapic alcohol, respectively (Lin et al. 2003).

4.1. Factors Influencing Lignin Synthesis

Different parts of plants would have different lignin content and composition. For example, the lignin content and structure are significantly different in the node and internode. The node lignin has a higher density than

the internode because of the high content of phenolic acids (p-coumaric acid and ferulic acid). In general, it has been observed that the overuse of nitrogen fertilizer will reduce the lignin content and hence stops the lignification of the plant. However, on the other hand, Phosphate fertilizer will greatly increase the lignin content in the cell wall of the plants.

4.2. Regulation of Lignin Biosynthesis

The lignin biosynthesis may be regulated by changing the activities of different enzymes in two main ways. The first way is to regulate the synthesis process of lignin monomers by simply reducing enzyme activities participating in the lignin synthesis, such as CCR, and CAD, and by reducing the lignin content. The second way is to regulate certain particular enzyme activity to influence the composition and chemical structure of lignin. It is generally believed that the degradation of GS lignin, which is composed of guaiacyl monomers and syringyl monomers, is easier than that for G lignin, which is simply composed of guaiacyl monomers.

In the gene regulation of lignin biosynthesis, the search for and separation of biological enzymes for lignin synthesis will be in first priority in the future. The amino acid sequence of zymoprotein is analyzed to obtain the sequence of its messenger RNA (mRNA), which is the coding sequence of the functional genes. Gene transfer can be done by using different methods like Agrobacterium-mediated indirect conversion and the gene gun technique. Antisense technology can be utilized for regulation of forest lignin. First, an oligonucleotide sequence is constructed that is antisense to the lignin synthase; then, the sequence is transferred into plants in direct or indirect ways, and it interacts with genes in plants to influence the translation and reduce the activity of zymoprotein. This is currently the most common and effective transgenic breeding technology in genetic engineering of lignin regulation. Finding and discovering a natural mutant in plants is also an equally effective and direct means.

5. POLYMERIZATION OF LIGNIN

Erdman (1930) studied the oxidative dimerization of various phenols in the biogenesis of natural products and reached the conclusion that lignin must be formed α,β-unsaturated C_6C_3 precursors of the coniferyl alcohol monomer through enzymatic dehydrogenation. Freudenberg and co-workers (1940-1970) had also verified the polymerization of precursors to lignin in nature follow the pathway as Erdman revealed and proposed (Figure 3). In their research, they confirmed that One-electron transfer from coniferyl alcohol by enzymatic dehydrogenation yield resonance-stabilized phenoxy radicals as mechanistically shown below:

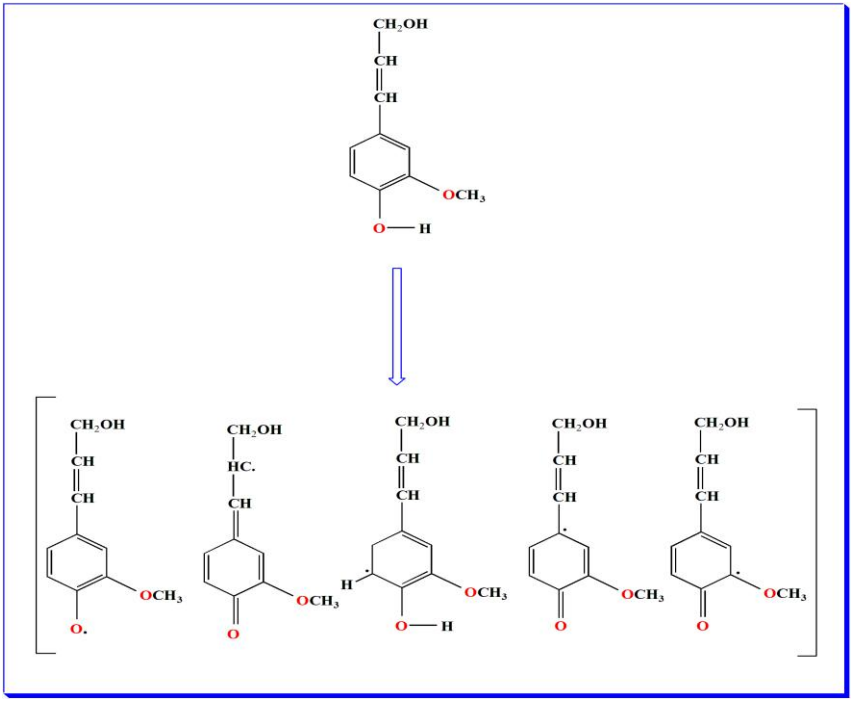

Figure 3. Formation of free radical monomers.

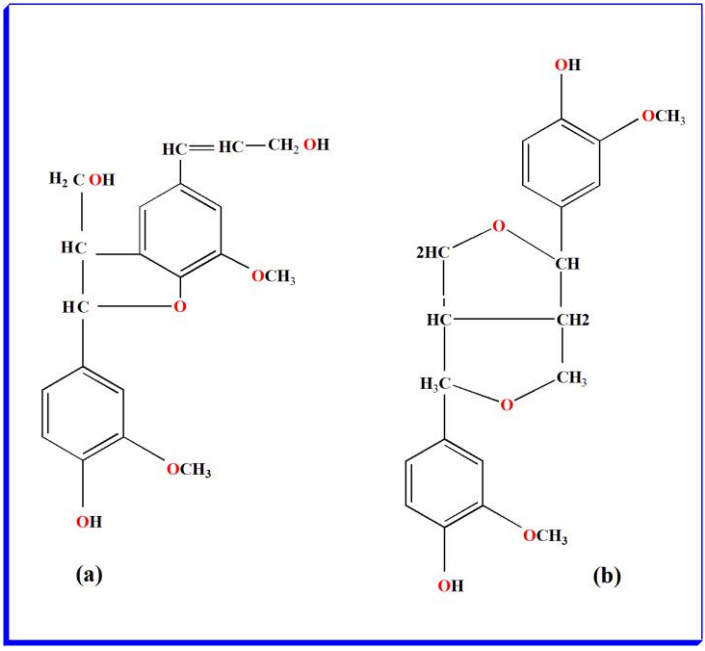

Figure 4. Polymerization of lignin monomer units.

Oligomeric products formed through coupling of coniferyl alcohol radicals as shown above. Endwise β-*O*-4 coupling of a coniferyl alcohol radical with a growing lignin group radical to an intermediate quinone methide (a) which is stabilized to a quaiacylglycerol-β-aryl ether (b) structure through addition of water (Figure 4). The scheme of oligomeric units polymerization is shown as under.

5.1. Types of Linkage and Dimeric Structure

It is clear and proved by the experiments that phenyl propane units are joined together both with C-O-C (ether) and C-C linkages. But however, the C-O-C linkages is dominant and is approximately 2/3 or more in the lignin structure. While the rest of the linkages are C-C type. Proportions of different type of linkages connecting the phenylpropane units in lignin are tabulated as below:

Table 1. Type of linkage and dimer structure

Linkage type	Dimer structure
β-O-4	Aryl glycerol-β-aryl ether
α-O-4	Noncyclic benzyl aryl ether
β-5	Phenylcoumaran
5-5	Biphenyl
4-O-5	Diaryl ether
β-1	1,2-Diaryl propane
β-β	Linkage through side chains

Table 2. Functional groups of lignin (per 100 C_6C_3 units)

Functional group	Softwood lignin	Hardwood lignin
Methoxyl	92 - 97	139 - 158
Phenolic hydroxyl	15 - 30	10 - 15
Benzyl alcohol	30 - 40	40 - 50
Carbonyl	10 - 15	-

5.2. Functional Groups in the Lignin Polymer

Lignin is a polymer contains characteristic Methoxyl groups, phenolic hydroxyl groups, and some terminal aldehyde groups in the side chain. However, only relatively few of the phenolic hydroxyls are free and most of them are occupied through linkages to the neighboring phenylpropane units. The syringyl units in hardwood lignin are extensively etherified. Alcoholic hydroxyl groups and carbonyl groups are introduced into the final lignin polymer during the dehydrogenative polymerization process. In some wood species, substantial amounts of the alcoholic hydroxyl groups are esterified with *p*-hydroxybenzoic acid or *p*-hydroxycinnamic acid. Ester of *p*-hydroxybenzoic acid is typical in aspen lignin. *p*-hydroxycinnamic acid is abundant in bamboo and grass lignin. The different functional groups and their distribution are tabulated as under:

6. APPLICATIONS

There are a number of applications of lignin in various fields which are discussed as under:

6.1. Antioxidant

Lignin acts as free radical scavengers. It's natural antioxidant properties provide a best use in cosmetic and topical formulations. Lignin sulfonate containing cosmetic compositions have been developed for decorative use on skin.

6.2. Paper

Lignin is used as a sizing agent. The polymerization of acrylamide and hydroxymethylated shown an enhance the tensile strength of paper. Packaging laminate comprising a barrier layer of lignin and oligo or polysaccharides, where the two are partly covalently bonded to each other.

6.3. Agriculture

The slow-release urea is composed of 90 - 99% urea and 1 - 10% lignin. That is why lignin is used either directly or after chemically modified as a binder dispersant agent for pesticides/herbicides, emulsifier and heavy metal sequestrate. The pulverized lignin, when blended with other chemicals, has been used as a soil water retention agent in acidic dry land or desert soil and also as a binder for fertilizer.

6.4. Dispersants

The Dye dispersant is prepared from sulfate or sulfite pulping liquors (lignin) which are cross-linked with formaldehyde products exhibit amazing properties like good dispersion, heat resistant stability, high-temperature dispersion property. Since the lignin sulfonates are biodegradable and non-toxic in nature and hence are used to prepare Jet printing ink. Chemically modified lignin has been used as a dispersing agent, complexing agent, flocculent, thickener or auxiliary agents for coatings, paints or adhesives. A mixture of polycarboxylic acid and lignin sulphonic acid has been used for cleaning aluminum plates.

6.5. Grease

When the calcium lignin sulphonate has been added to grease used to thickened the base grease in order to improve its lubricating quality. The grease which is mixed with lignin had improved not only corrosion protection properties but also provides anti-friction properties with longer lubrication life.

6.6. Heat

Since the artificial firelog using cellulosic matter, nonpetroleum based wax (lignin) and 1,3-propanediol derived from a renewable resource. However when an Indulin based lignin is added to wood pellets produces better quality pellets with high both fuel quality and value.

6.7. Fuel

The alkaline purified lignin, when mixed with diesel, are using as surfactants/emulsifiers. The lignin can be converted into the green gasoline

or diesel catalytically (metal precursor such as ruthenium or vanadium and a bidentate ligand) by the combination of different chemical methods pyrolysis, thermal cracking, hydrocracking or hydrocracking.

6.8. Battery

The lignin has great importance in batteries as it forms a thin layer on the graphite powder surface which prevents the battery from decreasing Hydrogen overvoltage and does not affect the condition of the graphite powder. It can also suppress generation of $4PbO.PbSO_4$ compound and hence enhances performance of energy storage devices.

6.9. Concrete

Low levels of lignin and its modified lignin can yield high-performance concrete strength aid. It can reduce damage to building external wall which can be caused by moisture and acid rain. Select lignins can improve the compressive strength of cement pastes and improves its binding property.

6.10. Plastics/Polymers

Lignin based rigid polyurethane resin which is comprised of an epoxy resin and a lignin-derived acid anhydride free lignin known as curing agent used for automotive brakes and epoxy resins for printed circuit boards. Polyphenylene oxide-based polymers and lignin esters are blended to exhibit modulus of elasticity, tensile strength, and elongation at break. Lignin can act as a water absorption inhibitor and as fluidization agents when mixed with polyamide. The use of alkali lignin poly(propylene carbonate) improves thermal stability and mechanical properties of the wonderful polymer.

6.11. Chemicals

One of the best use of lignin is the formations of phenols. Phenols are prepared by reacting lignin with hydrogen supplying solvent at elevated temperature or pressure. The reaction proceeds by the depolymerization of lignin in order to prepare phenolic compounds like:

- Cresols
- Catechols
- Resorcinol
- Quinones
- Vanillin
- Guaiacols

7. FUTURE RESEARCH

In the future, researchers are stressing to replace crude oil by lignin, as it is currently treated as industrial waste. The research route leading to this goal is being paved by new photo-catalysts. Unfortunately, despite many years of attempts by teams of chemists and other researchers from all over the world, still have not managed to develop efficiently. cheaper and successful methods of converting lignin. However, it seems a step closer to cheap solar biorefineries capable of processing lignin on an industrial scale using the new photo-catalysts. On the other hand, the efforts are also focused on how to make more efficient use of major raw materials streams of the paper and pulp industry of lignin. Since the lignin is the natural glue in plants and has a phenolic nature can be proved a new replacement for wood adhesives. An adhesive system for wood composites consisting mainly of lignin will be a new and great achievement in future.

CONCLUSION

The lignin is a wonderful complex natural product, secondary metabolite, and co-polymer. It is the second largest natural product after cellulose. It has a variety of applications in different fields as has been revealed and discussed in detail above. In past and present, a lot of work has been done on lignin. But however, the research on the lignin in future is open and will be a point of interest and consideration because of wood adhesive property of it.

ACKNOWLEDGMENTS

We highly acknowledge Dr. Masood Ayoub Kaloo Assistant professor (Chemistry) GDC Shopian for his discussion and support during various stages of preparation of this chapter. We are also highly thankful to Rukhsana Bilal, Sarhaan Bilal, Miss Gusia, Dr. Rafeeq Bhat and Saba Rafeeq for their valuable guidance and support with respect to the chapter.

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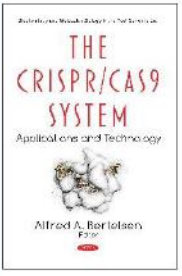

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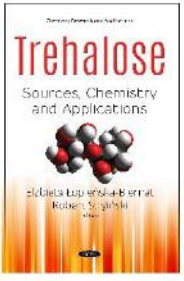

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8

Synthesis, Characterization, and Application of Modified Textile Nanomaterials

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Abstract

There is a growing concern related to the effects of textile nanomaterials. The development of textile nanomaterial has been one of the most active and important research areas in recent years. Design and synthesis of nanomaterials with a novel combination of textile material is expected to expand the demanding scope in the future. Present chapter will emphasis on the chemical nature and synthesis of textile nanomaterials by using different method such as hydrothermal, microwave, fabrication as well as the methods used to characterize them with regard to their different applications. Recent developments in textile nanomaterial have various applications in the field of sports, cosmetics, swimming, and lifestyle.

Keywords: Textile nanomaterials, nanofibers, synthesis, application

8.1 Introduction of Textile Nanomaterials

The word of nanotechnology (Nano-tech) can be applied in different fields [1–3]. This word was first time applied on textiles and also known as Nano-Tex. Later, other textile industries also started to invest in the textile nanomaterial development [4]. Nanoparticles on textile material have been the goal of different studies, to develop the fabrics with miscellaneous practical performance [5]. These nanomaterials (nano silver,

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nano ZnO, and nano TiO_2) have been used as an antibacterial [6, 7], UV-blocking [8, 9], and self-cleaning [10, 11]. Textile nanomaterials can observe the high toughness for washing purpose, as owning great surface area and increase surface energy which declare more attraction for fabrics (textile nanomaterial) [12]. Improve the fastness of textile nanoparticles against washing by a specific solution [13] and other properties of fabric (tensile and bursting strength, friction and air penetrability) can also enhance by this solution [14].

Textile materials were prepared from natural occurring fibers, and have an important part in human being's life. Nowadays nanomaterials are broadly used in the advance textile industry for their appreciated properties as high quality textile materials. Natural fibers such as silk, hemp wool, and cotton are wasted throughout dispensation till further usages. Recycling of these fibers has large marketing area by a new route, because their extra-ordinary characteristics. Any other industries such as bio-medical industries required such bio-compatible materials based on these characteristics [15–17]. Some other valuable applications of textile nanocomposites are in the field of paper and paperboard applications as dry strength, surface strength agent. Textile nanomaterials were also used in cosmetics creams, nano-coatings, bio-nanocomposites, food industry, nano-barriers, pharmaceutical applications, absorbent products, oil recovery applications, and dispersion applications. Current literature works have described a new technique of synthesis of textile nanomaterials and their application in bio-medical and bio-technological fields [18–20].

The most popular textile nanomaterial is Chitosan (derivative of chitin), which is also known as the most popular bio-polymer with exceptional morphological and physiological characteristics [21–23]. These nanomaterial known as ideal polymer for textiles, food science, pharmaceuticals, agriculture and biomedical industrial application, because it has exclusive properties like as biodegradability, biocompatibility, and antibacterial activity [21, 24, 25]. New technique is quickly developing and broadly used in chemical, Pharmaceutical, food processing, cosmetics, and in the present time to textile finishing, which is known as nano encapsulation [26].

8.2 Synthesis of Textiles Nanomaterials

The selection of synthesis technique can be an important factor in identify the effectiveness of the textile nanomaterial studies. There are different methods of synthesizing textile nanomaterial such as hydrothermal [27],

combustion synthesis [28], gas-phase methods [29], microwave synthesis, and sol–gel processing with silver, ZnO and TiO_2 [30]. Synthesis of textile nanomaterial to have a better control over particle morphology, size distribution, quality, purity, and quantity, by engaging environment friendly and economical processes has always been a big task for the scientist and scholars [31].

8.2.1 Synthesis via Hydrothermal Method

Hydrothermal synthesis is commonly performed in a pressurized vessel, which is known as autoclave. Autoclave can be increased the temperature more than 100°C or until form the vapor. This type of synthesis is widely recommended for the synthesis of TiO_2 nanoparticles, which can easily be synthesized through hydrothermal treatment of peptized precipitates of a titanium precursor with water [32]. The hydrothermal method can be utilized to control morphological properties such as (size, morphology), crystalline phase, and surface chemistry through control of the solution composition, pressure, solvent properties, additives, and aging time and reaction temperature [33].

8.2.2 Synthesis via Solvo-Thermal Method

The Solvo-thermal and hydrothermal method both are the same, but the solvo-thermal process variety of solvents can be used in the place of water. This method normally has better control of the shape and size distributions and the crystallinity compared to hydrothermal method. It has been used to synthesize TiO_2 nanoparticles and also used to synthesize nano rods with or without the surfactants.

8.2.3 Synthesis via Chemical Vapor Deposition (CVD) Method

In the chemical vapor deposition process the substrate is covered with volatile precursors, which react on the substrate surface to produce the desired film. The quality of the placed materials completely depends on the reaction temperature, reaction rate, and concentration of the precursors [34]. Gracia *et al.* synthesized metal-doped TiO_2 by the same process [35]. The main feature or advantages of this synthesis method is the uniform coating of the nanoparticles or nano film. Cao *et al.* prepared Sn4+-doped TiO_2 nanoparticle films by this method and found that due to doping with Sn and observed more surface defects were present on the surface [36].

8.2.4 Synthesis via Physical Vapor Deposition (PVD) Method

PVD is also another method to preparation of thin film for the covered the substrate. In this technique films are formed precursor to product without a chemical transition. It has greater features or advantage in the place of CVD. PVD grown films have smoothness, conductivity, presence of contaminations, and crystallinity of titanium dioxide films with E-beam evaporation [37].

8.2.5 Synthesis via Template Method

The synthesis of textile nanostructure materials using template method has become very ideal through the last decade. In this method prepare numerous new materials with a regular and controlled morphology in the range of nano and micro by simply changing the morphology of the template material. The different type of templates has been studied, which utilized the synthesized the TiO_2 nanomaterials [38].

8.2.6 Synthesis via Conventional Sol–Gel Method

This method is used for synthesized various oxide materials such as nano silver, nano ZnO, and nano TiO_2 nanoparticle. The important of this technique contains high purity of the precursors, molecular scale mixing, and homogeneity of the products with a high purity of chemical, physical, and morphological properties. It is also known as multipurpose method.

8.2.7 Synthesis via Microwave Method

Various nanomaterials have been synthesized by microwave radiation. Microwave technique use of high temperature calcination for extended periods of time and allow for fast the synthesis of crystalline TiO_2 nanomaterials. Corradi *et al.* prepared colloidal TiO_2 nanoparticle suspensions within 5 min using microwave radiation [39].

8.2.8 Synthesis via Fabrication Process

Electro-spinning is the most important method among the synthesis of nanofibers.

In the electro-spinning process a high voltage is create an electricity for deposition or melt or streaming of polymer solution (Figure 8.1). Electric

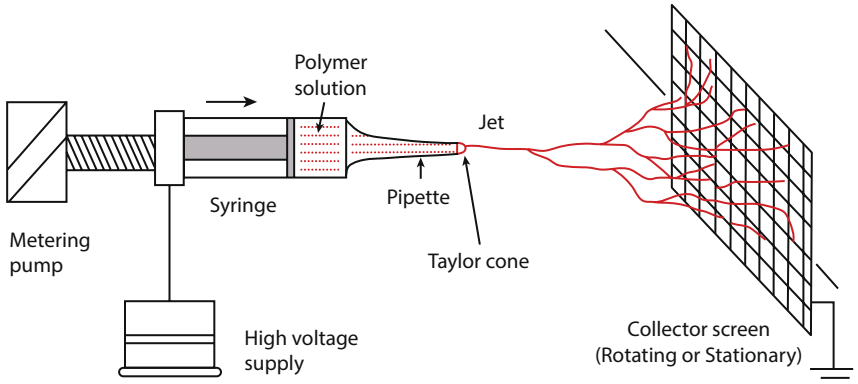

Figure 8.1 Schematic of electro-spinning.

field between the tip of capillary and a grounded collector is very high, and formed at the tip of capillary producing sub-micron diameter fibers. Different types of material were processed into nanofibers in the range of 50 to 1000 nm [40].

8.3 Characterization

Textile nanomaterial characterized by different technique such as spectroscopic, microscopic, X-ray, and other common techniques. The imaging techniques such as (SEM) scanning electron microscopy, (TEM/HRTEM) transmission electron microscopy, (AFM) atomic force microscopy, (STM) scanning tunneling microscopy have been utilized to observe the micro and nano size materials. The basic concepts of all the techniques are different but some common thing is that they observed extremely magnified image of the surface. The spectroscopic method such as (UV-Vis) Ultraviolet-Visible, Raman, infrared spectroscopy and many spectroscopic methods have been utilized to observe the optical properties of micro and nano size materials of textile. Textile nanomaterials can be analyze through X-rays technique like as (EDX) energy dispersive X-ray analysis, wide angle X-ray diffraction, (XPS) X-ray photoelectron spectroscopy, particle size analyzer. Some other common techniques also analyze the physical properties of textile nanomaterials. The basic principles of all these methods used in nanotechnology are described below (Figure 8.2).

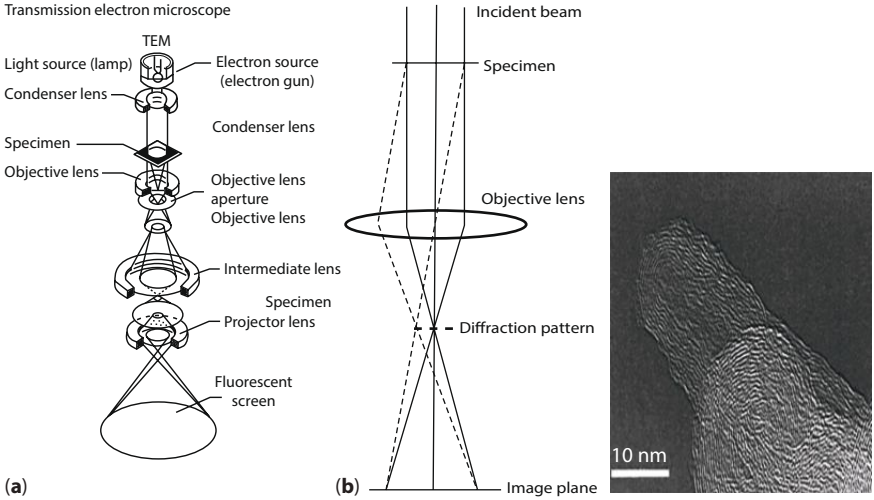

Figure 8.2 (a) Schematic diagram of transmission electron microscopy (b) TEM images of PP/MMT nanocomposites.

8.3.1 Microscopic Characterization of Textile Nanomaterials

8.3.1.1 Transmission Electron Microscopy (TEM)

The micro and nano image is formed by the electron transmeter by the sample and focused by a microscopic lens and looked on a display screen. This technique is widely used in material science, textile, metallurgy, and biological sciences. TEM images reveal the intercalation, exfoliation, and dispersion of nanoparticles in polymer matrices of textile nanomaterial, etc. [40].

High resolution transmission electron microscopy (HRTEM) is a similar imaging technique of electron microscope that allows to take image of the crystal sample at an atomic length with high resolution. This technique is a useful tool to find the nanoscale properties of crystalline material. It showed the maximum resolution is 0.8 Å.

8.3.1.2 Atomic Force Microscope (AFM)

This technique is ideal for quantitative measurement the nano scale textile material. AFM also used for surface imagining and roughness of the surface. Many types of material surface such as polymer nanocomposites, nanofinished, and nanocoated textiles were coated by nano-texture. It is a nondestructive technique and has very high three dimension (3D) [41] (Figure 8.3).

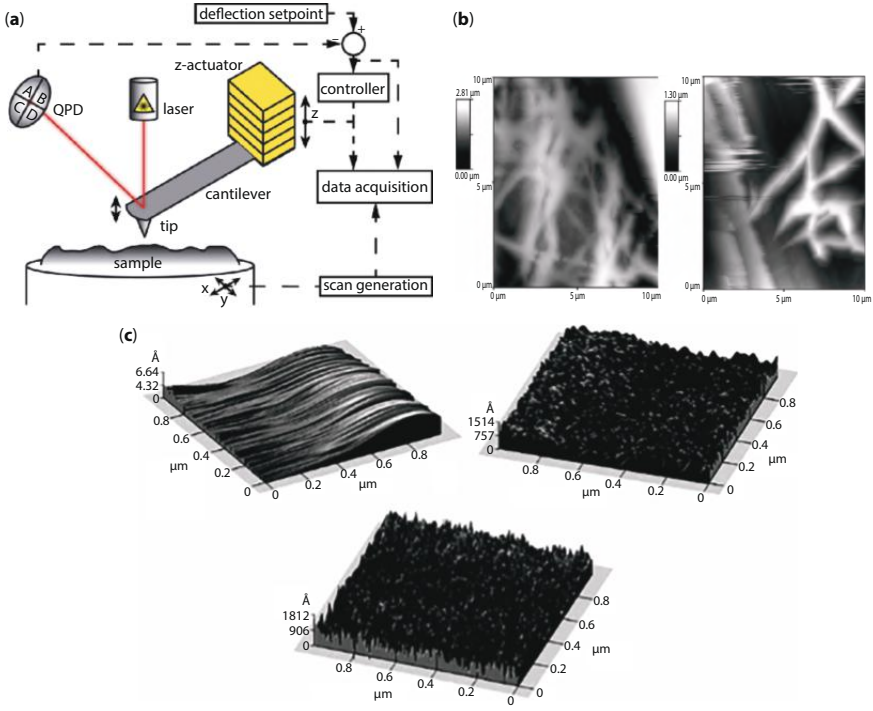

Figure 8.3 (a) Schematic diagram of atomic force microscopy. (b) nanofibers, nanofibers laid on nonwoven substrate (c) 3D views of non-contact mode AFM images of PET textile surface.

AFM can be used to identify the properties, nanostructures, surfaces, and interfaces of fibers and fabrics.

8.3.1.3 Scanning Electron Microscopy (SEM)

SEM is also an electron microscope that images is scanning of surface with a high energy beam of electrons. The SEM shows perfect 3D images with high magnifications (up to 300,000). But the images are only black and white which formed without light waves. The surface image and texture of polymer nanofibers, nanocomposites, nanoparticles, and nanocoating can be viewed through Scanning electron micrograph with high clarity by high magnification [42].

This technique can also be used to interpretation of the dispersion of nanoparticles such as carbon nanotubes, nanoclays, and hybrid POSS nanofillers and coatings on yarns and fabric samples (Figure 8.4c).

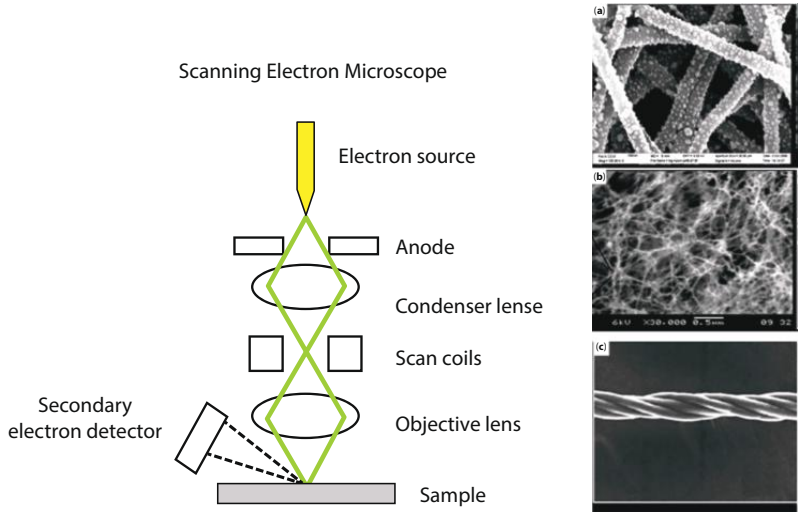

Figure 8.4 Schematic diagram of scanning electron microscopy. (a) Electrospun nylon 6 nanofibers with surface bound silver nanoparticles, (b) peptide nanofiber scaffold for tissue engineering, and (c) SEM image of plied CNT yarn.

8.3.1.4 Scanning Tunneling Microscopy (STM)

Scanning tunneling microscopy (Figure 8.5) is a minor different instrument for observing surface images with atomic scale resolution, in this technique a fine probe tip is scanned over the surface of a sample, with the help of a piezoelectric crystal, and the resulting tunneling [43].

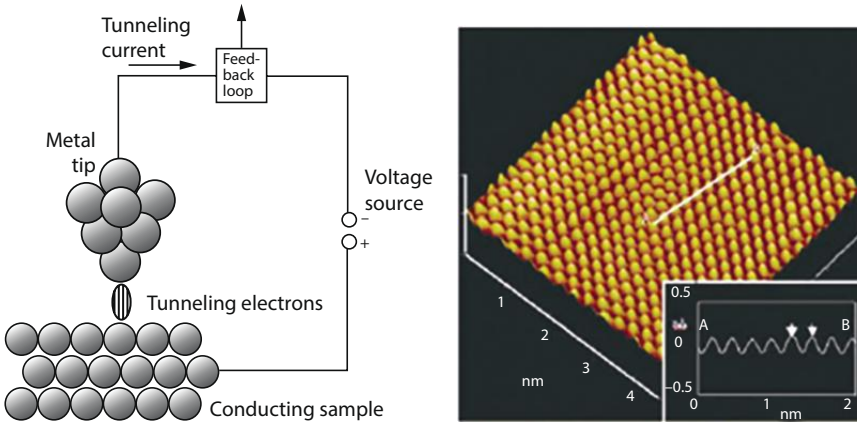

Figure 8.5 Schematic diagram of scanning tunneling microscopy and highly oriented pyrolytic graphite sheet under STM.

8.3.2 Spectroscopic Characterization of Textile Nanomaterials

8.3.2.1 Ultraviolet-Visible (UV-VIS) Spectroscopy

In the Ultraviolet spectrophotometers light source forced on reference and sample beams then output comes in monochromator, detector, and form the spectrum. The ultraviolet spectrum for a sample is obtained by exposing a sample of the compound by Xenon lamp. Spectrum was observed for absorbance versus wavelength [44] (Figure 8.6).

8.3.2.2 Raman Spectroscopy

This type of spectroscopic technique used for condensed matter physics and chemistry. It used to study vibrational, rotational, and other low-frequency modes in a system [45]. The laser light interacts with phonons or other excitations in the system, and the energy of photons being change high or low. The level of energy provides information about the energy of phonon in the system (Figure 8.7).

8.3.2.3 Infrared Spectroscopy (IR)

This technique specially used for characterization of nanomaterials. Fourier transform infrared (FTIR) spectrometer is preferred over dispersive spectrometer due to non-destructive technique. It can increase sensitivity of scan rate

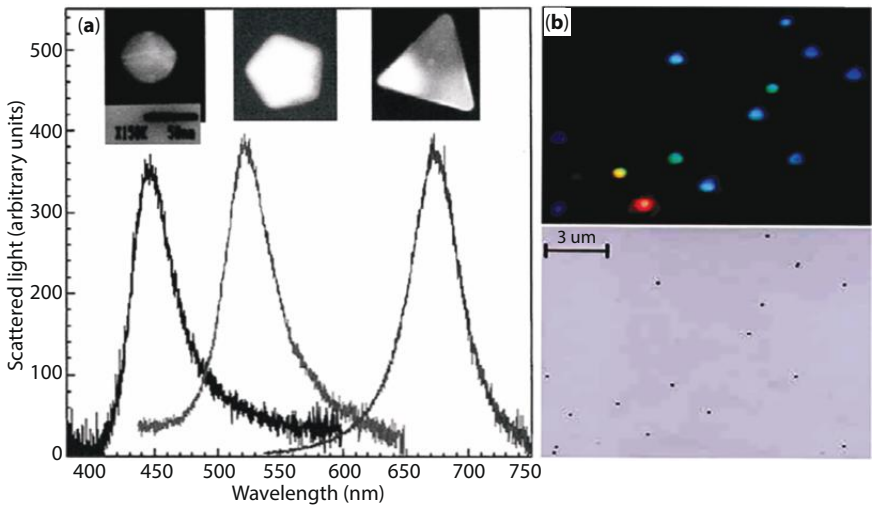

Figure 8.6 (a) UV-Vis spectroscopy of silver nanoparticles of different shapes and (b) color image of a typical sample of silver nanoparticles.

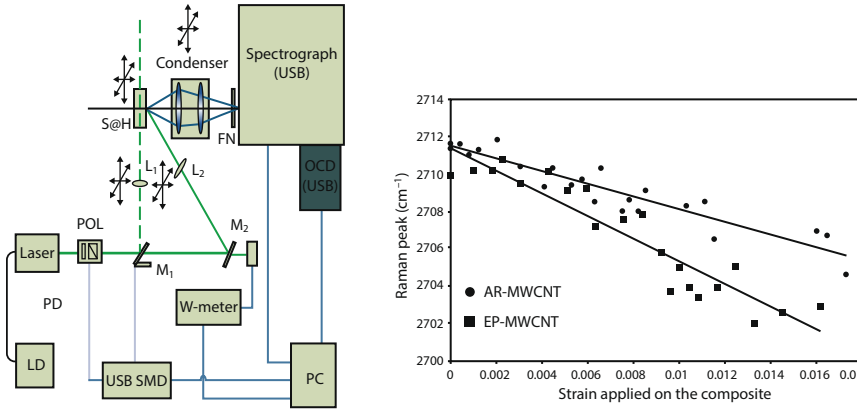

Figure 8.7 Schematic diagram of Raman spectroscopy and Shift in the Raman peak as a function of applied strain.

and co-added together to ratio of random noise. It has better optical through output and is also mechanically simple with only one moving part, etc.

8.3.3 Characterization of Textile Nanomaterials by X-Ray

8.3.3.1 Energy Dispersive X-Ray Analysis (EDX)

This technique analyzes the surface elements at different positions and provides an overall measurement of the sample. The concentration of nanomaterials at the surface can be observed using this technique. EDX contain some heavy metal ions (Au, Pd, and Ag) on the surface of nanoparticles (Figures 8.8b, c). EDX spectra have to be taken by focusing the beam at different regions of the same sample to verify spatially uniform composition of the bimetallic materials [46].

8.3.3.2 Wide Angle X-Ray Diffraction

This technique is similar to electromagnetic radiation of X-ray diffraction, but have shorter wavelength. This technique produced spectrum when electrically charged particles have sufficient energy. In an X-ray tube, the high voltage is maintained by electrodes toward a metal target. X-rays are produced and radiate in all directions.

8.3.3.3 X-Ray Photoelectron Spectroscopy (XPS)

This spectroscopy (Figure 8.9) is a quantitative spectroscopic. Surface chemical, elemental composition, chemical state, and electronic state of

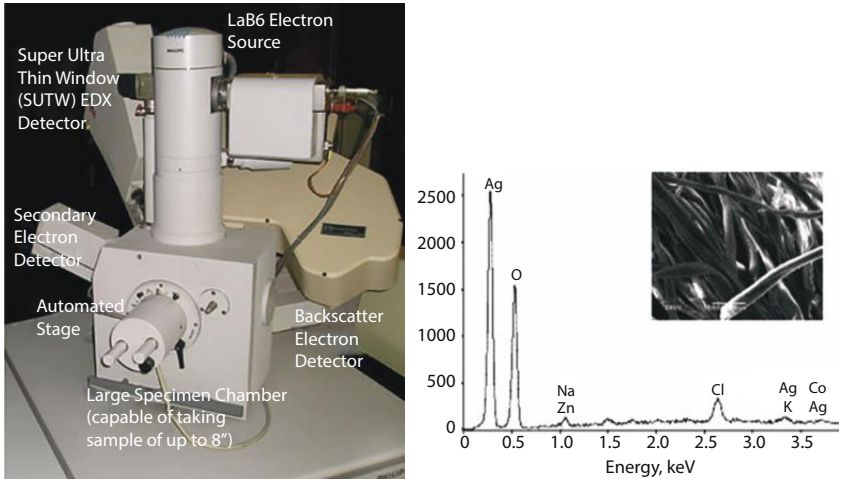

Figure 8.8 Schematic diagram of energy dispersive spectroscopy and SEM images and EDX spectra of nanoporous materials made of cotton cloth with silver nanoparticles 8.

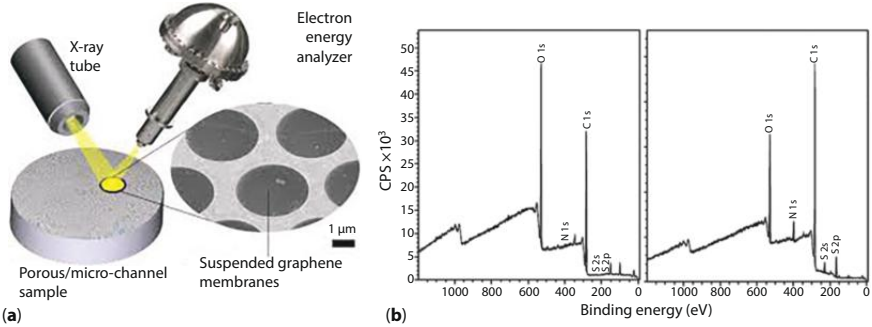

Figure 8.9 Schematic view of XPS. (a) Positively charged woven cotton fabric and (b) positively charged woven cotton fabric supporting 20 self-assembled layers of PSS/PAH.

the elements on the surface (up to 10 nm) of a material were analyzed by this technique [47]. XPS is also known as ESCA (electron spectroscopy of chemical analysis).

8.3.3.4 Particle Size Analyzer

Different techniques were available for the measurement of particle size distribution (PSD) such as optical counting methods, sieve analysis, electro resistance counting methods, laser diffraction methods, sedimentation

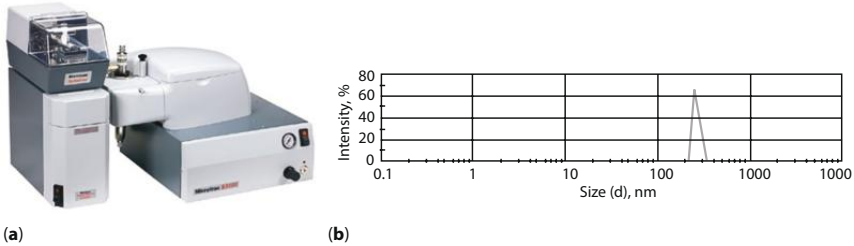

Figure 8.10 (a) Schematic diagram of particle size analyzer. (b) Size distribution of TiO_2 nanoparticles.

techniques, dynamic light scattering method, acoustic spectroscopy, etc. All of them dynamic light scattering (DLC) is regularly used for obtaining size of silver, titanium, silica, and zinc oxide nanoparticle are often used in textile substrates to get enhanced quality of the nanoparticle finished textile materials.

TiO_2 nanoparticle size and size distribution (Figure 8.10b) can be observed using DLS technique [48]. The enhanced property is dependent on the size of the sample nanoparticles. Therefore, size and size distribution performance of the nanoparticle in the dispersion as well as suspension is important before to characterize to the textile substrates.

8.3.4 Characterization of Textile Nanomaterial by Some Other Technique

The complete structural and chemical modifications of fabrics were further analyzed in terms of physical testing, determine the tensile properties, crease recovery angle, bending length, air, and water permeability.

8.3.4.1 Physical Testing

Before starting physical testing the samples were dried and conditioned at 65± 2% RH and 27 ± 2°C temperature.

8.3.4.2 Determination of Recovery Angle and Tensile Properties

Recovery angle was measured by folding and compressing the specimen under controlled condition. Tensile strength was observed as per B.S. 2576:1959.

8.3.4.3 Determination of Absorbency by Wicking Test and Bending Length

Wicking behavior of the treated and untreated samples were evaluated as per T-PACC standard method.

8.3.4.4 Evaluation of Water and Air Permeability

Water permeability test conducted using ASTM D 4491 constant head Methods. Metefem air permeability tester used ASTMD 737 test method for measurement of air permeability.

8.4 Application of Textiles Nanomaterials

Nanotechnology can offer high strength for textile material because nanoparticles have high surface energy and area and, based on this quality, improved the affinity for these materials and have to increase the strength. The overlap of nanoparticles on textile material will not affect their breathing and observation.

Now current researchers are developing nanotechnology to enhance the performances or to create extraordinary quality of textile material, which is prosperous.

8.4.1 Application Based on Properties of Textile Material

The properties of textile nanomaterials comprise oil resistance, water repellence, anti-static, wrinkle resistance, UV-protection, anti-bacterial, improvement of dye, flame retardation, ability, self-cleaning fabrics, and many more, which are described below.

8.4.1.1 Anti-Bacterial Properties of Textile Nanomaterial

Nano-sized silver, titanium dioxide, and zinc oxide are used for the anti-bacterial properties of textile nanomaterial. These metallic ions and compounds show the degree of sterilizing condition. The number of the oxygen in the air or water is changed into active oxygen by catalysis with the metallic ion and dissolves the organic substance for sterilizing effect. The use of nano-sized particles per unit area is increased, and thus anti-bacterial effects can be also increased [49].

8.4.1.2 UV Protective Properties of Textile Nanomaterial

The UV-protection property of a textile nanomaterial is improved when a dye, pigment, delustrant, or ultraviolet absorbance is complete, and the absorbed ultraviolet radiation blocks its transmission through a fabric to the skin. The excess of skin protection is required for different types of human skin, and it depends on distribution in reference to geographical location, time of day, UV radiation intensity, and season. This UV-protection is known as SPF (Sun Protection Factor). High SPF value is a better protection against UV radiation [50].

8.4.1.3 Water Repellence Properties of Textile Nanomaterial

Nano technology in the textile nanomaterial enhances the water-repelled property of fabric such as production of nano-whiskers, which are also hydrocarbons and known as cotton fiber. The addition of this fabric creates a peach fuzz effect without decrease in the strength of cotton. The particular space of the whiskers on the textile nanomaterial (fabric) is smaller than a drop of water and larger than water molecules [51]. However, liquid can still pass through the fabric, if pressure is applied.

8.4.1.4 Anti-Static Properties of Textile Nanomaterial

Static charge usually builds up in synthetic fibers such as nylon and polyester because they absorb little water. Cellulose textile nanomaterial have higher moisture ratio to carry away static charges. As we know synthetic fibers provide poor anti-static properties, so the scientist and researcher work to enhance the anti-static properties of textile materials by using nanotechnology. TiO_2, ZnO, and ATO show anti-static effects because they are electrically conductive nanomaterials. Such material helps to disperse the static charge, which is collected on the fabric. Silane nano sol improves anti-static properties, as the silane gel particles on fiber absorb water and moisture in the air by amino and hydroxyl groups in water [52].

8.4.1.5 Flame Retardant Properties of Textile Nanomaterial

Nanotechnologies has been applied in textile nanomaterials for flame retardant finish, which known by colloidal antimony pentoxide. Colloidal antimony pentoxide has a fine dispersive particle for use as a flame retardant synergist with halogenated flame retardants. Nano antimony pentoxide is used with halogenated flame retardants for a flame retardant finish to the textile nanomaterial [53].

8.4.1.6 Wrinkle-Free Properties of Textile Nanomaterial

Improved performance of nano-Tex has known as a new nanotechnology (wrinkle-free treatment). This technology preserves fabric strength and integrity, an alternative to harsh traditional processes. Conventional methods are commonly used to wrinkle resistance to fabric, resin. However, there are boundaries to applying its in fibers and resin, such as decrease in the tensile strength of fiber, abrasion resistance, water absorbency, dye ability, and breathability. To overcome the limitations of using resin, some scientist employed nano-titanium dioxide, and nano-silica [54] to improve the wrinkle resistance of cotton and silk, respectively.

8.4.1.7 Self-Cleaning Properties of Textile Nanomaterial

American company was developed nano-care, which is known as a self-cleaning cotton fabric. In the scientific terms, the fabric has been purified super-hydrophobic or super-non wet able. The nanowhiskers also make less interaction with dirt. When water is react to stained fabric, the dirt adheres to the water far better than it adheres to the textile surface and is carried off with the water as it beads up and rolls off the surface of the fabric. Self-cleaning fabrics could reform the sport apparel industry. The technology has already been used to create t-shirts and underwear that can be worn hygienically for weeks without washing [55].

8.4.1.8 Economical and Environmental Aspects of Textile Nanomaterial

The extraordinary properties of textile nanomaterials have attracted not only scientists and research scholar but also attract by businessman. The national science foundation (NSF) reported that textile nanomaterial related product and facilities will increase in 2015 with 1 trillion dollar. This amount is more than the all businesses such as telecommunications and information technology industries. In the future more than hundred billion Euros are forecast to be created by textile nanotechnology [56]. The textile nanomaterial markets could expand to US$ 1 billion. Due to huge development of textile nanomaterials, it was believed that 2 million new employment opportunities would be created in order to meet the worldwide annual production demand of US$ 1 trillion in future. Nanotechnology may impart favorably on the economical as well environment. Nanotechnology may save raw materials and also upgrade quality of life by using less resource without forgoing performance.

8.4.2 Application in Textile Industry

Nanotech enhanced the overall properties of textile material, which are seeing above based on properties. Some applications have for sport industry, space research, skin care, garments, and material technologies with better protection in environments. The modified textile material by nanotechnology is a unique method to improve the properties of the textile material, prolonging the process and also having multiple color options, etc. Nanotechnology can also be used to add new advantage such as energy storage and communications.

8.4.2.1 Textile Nanomaterial Used in Swimming Costume

The currently used swimming costumes have a plasma layer to repel the water molecules. The quality of the plasma layer is enhanced by nanotechnology that is prepared with the help of swimmer glide. The most widely recognized application is in the shark-skin costume in the Olympic swimming championship.

8.4.2.2 Textile Nanomaterial Used in Sports Goods

The quality of all sports wear has also been enhanced by textile nanomaterial. Scientists have developed naturally existing viral textile nanoparticles that have some of the toughest environments on earth and have new material for nanotechnology, a textile nanomaterial that minds their surface and interacts with the wearer. These textile-based nanosensors could provide a personalized healthcare system, which monitors your changes sign, such as responding to changes in the weather.

8.4.2.3 Textile Nanomaterial Used Inflexible Electronic Circuit

Textile nanomaterial (nano ribbon) used as chips, which are very flexible. These nano ribbons can cover the control of stretchable microscope cover slip. The researchers and scientists are describing applications in the healthcare industry and where these little, flexible electronic circuit could be used to monitor the activity of patients' brain. This circuit could also be used in surgical apparatus to monitor patients during surgery.

8.4.2.4 Textile Nanomaterial Used in Lifestyle

Nanotechnology is seen in many fields and also has application in lifestyle. Textile with the combination of cosmetics is among the first products to

use in nanomaterials. Nanotube fibers are used to make a material at least 17 times tougher than the present quality. In this view there are future developments with the use of this nanotechnology to create smart and interactive textiles (SMIT). That can be sensitive chemically, electrically, magnetically, thermally, or other stimuli.

8.5 Current Trends and Future Prospects

In the literature various studies have been describe the synthesis and characterization of nanomaterials for textile industry. Nanomaterials can be practically applied to textiles to impart antibacterial, self-cleaning, anti-wrinkle, UV protection, waterproof, and electrical conductivity functions. There have been many efforts to apply nanomaterials in the textile so far, but further research and developments would be necessary in the future. In this chapter, we have reviewed that the synthesis and characterization the textile material for different type of application. Although many researchers and scientist have been show interest for discovered more textile nanomaterials, and understand their functions. It is compulsory to increase its application for functional textiles such as sportswear, military wear, and fire safety wear, etc. Nanotechnology research in textiles has maximum possibility for the future approach but would be primarily an overview by current research progress in the simple, fast, new, and more resourceful characterization techniques for nanomaterials, nano-coatings, and nano-composites used in textile applications.

8.6 Conclusion

Textile nanomaterials have the possibility to improve the quality and stability of human life as well as industrial effectiveness in world. Still, the new textile nanomaterial may also pose harmful for the environment and decrease health safety issues. The Scientific Committee has decided that recently developed and identified nanomaterial is not risky for health and textile nanomaterials are not hazardous. There is still scientific doubt, which is not clear about the safety from textile nanomaterials by many characteristics, and therefore the safety concern of the substances must be done on a case-by-case basis. Although these are textiles, still very few studies are available in the literature, which describe the possible health risks involved with “nanotextile.”

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8

Synthesis, Characterization, and Application of Modified Textile Nanomaterials

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Abstract

There is a growing concern related to the effects of textile nanomaterials. The development of textile nanomaterial has been one of the most active and important research areas in recent years. Design and synthesis of nanomaterials with a novel combination of textile material is expected to expand the demanding scope in the future. Present chapter will emphasis on the chemical nature and synthesis of textile nanomaterials by using different method such as hydrothermal, microwave, fabrication as well as the methods used to characterize them with regard to their different applications. Recent developments in textile nanomaterial have various applications in the field of sports, cosmetics, swimming, and lifestyle.

Keywords: Textile nanomaterials, nanofibers, synthesis, application

8.1 Introduction of Textile Nanomaterials

The word of nanotechnology (Nano-tech) can be applied in different fields [1–3]. This word was first time applied on textiles and also known as Nano-Tex. Later, other textile industries also started to invest in the textile nanomaterial development [4]. Nanoparticles on textile material have been the goal of different studies, to develop the fabrics with miscellaneous practical performance [5]. These nanomaterials (nano silver,

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Mohd Shabbir, Shakeel Ahmed, and Javed N. Sheikh (eds.) Frontiers of Textile Materials: Polymers, Nanomaterials, Enzymes, and Advanced Modification Techniques, (167–188)

nano ZnO, and nano TiO_2) have been used as an antibacterial [6, 7], UV-blocking [8, 9], and self-cleaning [10, 11]. Textile nanomaterials can observe the high toughness for washing purpose, as owning great surface area and increase surface energy which declare more attraction for fabrics (textile nanomaterial) [12]. Improve the fastness of textile nanoparticles against washing by a specific solution [13] and other properties of fabric (tensile and bursting strength, friction and air penetrability) can also enhance by this solution [14].

Textile materials were prepared from natural occurring fibers, and have an important part in human being's life. Nowadays nanomaterials are broadly used in the advance textile industry for their appreciated properties as high quality textile materials. Natural fibers such as silk, hemp wool, and cotton are wasted throughout dispensation till further usages. Recycling of these fibers has large marketing area by a new route, because their extra-ordinary characteristics. Any other industries such as bio-medical industries required such bio-compatible materials based on these characteristics [15–17]. Some other valuable applications of textile nanocomposites are in the field of paper and paperboard applications as dry strength, surface strength agent. Textile nanomaterials were also used in cosmetics creams, nano-coatings, bio-nanocomposites, food industry, nano-barriers, pharmaceutical applications, absorbent products, oil recovery applications, and dispersion applications. Current literature works have described a new technique of synthesis of textile nanomaterials and their application in bio-medical and bio-technological fields [18–20].

The most popular textile nanomaterial is Chitosan (derivative of chitin), which is also known as the most popular bio-polymer with exceptional morphological and physiological characteristics [21–23]. These nanomaterial known as ideal polymer for textiles, food science, pharmaceuticals, agriculture and biomedical industrial application, because it has exclusive properties like as biodegradability, biocompatibility, and antibacterial activity [21, 24, 25]. New technique is quickly developing and broadly used in chemical, Pharmaceutical, food processing, cosmetics, and in the present time to textile finishing, which is known as nano encapsulation [26].

8.2 Synthesis of Textiles Nanomaterials

The selection of synthesis technique can be an important factor in identify the effectiveness of the textile nanomaterial studies. There are different methods of synthesizing textile nanomaterial such as hydrothermal [27],

combustion synthesis [28], gas-phase methods [29], microwave synthesis, and sol–gel processing with silver, ZnO and TiO_2 [30]. Synthesis of textile nanomaterial to have a better control over particle morphology, size distribution, quality, purity, and quantity, by engaging environment friendly and economical processes has always been a big task for the scientist and scholars [31].

8.2.1 Synthesis via Hydrothermal Method

Hydrothermal synthesis is commonly performed in a pressurized vessel, which is known as autoclave. Autoclave can be increased the temperature more than 100°C or until form the vapor. This type of synthesis is widely recommended for the synthesis of TiO_2 nanoparticles, which can easily be synthesized through hydrothermal treatment of peptized precipitates of a titanium precursor with water [32]. The hydrothermal method can be utilized to control morphological properties such as (size, morphology), crystalline phase, and surface chemistry through control of the solution composition, pressure, solvent properties, additives, and aging time and reaction temperature [33].

8.2.2 Synthesis via Solvo-Thermal Method

The Solvo-thermal and hydrothermal method both are the same, but the solvo-thermal process variety of solvents can be used in the place of water. This method normally has better control of the shape and size distributions and the crystallinity compared to hydrothermal method. It has been used to synthesize TiO_2 nanoparticles and also used to synthesize nano rods with or without the surfactants.

8.2.3 Synthesis via Chemical Vapor Deposition (CVD) Method

In the chemical vapor deposition process the substrate is covered with volatile precursors, which react on the substrate surface to produce the desired film. The quality of the placed materials completely depends on the reaction temperature, reaction rate, and concentration of the precursors [34]. Gracia *et al.* synthesized metal-doped TiO_2 by the same process [35]. The main feature or advantages of this synthesis method is the uniform coating of the nanoparticles or nano film. Cao *et al.* prepared Sn4+-doped TiO_2 nanoparticle films by this method and found that due to doping with Sn and observed more surface defects were present on the surface [36].

8.2.4 Synthesis via Physical Vapor Deposition (PVD) Method

PVD is also another method to preparation of thin film for the covered the substrate. In this technique films are formed precursor to product without a chemical transition. It has greater features or advantage in the place of CVD. PVD grown films have smoothness, conductivity, presence of contaminations, and crystallinity of titanium dioxide films with E-beam evaporation [37].

8.2.5 Synthesis via Template Method

The synthesis of textile nanostructure materials using template method has become very ideal through the last decade. In this method prepare numerous new materials with a regular and controlled morphology in the range of nano and micro by simply changing the morphology of the template material. The different type of templates has been studied, which utilized the synthesized the TiO_2 nanomaterials [38].

8.2.6 Synthesis via Conventional Sol–Gel Method

This method is used for synthesized various oxide materials such as nano silver, nano ZnO, and nano TiO_2 nanoparticle. The important of this technique contains high purity of the precursors, molecular scale mixing, and homogeneity of the products with a high purity of chemical, physical, and morphological properties. It is also known as multipurpose method.

8.2.7 Synthesis via Microwave Method

Various nanomaterials have been synthesized by microwave radiation. Microwave technique use of high temperature calcination for extended periods of time and allow for fast the synthesis of crystalline TiO_2 nanomaterials. Corradi *et al.* prepared colloidal TiO_2 nanoparticle suspensions within 5 min using microwave radiation [39].

8.2.8 Synthesis via Fabrication Process

Electro-spinning is the most important method among the synthesis of nanofibers.

In the electro-spinning process a high voltage is create an electricity for deposition or melt or streaming of polymer solution (Figure 8.1). Electric

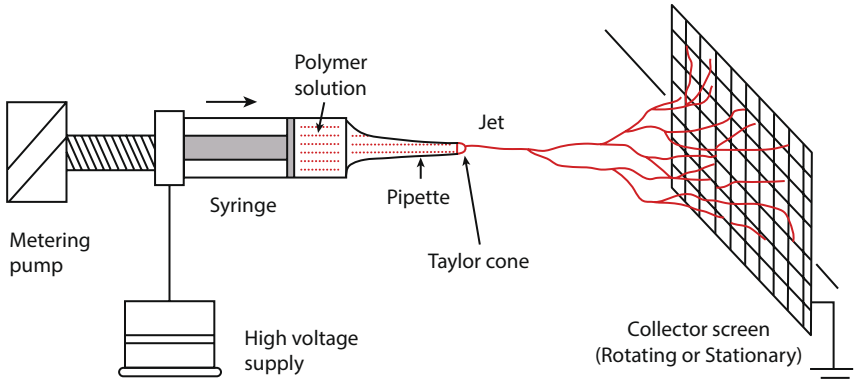

Figure 8.1 Schematic of electro-spinning.

field between the tip of capillary and a grounded collector is very high, and formed at the tip of capillary producing sub-micron diameter fibers. Different types of material were processed into nanofibers in the range of 50 to 1000 nm [40].

8.3 Characterization

Textile nanomaterial characterized by different technique such as spectroscopic, microscopic, X-ray, and other common techniques. The imaging techniques such as (SEM) scanning electron microscopy, (TEM/HRTEM) transmission electron microscopy, (AFM) atomic force microscopy, (STM) scanning tunneling microscopy have been utilized to observe the micro and nano size materials. The basic concepts of all the techniques are different but some common thing is that they observed extremely magnified image of the surface. The spectroscopic method such as (UV-Vis) Ultraviolet-Visible, Raman, infrared spectroscopy and many spectroscopic methods have been utilized to observe the optical properties of micro and nano size materials of textile. Textile nanomaterials can be analyze through X-rays technique like as (EDX) energy dispersive X-ray analysis, wide angle X-ray diffraction, (XPS) X-ray photoelectron spectroscopy, particle size analyzer. Some other common techniques also analyze the physical properties of textile nanomaterials. The basic principles of all these methods used in nanotechnology are described below (Figure 8.2).

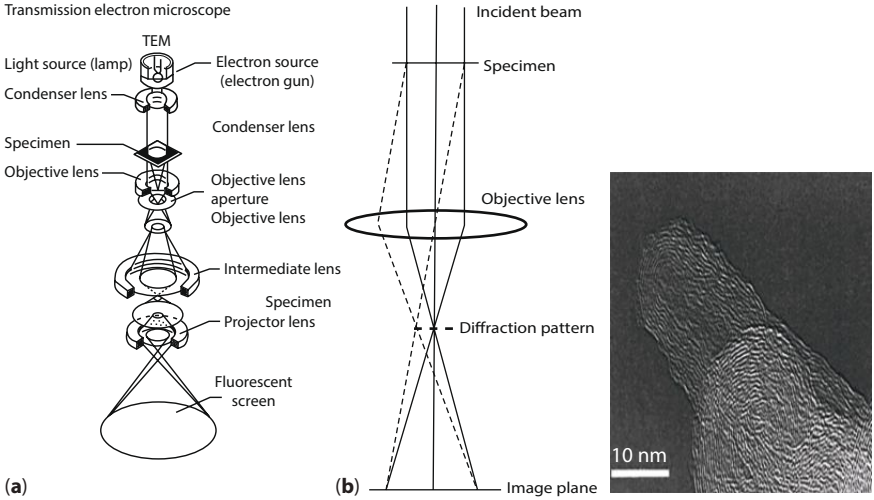

Figure 8.2 (a) Schematic diagram of transmission electron microscopy (b) TEM images of PP/MMT nanocomposites.

8.3.1 Microscopic Characterization of Textile Nanomaterials

8.3.1.1 Transmission Electron Microscopy (TEM)

The micro and nano image is formed by the electron transmeter by the sample and focused by a microscopic lens and looked on a display screen. This technique is widely used in material science, textile, metallurgy, and biological sciences. TEM images reveal the intercalation, exfoliation, and dispersion of nanoparticles in polymer matrices of textile nanomaterial, etc. [40].

High resolution transmission electron microscopy (HRTEM) is a similar imaging technique of electron microscope that allows to take image of the crystal sample at an atomic length with high resolution. This technique is a useful tool to find the nanoscale properties of crystalline material. It showed the maximum resolution is 0.8 Å.

8.3.1.2 Atomic Force Microscope (AFM)

This technique is ideal for quantitative measurement the nano scale textile material. AFM also used for surface imagining and roughness of the surface. Many types of material surface such as polymer nanocomposites, nanofinished, and nanocoated textiles were coated by nano-texture. It is a nondestructive technique and has very high three dimension (3D) [41] (Figure 8.3).

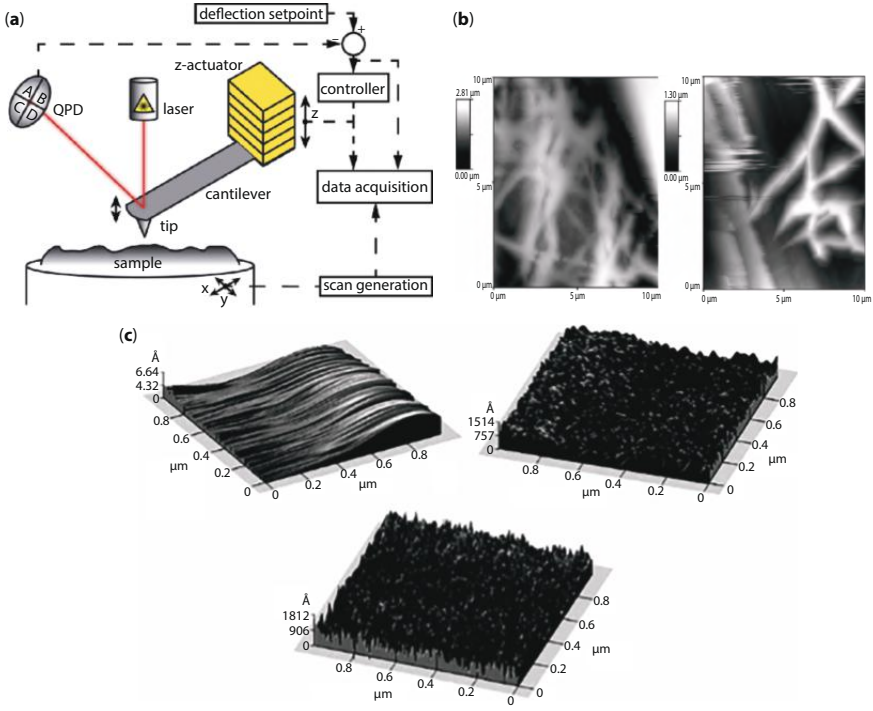

Figure 8.3 (a) Schematic diagram of atomic force microscopy. (b) nanofibers, nanofibers laid on nonwoven substrate (c) 3D views of non-contact mode AFM images of PET textile surface.

AFM can be used to identify the properties, nanostructures, surfaces, and interfaces of fibers and fabrics.

8.3.1.3 Scanning Electron Microscopy (SEM)

SEM is also an electron microscope that images is scanning of surface with a high energy beam of electrons. The SEM shows perfect 3D images with high magnifications (up to 300,000). But the images are only black and white which formed without light waves. The surface image and texture of polymer nanofibers, nanocomposites, nanoparticles, and nanocoating can be viewed through Scanning electron micrograph with high clarity by high magnification [42].

This technique can also be used to interpretation of the dispersion of nanoparticles such as carbon nanotubes, nanoclays, and hybrid POSS nanofillers and coatings on yarns and fabric samples (Figure 8.4c).

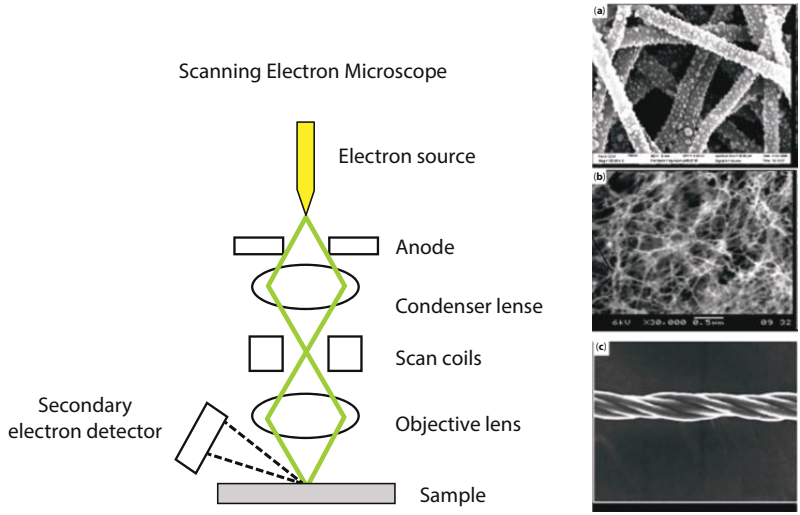

Figure 8.4 Schematic diagram of scanning electron microscopy. (a) Electrospun nylon 6 nanofibers with surface bound silver nanoparticles, (b) peptide nanofiber scaffold for tissue engineering, and (c) SEM image of plied CNT yarn.

8.3.1.4 Scanning Tunneling Microscopy (STM)

Scanning tunneling microscopy (Figure 8.5) is a minor different instrument for observing surface images with atomic scale resolution, in this technique a fine probe tip is scanned over the surface of a sample, with the help of a piezoelectric crystal, and the resulting tunneling [43].

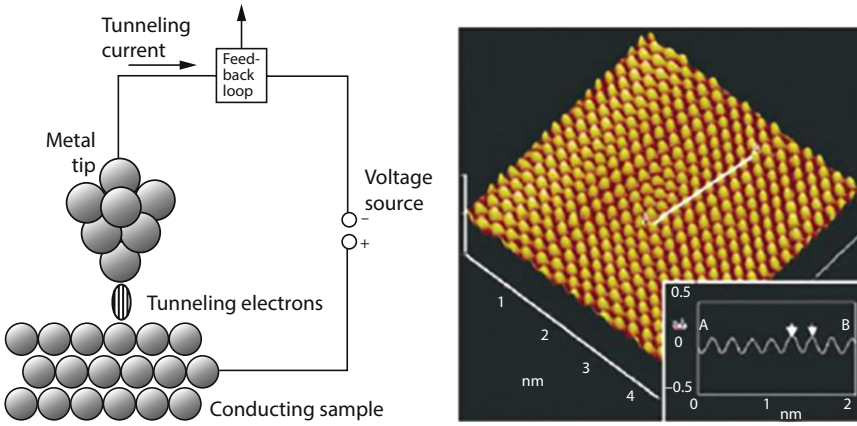

Figure 8.5 Schematic diagram of scanning tunneling microscopy and highly oriented pyrolytic graphite sheet under STM.

8.3.2 Spectroscopic Characterization of Textile Nanomaterials

8.3.2.1 Ultraviolet-Visible (UV-VIS) Spectroscopy

In the Ultraviolet spectrophotometers light source forced on reference and sample beams then output comes in monochromator, detector, and form the spectrum. The ultraviolet spectrum for a sample is obtained by exposing a sample of the compound by Xenon lamp. Spectrum was observed for absorbance versus wavelength [44] (Figure 8.6).

8.3.2.2 Raman Spectroscopy

This type of spectroscopic technique used for condensed matter physics and chemistry. It used to study vibrational, rotational, and other low-frequency modes in a system [45]. The laser light interacts with phonons or other excitations in the system, and the energy of photons being change high or low. The level of energy provides information about the energy of phonon in the system (Figure 8.7).

8.3.2.3 Infrared Spectroscopy (IR)

This technique specially used for characterization of nanomaterials. Fourier transform infrared (FTIR) spectrometer is preferred over dispersive spectrometer due to non-destructive technique. It can increase sensitivity of scan rate

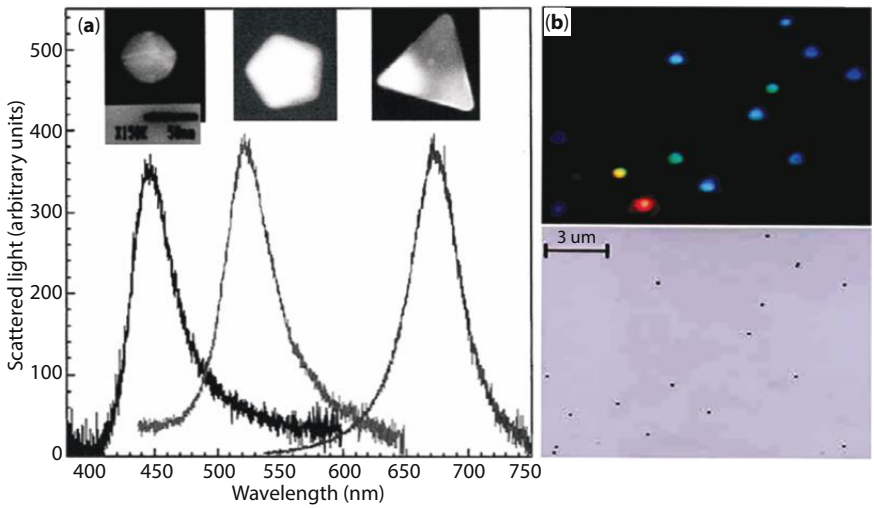

Figure 8.6 (a) UV-Vis spectroscopy of silver nanoparticles of different shapes and (b) color image of a typical sample of silver nanoparticles.

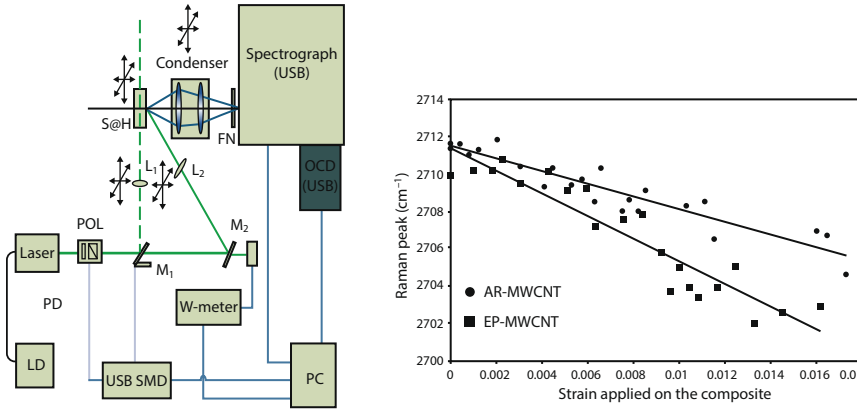

Figure 8.7 Schematic diagram of Raman spectroscopy and Shift in the Raman peak as a function of applied strain.

and co-added together to ratio of random noise. It has better optical through output and is also mechanically simple with only one moving part, etc.

8.3.3 Characterization of Textile Nanomaterials by X-Ray

8.3.3.1 Energy Dispersive X-Ray Analysis (EDX)

This technique analyzes the surface elements at different positions and provides an overall measurement of the sample. The concentration of nanomaterials at the surface can be observed using this technique. EDX contain some heavy metal ions (Au, Pd, and Ag) on the surface of nanoparticles (Figures 8.8b, c). EDX spectra have to be taken by focusing the beam at different regions of the same sample to verify spatially uniform composition of the bimetallic materials [46].

8.3.3.2 Wide Angle X-Ray Diffraction

This technique is similar to electromagnetic radiation of X-ray diffraction, but have shorter wavelength. This technique produced spectrum when electrically charged particles have sufficient energy. In an X-ray tube, the high voltage is maintained by electrodes toward a metal target. X-rays are produced and radiate in all directions.

8.3.3.3 X-Ray Photoelectron Spectroscopy (XPS)

This spectroscopy (Figure 8.9) is a quantitative spectroscopic. Surface chemical, elemental composition, chemical state, and electronic state of

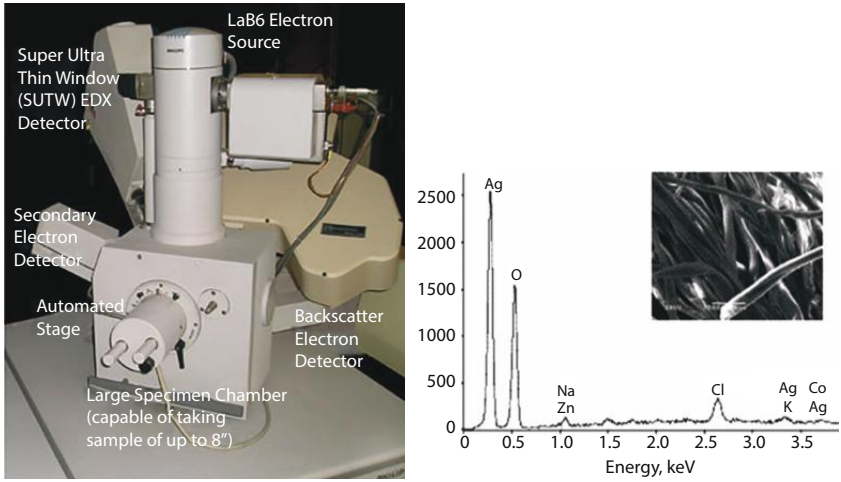

Figure 8.8 Schematic diagram of energy dispersive spectroscopy and SEM images and EDX spectra of nanoporous materials made of cotton cloth with silver nanoparticles 8.

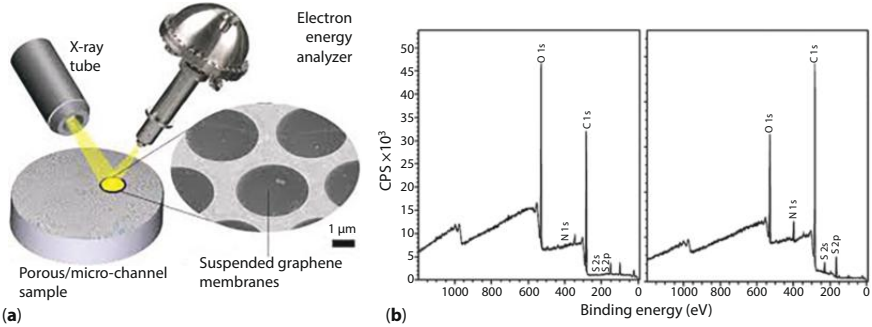

Figure 8.9 Schematic view of XPS. (a) Positively charged woven cotton fabric and (b) positively charged woven cotton fabric supporting 20 self-assembled layers of PSS/PAH.

the elements on the surface (up to 10 nm) of a material were analyzed by this technique [47]. XPS is also known as ESCA (electron spectroscopy of chemical analysis).

8.3.3.4 Particle Size Analyzer

Different techniques were available for the measurement of particle size distribution (PSD) such as optical counting methods, sieve analysis, electro resistance counting methods, laser diffraction methods, sedimentation

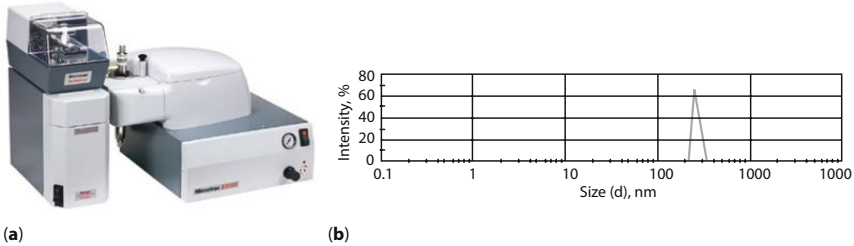

Figure 8.10 (a) Schematic diagram of particle size analyzer. (b) Size distribution of TiO_2 nanoparticles.

techniques, dynamic light scattering method, acoustic spectroscopy, etc. All of them dynamic light scattering (DLC) is regularly used for obtaining size of silver, titanium, silica, and zinc oxide nanoparticle are often used in textile substrates to get enhanced quality of the nanoparticle finished textile materials.

TiO_2 nanoparticle size and size distribution (Figure 8.10b) can be observed using DLS technique [48]. The enhanced property is dependent on the size of the sample nanoparticles. Therefore, size and size distribution performance of the nanoparticle in the dispersion as well as suspension is important before to characterize to the textile substrates.

8.3.4 Characterization of Textile Nanomaterial by Some Other Technique

The complete structural and chemical modifications of fabrics were further analyzed in terms of physical testing, determine the tensile properties, crease recovery angle, bending length, air, and water permeability.

8.3.4.1 Physical Testing

Before starting physical testing the samples were dried and conditioned at 65± 2% RH and 27 ± 2°C temperature.

8.3.4.2 Determination of Recovery Angle and Tensile Properties

Recovery angle was measured by folding and compressing the specimen under controlled condition. Tensile strength was observed as per B.S. 2576:1959.

8.3.4.3 Determination of Absorbency by Wicking Test and Bending Length

Wicking behavior of the treated and untreated samples were evaluated as per T-PACC standard method.

8.3.4.4 Evaluation of Water and Air Permeability

Water permeability test conducted using ASTM D 4491 constant head Methods. Metefem air permeability tester used ASTMD 737 test method for measurement of air permeability.

8.4 Application of Textiles Nanomaterials

Nanotechnology can offer high strength for textile material because nanoparticles have high surface energy and area and, based on this quality, improved the affinity for these materials and have to increase the strength. The overlap of nanoparticles on textile material will not affect their breathing and observation.

Now current researchers are developing nanotechnology to enhance the performances or to create extraordinary quality of textile material, which is prosperous.

8.4.1 Application Based on Properties of Textile Material

The properties of textile nanomaterials comprise oil resistance, water repellence, anti-static, wrinkle resistance, UV-protection, anti-bacterial, improvement of dye, flame retardation, ability, self-cleaning fabrics, and many more, which are described below.

8.4.1.1 Anti-Bacterial Properties of Textile Nanomaterial

Nano-sized silver, titanium dioxide, and zinc oxide are used for the anti-bacterial properties of textile nanomaterial. These metallic ions and compounds show the degree of sterilizing condition. The number of the oxygen in the air or water is changed into active oxygen by catalysis with the metallic ion and dissolves the organic substance for sterilizing effect. The use of nano-sized particles per unit area is increased, and thus anti-bacterial effects can be also increased [49].

8.4.1.2 UV Protective Properties of Textile Nanomaterial

The UV-protection property of a textile nanomaterial is improved when a dye, pigment, delustrant, or ultraviolet absorbance is complete, and the absorbed ultraviolet radiation blocks its transmission through a fabric to the skin. The excess of skin protection is required for different types of human skin, and it depends on distribution in reference to geographical location, time of day, UV radiation intensity, and season. This UV-protection is known as SPF (Sun Protection Factor). High SPF value is a better protection against UV radiation [50].

8.4.1.3 Water Repellence Properties of Textile Nanomaterial

Nano technology in the textile nanomaterial enhances the water-repelled property of fabric such as production of nano-whiskers, which are also hydrocarbons and known as cotton fiber. The addition of this fabric creates a peach fuzz effect without decrease in the strength of cotton. The particular space of the whiskers on the textile nanomaterial (fabric) is smaller than a drop of water and larger than water molecules [51]. However, liquid can still pass through the fabric, if pressure is applied.

8.4.1.4 Anti-Static Properties of Textile Nanomaterial

Static charge usually builds up in synthetic fibers such as nylon and polyester because they absorb little water. Cellulose textile nanomaterial have higher moisture ratio to carry away static charges. As we know synthetic fibers provide poor anti-static properties, so the scientist and researcher work to enhance the anti-static properties of textile materials by using nanotechnology. TiO_2, ZnO, and ATO show anti-static effects because they are electrically conductive nanomaterials. Such material helps to disperse the static charge, which is collected on the fabric. Silane nano sol improves anti-static properties, as the silane gel particles on fiber absorb water and moisture in the air by amino and hydroxyl groups in water [52].

8.4.1.5 Flame Retardant Properties of Textile Nanomaterial

Nanotechnologies has been applied in textile nanomaterials for flame retardant finish, which known by colloidal antimony pentoxide. Colloidal antimony pentoxide has a fine dispersive particle for use as a flame retardant synergist with halogenated flame retardants. Nano antimony pentoxide is used with halogenated flame retardants for a flame retardant finish to the textile nanomaterial [53].

8.4.1.6 Wrinkle-Free Properties of Textile Nanomaterial

Improved performance of nano-Tex has known as a new nanotechnology (wrinkle-free treatment). This technology preserves fabric strength and integrity, an alternative to harsh traditional processes. Conventional methods are commonly used to wrinkle resistance to fabric, resin. However, there are boundaries to applying its in fibers and resin, such as decrease in the tensile strength of fiber, abrasion resistance, water absorbency, dye ability, and breathability. To overcome the limitations of using resin, some scientist employed nano-titanium dioxide, and nano-silica [54] to improve the wrinkle resistance of cotton and silk, respectively.

8.4.1.7 Self-Cleaning Properties of Textile Nanomaterial

American company was developed nano-care, which is known as a self-cleaning cotton fabric. In the scientific terms, the fabric has been purified super-hydrophobic or super-non wet able. The nanowhiskers also make less interaction with dirt. When water is react to stained fabric, the dirt adheres to the water far better than it adheres to the textile surface and is carried off with the water as it beads up and rolls off the surface of the fabric. Self-cleaning fabrics could reform the sport apparel industry. The technology has already been used to create t-shirts and underwear that can be worn hygienically for weeks without washing [55].

8.4.1.8 Economical and Environmental Aspects of Textile Nanomaterial

The extraordinary properties of textile nanomaterials have attracted not only scientists and research scholar but also attract by businessman. The national science foundation (NSF) reported that textile nanomaterial related product and facilities will increase in 2015 with 1 trillion dollar. This amount is more than the all businesses such as telecommunications and information technology industries. In the future more than hundred billion Euros are forecast to be created by textile nanotechnology [56]. The textile nanomaterial markets could expand to US$ 1 billion. Due to huge development of textile nanomaterials, it was believed that 2 million new employment opportunities would be created in order to meet the worldwide annual production demand of US$ 1 trillion in future. Nanotechnology may impart favorably on the economical as well environment. Nanotechnology may save raw materials and also upgrade quality of life by using less resource without forgoing performance.

8.4.2 Application in Textile Industry

Nanotech enhanced the overall properties of textile material, which are seeing above based on properties. Some applications have for sport industry, space research, skin care, garments, and material technologies with better protection in environments. The modified textile material by nanotechnology is a unique method to improve the properties of the textile material, prolonging the process and also having multiple color options, etc. Nanotechnology can also be used to add new advantage such as energy storage and communications.

8.4.2.1 Textile Nanomaterial Used in Swimming Costume

The currently used swimming costumes have a plasma layer to repel the water molecules. The quality of the plasma layer is enhanced by nanotechnology that is prepared with the help of swimmer glide. The most widely recognized application is in the shark-skin costume in the Olympic swimming championship.

8.4.2.2 Textile Nanomaterial Used in Sports Goods

The quality of all sports wear has also been enhanced by textile nanomaterial. Scientists have developed naturally existing viral textile nanoparticles that have some of the toughest environments on earth and have new material for nanotechnology, a textile nanomaterial that minds their surface and interacts with the wearer. These textile-based nanosensors could provide a personalized healthcare system, which monitors your changes sign, such as responding to changes in the weather.

8.4.2.3 Textile Nanomaterial Used Inflexible Electronic Circuit

Textile nanomaterial (nano ribbon) used as chips, which are very flexible. These nano ribbons can cover the control of stretchable microscope cover slip. The researchers and scientists are describing applications in the healthcare industry and where these little, flexible electronic circuit could be used to monitor the activity of patients' brain. This circuit could also be used in surgical apparatus to monitor patients during surgery.

8.4.2.4 Textile Nanomaterial Used in Lifestyle

Nanotechnology is seen in many fields and also has application in lifestyle. Textile with the combination of cosmetics is among the first products to

use in nanomaterials. Nanotube fibers are used to make a material at least 17 times tougher than the present quality. In this view there are future developments with the use of this nanotechnology to create smart and interactive textiles (SMIT). That can be sensitive chemically, electrically, magnetically, thermally, or other stimuli.

8.5 Current Trends and Future Prospects

In the literature various studies have been describe the synthesis and characterization of nanomaterials for textile industry. Nanomaterials can be practically applied to textiles to impart antibacterial, self-cleaning, anti-wrinkle, UV protection, waterproof, and electrical conductivity functions. There have been many efforts to apply nanomaterials in the textile so far, but further research and developments would be necessary in the future. In this chapter, we have reviewed that the synthesis and characterization the textile material for different type of application. Although many researchers and scientist have been show interest for discovered more textile nanomaterials, and understand their functions. It is compulsory to increase its application for functional textiles such as sportswear, military wear, and fire safety wear, etc. Nanotechnology research in textiles has maximum possibility for the future approach but would be primarily an overview by current research progress in the simple, fast, new, and more resourceful characterization techniques for nanomaterials, nano-coatings, and nano-composites used in textile applications.

8.6 Conclusion

Textile nanomaterials have the possibility to improve the quality and stability of human life as well as industrial effectiveness in world. Still, the new textile nanomaterial may also pose harmful for the environment and decrease health safety issues. The Scientific Committee has decided that recently developed and identified nanomaterial is not risky for health and textile nanomaterials are not hazardous. There is still scientific doubt, which is not clear about the safety from textile nanomaterials by many characteristics, and therefore the safety concern of the substances must be done on a case-by-case basis. Although these are textiles, still very few studies are available in the literature, which describe the possible health risks involved with “nanotextile.”

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 2

CELLULOSE BASED NANOCOMPOSITES FOR BIOMEDICAL AND PHARMACEUTICAL APPLICATIONS

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ABSTRACT

In recent years cellulose-based nanocomposites have gained attention owing to the enhanced mechanical, thermal, high strength and stiffness, renewability and biodegradability, along with their production and application in the expansion of composites. These are emerging renewable nanocomposites that hold potential in many different applications such as food, chemicals, personal care, packaging and products, automotive, construction, electronics and furniture along with. High-performance nanocomposites can be prepared by appropriate modification of cellulose fibers as reinforcement material, resulting in improved physical, chemical as well as biological properties. The chapter provides an overview of cellulose nanocomposites focusing on the processing, properties, and applications in pharmaceutical and biomedical fields.

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Keywords: cellulose, nanocomposites, pharmaceutical, biomedical

1. INTRODUCTION

Cellulose is the most plentiful form of living terrestrial biomass material in nature (Crawford 1981) which is a common plant biopolymer, complex polysaccharide or carbohydrate comprising of 3,000 or more glucose units with 33 percent of all vegetable matter and the annual production is estimated to be around 10^{11} tons. It is a natural polymer, which is a long chain macromolecule and made by the linkage of smaller molecules. In the cellulose chain, the links are made by consisting of sugar, β-D-glucose (Dorée 1947). These sugar units are connected when water is removed by merging the H and –OH group. Above two of these sugars linkage results, a disaccharide is known as cellobiose (Kalia et al. 2011). Cellulose is most profuse of all naturally existing organic compounds and it is the basic structural component of the cell wall. In 1980, *Anselm Payen* (Payen 1838) first recognized the existence of cellulose as the communal material of plant cell walls. Several natural fibers like cotton and higher plants have cellulose as their main component. It comprises of long chains of anhydrous-D-glucopyranose units (AGU) and is insoluble in water as well as most common solvents. Therefore, chemical modification of cellulose is performed to enhance processability and to yield cellulosic (cellulose derivatives) so that they can be tailored for specific industrial applications. Cellulose has been widely investigated due to its advantageous properties, like low-cost, hydrophilicity, non-toxicity, biocompatibility, biodegradeability, low density, combustible and nonabrasive (Fu et al. 2019).

Composites are a combination of two or more different components with knowingly different chemical and physical properties. They have improved mechanical performance along with new functionalities. Generally, a composite contains a stiff and strong component known as the reinforcement which is embedded in a softer constituent, the matrix. In this way, the composite has advantageous properties of reinforcement and the matrix. Composites can be classified into three categories in terms of matrix used

are (1) ceramic matrix composites (2) metal matrix composites (3) polymer matrix composites. There are many thermoplastic polymers like poly (ethylene) (Lu, Lin, and Chen 2007), poly (ethylene oxide) (Chen and Tsubokawa 2000) and poly (vinyl chloride) (Chazeau et al. 1999) while thermosetting polymers like phenolic resin (Zárate, Aranguren, and Reboredo 2008), unsaturated polyester (Vilay et al. 2008), rubber (Setua and De 1984) and epoxy resin (Zhou et al. 2006). With increased awareness on environmental protection and sustainability, researchers have been shown interest in yield biodegradable polymer composites based on starch (Kvien et al. 2007) poly (lactic acid) (Bondeson and Oksman 2007) and cellulose (Gindl and Keckes 2005). Composites achieve the properties of both reinforcement and matrix with enhanced properties of compressive and strengths. Booker and Boysen (2005) presented special efforts towards nanotechnology and gave a high expectation for researchers. A nanoparticle is usually considered when as a minimum one of the linear dimensions is lesser than 100 nm (Henriksson et al. 2007). The perspective of nanocomposites in several areas of research and application is auspicious and attracting. Nanocomposite materials have many advantages properties like their superior mechanical, thermal, and barrier properties at low reinforcement levels along with their transparency, low weight, and better recyclability when compared with conventional composites (Oksman et al. 2006; Sorrentino, Gorrasi, and Vittoria 2007). Loads of research works have been carried out all over the world for the preparation of various types of nanocomposites by using cellulose fibers as a reinforcing material. The main reason to utilize cellulose nanofibers in composite materials is that one can potentially exploit the high stiffness of the cellulose crystal for reinforcement. This can be done by breaking down the hierarchical structure of the plant into individualized nanofibers of high crystallinity, with a reduction of amorphous parts.

2. METHODS

2.1. Cellulose Nanocomposite Processing

Processing of nanocomposites of cellulose makes them suitable candidate for low-cost engineering material with plant fiber reinforcement in industry (Berglund and Peijs 2010) along with its cheaper, renewable and low abrasive nature, impressive mechanical properties, abundance, low weight, and biodegradability of cellulose nanocrystals (Azizi Samir, Alloin, and Dufresne 2005; Oksman et al. 2002; Hornsby, Hinrichsen, and Tarverdi 1997; Bledzki, Reihmane, and Gassan 1996). In determining the composite properties, processing condition plays an important role such as Glass fibers have high strength when freshly drawn whereas the condition was altered i.e., exposed to humid air then fibers absorb water surfaces of fibers become damaged because of rubbing action during processing, the strength decreases. The temperature of processing is also restricted for specific materials like for lignocellulosic materials, it is controlled to about 200°C due to their degradation temperature starts from 230°C (Hamad 2013). Cellulose nanocomposites can be processed using conventional processing methods. Before processing, drying of fibers is the key point as the water content in the fiber can outcome in weak adhesion in between fiber and polymer or it may cause voids in the nanocomposite when the water evaporates during processing.

Nishino, Matsuda, and Hirao (2004) reported the two typical routes for the preparation of cellulose nanocomposites, one-step and two-step methods (Figure 1). In this method, cellulose is firstly dissolved in a solvent which was followed by regeneration of the cellulose in the existence of another cellulose component which was undissolved. Vallejos, Peresin, and Rojas (2012) synthesized all-cellulose composites by electrospinning cellulose acetate (CA) solution having dispersed cellulose nanocrystals (CNC) to yield precursor CA/CNC composites. However, in the one-step method, cellulosic fibers are slightly dissolved in a solvent and then redeveloped in situ to obtain a matrix around the undissolved part. Cellulose composites are prepared using different composites manufacturing techniques like injection

molding, resin transfer molding (RTM), compression molding and vacuum bagging. Rånby (1951); Ranby (1952) firstly synthesized cellulose nanocrystals by hydrolysis of cellulosic biomass in mineral acid (hydrochloric or sulfuric). Processing starts with milling the pulp for small uniform particles followed by acid hydrolysis of the cellulose raw material for removing the bonded polysaccharides on cellulose fibril surface and a disordered or amorphous portion of cellulose that separates the fibrils (Revol et al. 1992). Acid hydrolysis is terminated by acid's rapid dilution, followed by the removal of acid via dialysis or centrifugation. Some mechanical forces like sonication are applied to terminate the aggregation of cellulose fibrils in order to yield cellulose nanocrystals having high crystallinity (Guo and Catchmark 2012). Cellulose nanocomposites show the different appearance from different sources, Figure 2 (Azizi Samir, Alloin, and Dufresne 2005).

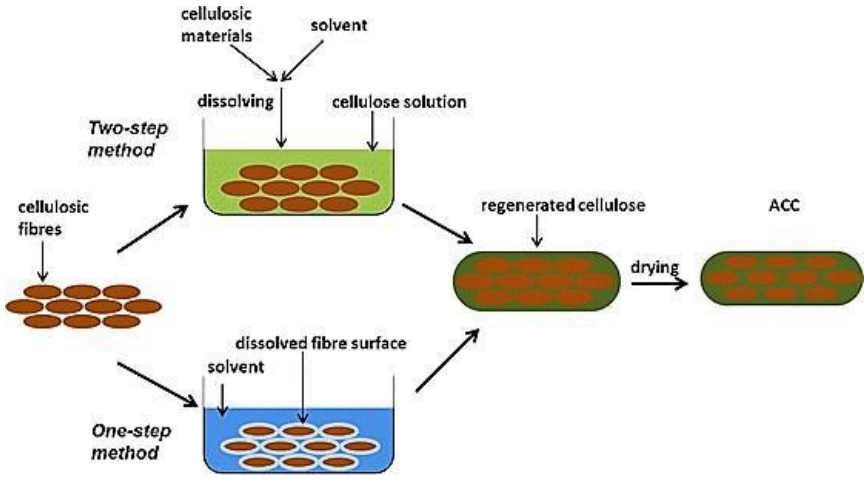

Figure 1. Schematic representation of the two-step (top) and one-step (bottom) preparation methods of ACCs Reprinted with permission from *(*Miao and Hamad 2013) Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262.

Favier (1995) first published the preparation of cellulose nanocrystals-reinforced polymer nanocomposites by using a latex which was achieved by the copolymerization of butyl acrylate (poly (S-co-BuA) and styrene and

tunicin whiskers (the cellulose mined from tunicate-a sea animal). Numerous studies have been furnished on isolation and characterization of cellulose nanofibers due to in the development of nanocomposites, cellulose nanofibers have a great potential to be used in a various different area as reinforcement from various sources. These nanofibers can be extracted by only chemical or both chemical and mechanical methods from the cell walls (Alemdar and Sain 2008) Compatibility of fibers and polymers is a very common problem in cellulose fiber-based composites due to high polarity and hydrophilic nature of fibers but non-polar and hydrophobic nature of polymers. To overcome this problem surfaces of fibre can be treated using various methods such as physical (stretching (Haig Zeronian, Kawabata, and

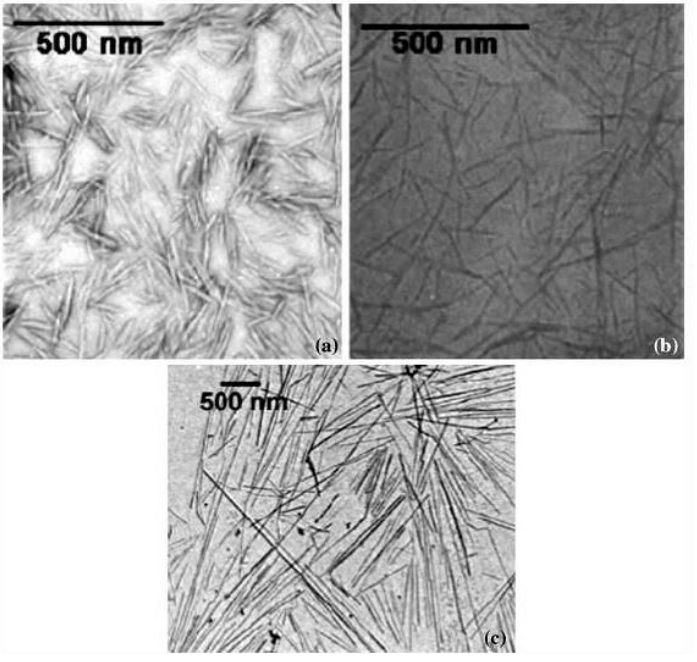

Figure 2. TEM images of CNC from different sources. a Cotton, b sugar-beet pulp, and c tunicin (the cellulose extracted from tunicate, a sea animal) Reprinted with permission from *(*Miao and Hamad 2013) Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262.

Alger 1990), calendering (Semsarzadeh 1986) and thermo-treatment Ray, Chakravarty, and Bandyopadhaya (1976), Physico-chemical (Takacs et al. 1999; Uehara and Sakata 1990; Carlsson and Stroem 1991; Kato et al. 1999; Kolar et al. 2000) and chemical methods (Belgacem and Gandini 2005). Various techniques can be used to characterize the modified fiber surface including scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FT-IR), contact angle measurements, confocal laser scanning microscopy (CLSM), elemental analysis, inverse gas chromatography (IGC), nuclear magnetic resonance (NMR) and atomic force microscopy (AFM) (Belgacem 2005; Mohanty, Misra, and Drzal 2001). Processing of cellulose nanofibers-reinforced nanocomposites by extrusion methods are explored rarely. The synthesis of cellulose nanocomposites by melt extrusion was prosecuted by injecting the suspension of nanocrystals into the polymer melt throughout the extrusion process (Oksman et al. 2006).

2.2. Properties of Cellulose Nanocomposites

2.2.1. Thermal Stability

Azizi Samir (2004) and Samir (2004) performed thermogravimetric analysis (TGA) experiments inspect the thermal degradation and stability of tunicin whiskers/POE nanocomposites and suggested that there was no effect of cellulosic fibers on POE nanocomposites degradation temperature. Choi and Simonsen (2006) suggested the effect of cotton cellulose nanocrystals content on the thermal behavior of CMC plasticized with glycerin revealed a close connotation between the filler and the matrix.

2.2.2. Mechanical Performance

Hajji (1996) studied the effect of preparation methods on the mechanical properties of a CNC-based nanocomposite. Nishino, Matsuda, and Hirao (2004) synthesized the cellulose nanocomposite films with cellulose I and II in the different ratio by the slight dissolution of microcrystalline cellulose powder in N, N-dimethylacetamide /lithium chloride and subsequent film

casting and the structure and mechanical properties of these films were characterized by XRD and tensile strength. The resulting films are transparent to visible light, isotropic, highly crystalline having different amounts of undissolved cellulose I crystallites. By varying the cellulose I and II ratio, the mechanical recital of the nanocomposites can be tuned. studied The consequence of preparation or processing methods on the mechanical properties of a CNC-based nanocomposite was studied by Hajji (Hajji et al. 1996). He suggested that the composite film synthesized by water evaporation reveals the best mechanical property due to less impact on the orientation of CNC, offers better dispersion of CNC in matrices which safes CNC structure from damage. Hence, Table 1 shows the importance of processing methods and even dispersion of the reinforcement in the matrix on nanocomposite properties.

Table 1. Mechanical properties of CNC based nanocomposites processed by different methods (Miao and Hamad 2013) Reprinted with permission from Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262

CNC content (wt%)	E		HP		XP	
	Modulus (MPa)	Tensile strength (MPa)	Modulus (MPa)	Tensile strength (MPa)	Modulus (MPa)	Tensile strength (MPa)
0	0.2	0.15	0.2	0.12	0.2	0.12
1	0.6	0.49	0.5	0.31	0.4	0.23
6	32.3	5	5.2	1.63	1.5	1.06

The factors which affect the mechanical properties of cellulose nanocomposites are compatibility of polymer resin and CNC, the molecular structure of the matrix, the aspect ratio of CNC particles and composite preparation procedure.

3. APPLICATIONS

Application in the field of development of composites by cellulose nanofibers is a comparatively new research area. Eichhorn (2009) incorporated uses of cellulose-based nanocomposites in reinforce adhesives for making optically transparent paper designed for electronic display and to produce DNA-hybrid materials, to create hierarchical composites aimed to use in foams, aerogels and for improved coupling between fiber and matrix. Cellulose nanocomposites have proven to be an unusually multipurpose biomaterial that may be used in an extensive variety of applied scientific endeavors like electronics, paper products, acoustics, automotive industry and most important in pharmaceutical and biomedical devices.

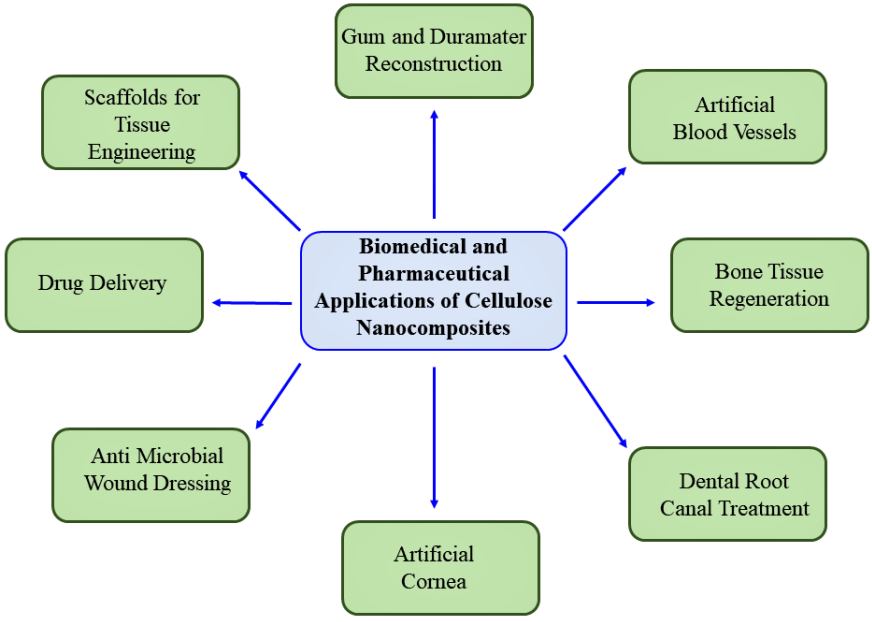

Figure 3. Biomedical and pharmaceutical applications of cellulose nanocomposites.

3.1. Pharmaceutical

Cellulose-based nanocomposites are highly useful in the pharmaceutical industry as cellulose has an outstanding property of compaction which blended smoothly with excipients in order to drug-loaded tablets form condensed matrices suitable for the oral management of drugs (Longer and Robinson 1990; Alderman 1984). Various potential advantages as a drug delivery excipient are offered by crystalline nanocellulose (Baumann et al. 2009; Watanabe et al. 2002). A large number of drugs can be found on the surface of cellulose nanocomposites due to high surface area along with the negative charge, makes them a potential candidate for high payloads and optimal control of dosing and it is also suitable because of established biocompatibility of cellulose. The hydroxyl groups present on the surface of crystalline nanocellulose offer a place for the surface amendment of the material with a wide range of chemical groups via many different methods. Modification of surface can be used to modulate the drug loading and release that would not normally tie to nanocellulose i.e., hydrophobic and nonionized. (Lönnberg et al. 2008; Shaikh et al. 2007).

3.2. Medical

Nowadays, eyes of biomaterial term has been used for nanocellulose because of its high applications in biomedical industry including drugs releasing system, skins replacements for wounds and burnings, nerves, blood vessel growth, scaffolds for tissue engineering, gum and dura mater reconstruction, stent covering and bone reconstruction (Mello et al. 2001; W. K. Czaja et al. 2007; Negrão et al. 2006; Klemm et al. 2001). Odontology is defied to find novel materials to substitute the bones in numerous procedures like facial deformities, maxillary, bone malformation and the loss of alveolar bone is the biggest challenge in this. Nanocellulose with appropriate porosity that provides the mat an infection barrier, painkiller effect, loss of fluids and allows medicines to be effortlessly applied and also works on purulent fluids by absorbing it during all inflammatory phases,

ousting it later on in a painless and controlled manner (W. Czaja et al. 2006). Cellulose nanocomposites have all types of properties like physical, mechanical and chemical along with huge superficial areas that give outstanding water absorption capacity and also elasticity shows characteristics of an ideal healing bandage. Barud (2009) have developed a biological membrane with cellulose nanocomposites to standardized extract of propolis, it has several biological properties with anti-inflammatory and antimicrobial activities which makes the membrane for good treatment for chronic wounds and burns. Raghavendra (2013) reported the antibacterial activity of the cellulose nanocomposites against Escherichia coli which was done by inhibition zone method, suggested that the synthesized CSNCFs can function effectually as anti-microbial agents and can be used for tissue scaffolding.

3.3. Others

Other applications of nanocellulose composites are mainly focused on paper and packaging products as well as furniture, automotive, electronics, electroacoustic devices, construction, cosmetics, and pharmacy. Additionally, they are applied in ultrafiltration membranes (water purification), additives for a high-quality electronic paper (e-paper), membrane for combustible cells (hydrogen) and membranes used to retrieve mineral and oils (Brown 1998). The high stiffness and strength along with the small dimensions of nanocellulose may enhanced properties to composite materials reinforced with cellulose fibers and these could afterward be used in wide range of applications. Cellulose nanocomposites have been used in audio diaphragms due to its property to bear two essential properties that are low dynamic loss and high sonic velocity. It is stated that the sonic velocity of films was virtually equivalent to those of titanium and aluminum (Iguchi, Yamanaka, and Budhiono 2000). Jonas and Farah (1998) reported that SONY had already been using it in headphones diaphragm. In Kyoto University, researchers prepared strong but enhanced transparent composite material by isolating nanofibrillated cellulose structure by

improving the dispersion of nanofibers in the matrix and on this basis, an organic display system is being developed recently (Shimazaki et al. 2007; Iwamoto et al. 2005).

CONCLUSION

Cellulose nanocomposites are unique nanomaterials derived from most abundant natural polymer, cellulose, which is made from superfine fibrils in nanoscale diameters. It has been observed that from last 15 years there has been steady progress in the field of cellulosic nanocomposites. Cellulose nanofibers have exciting potential to be used as reinforcement in nanocomposites as these are non-toxic, sustainable, renewable and biocompatible nanomaterials. The present chapter gives an overview of the use of cellulose fibers as reinforcement material in polymer matrices. The aim of chapter is to provide knowledge of cellulose nanocomposites for further research and studies. The chapter also summarizes the effect of processing methods and other parameters on thermal and mechanical properties of nanocomposites. The potential mechanical properties of cellulose nanocomposites vie well with other engineering materials and devices. Processing methods, properties, and applications in various fields such as pharmaceutical, medical and others are well discussed in the chapter.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 4

POLYLACTIDE (PLA) BASED NANOCOMPOSITES FOR APPLICATIONS IN ANTIBACTERIAL/MICROBIAL AND BIOMEDICAL ENGINEERING

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ABSTRACT

For the last few decades, there has been growing interest in bio-based polymers and nanocomposites open an opportunity for the use of new, high-performance material. The use of biodegradable polymers and nanocomposites are of great importance currently in many applications, Polylactide (PLA) represents the best polymeric substitutes in the framework of environmentally friendly and sustainable processes and products for several petropolymers due to its renewability, bio-compatibility, ease of surface chemistry modification, biodegradability, good thermomechanical and optical properties. Having the above properties polylactide (PLA) nanocomposite shows immense potential in food packaging, antimicrobial as well as in pharmacology and biomedical engineering areas.

Keywords: polylactide (PLA), nanocomposites, food packaging, biomedicine

INTRODUCTION

Polylactide (PLA) is a thermoplastic that can be derived from renewable sources and degrades to nontoxic compounds in landfills (Martin and Averous 2001; Tsuji and Ikada 1998). Polylactide (PLA) has been the leader in all biopolymers due to its outstanding mechanical properties, biodegradability, renewability, and relatively low cost and also justify environmental concerns of greenhouse gas emissions, environmental pollution and the depletion of fossil resource (Auras, Harte, and Selke 2004; Kümmerer 2007; Jenck, Agterberg, and Droescher 2004). It is a polymer of monomer lactic acid, which may be easily produced by carbohydrate feedstock's fermentation. Hence, PLA provides more disposal options and its production is less environmentally burdensome in comparison to other traditional petroleum-based plastics (Doi and Steinbüchel 2002; Lunt 1998). Low molecular weight PLA was firstly prepared by *Pelouze* in 1845 by the action of condensation of l-lactic acid followed by removing of water continuously (Carothers, Dorough, and Natta 1932). To substitute the conventional petroleum-based plastics, Polylactic acid (PLA) has been explored recently by researchers or polymer scientists as potential biopolymer (Sinha Ray, Maiti, et al. 2002; Sinha Ray et al. 2003; Ray and Okamoto 2003). PLA, in comparison to some other polymers, is stiff and brittle with low impact strength and low deformation at break (Jacobsen et al. 1999). In recent, PLA has grabbed attention as of biodegradable polymers, though, as packaging material, the use of PLA is still a barrier due to its high cost and low performance as compared to other commodity polymers. The most important limitation is its low gas barrier properties for the application of PLA in food packaging. For applications in various fields, PLA suffers some other limitations like heat distortion temperature, low thermal resistance, and rate of crystallization, while some other precise properties are essential by different end-use sectors such as antistatic to

conductive electrical characteristics, flame retardancy, antibacterial, anti-UV or barrier properties, etc.

Polymer nanocomposites have grabbed a lot of attention from the last few years. These are low cost and high-performance materials for applications in various fields from tissue engineering to automotive to food packaging have become enchanting to researchers around the world (Vaia and Giannelis 2001; Alexandre and Dubois 2000; Giannelis 1996). Nanocomposites technology has the great potential to enhance polymer properties and inflate the applications of PLA, therefore, by adding nanofillers in PLA represents an interesting way to outspread and to enhance the properties of PLA (Raquez et al. 2013; Thellen et al. 2005; Rhim, Hong, and Ha 2009; Sinclair 1996). A number of researchers have been worked on PLA-based nanocomposites with layered silicates so as to mark highly exfoliated structures. *Bordes* et al. (Bordes, Pollet, and Avérous 2009) reported routes for the synthesis of PLA/layered silicate nanocomposites which was based on solvent intercalation, melt-intercalation and in situ intercalation.

METHODS

Preparation and Properties of Polylactide (PLA) Nanocomposites

Sinha Ray and Maiti (2002) synthesized polylactide (PLA)/layered silicate nanocomposites by simple melt extrusion of PLA with organically modified montmorillonite. These intercalated nanocomposites revealed outstanding enhancement of materials properties in both melt and solid states in comparison to PLA matrices without clay. Cabedo (2006) reported nanocomposites of amorphous PLA and chemically modified kaolinite and noticed good interaction within polymer and clay led to an increase in oxygen barrier properties of about 50%. They also studied the addition of plasticizers to conquer the inherent brittleness of PLA. Schmidt, Shah, and Giannelis (2002) developed many poly(l-lactic acid) (PLA) nanocomposites

which were based on different layered inorganics. These nanocomposites exhibited enhanced mechanical properties with higher moduli in compare to pure PLA. The increment was above T_g, by which work temperature was enhanced and this enhancement did not hinder biodegradation. In nanocomposites, the rate of biodegradation was enhanced six to ten times and it was cleared by marine respirometry and crystallinity measurements in solution pretending a physiological environment. PLA/PBAT bio-nano composites were prepared by *Moustafa* and coworkers for their application in antimicrobial natural rosin for green packaging. They used green modification method of organoclay, non-toxic reinforcing material makes the material to maintain its green character. The attained results revealed the outstanding possibility of using expanded OC modified PLA/PBAT polymer blends in which green material antimicrobial natural rosin was added, for their applications in food packaging and biomembranes (Moustafa et al. 2017).

Table 1. Comparison of material properties between neat PLA and PLACN4 reprinted with permission from Nano Letters, 2002, 2 (10), pp 1093–1096. Copyright (2002) American Chemical Society

Material properties	Neat PLA	PLACN4
Storage modulus/GPa at 25°C	1.63	2.32
Flexural modulus/GPa at 25°C	4.8	5.5
Flexural strength/MPa at 25°C	86	134
Distortion at break/%	1.9	3.1
HDT/°C	76.2	94
O_2 gas permeability coefficient ($mL.mm.m^{-2}.day^{-1}.MPa^{-1}$)	200	177

Ray and coworkers developed polylactide (PLA)-layered silicate nanocomposite and studied material properties and biodegradability. They found that material properties were increased after nanocomposite formation in comparison to neat PLA, Table 1 (Sinha Ray, Yamada, et al. 2002). D. R. Paul and Robeson (2008) reported that the addition of montmorillonite increased the biodegradation of PLA under compost. In these conditions, PLA firstly fragmented and followed by a biodegradation process, when PLA underwent fragmented to about 10,000 g/mol.

Sabet and Katbab (2009) prepared PLA based nanocomposites with improved biodegradability and abridged oxygen permeability via melt hybridization of poly (lactic acid) (PLA) and organomodified clay which showed a correlation between the structure of nanocomposites and rate of biodegradation.

Preparation of Poly(L-lactide)/layered aluminosilicate nanocomposites in the presence of two organo-modified montmorillonites by ring-opening polymerization was reported by Paul and coworkers (M. A. Paul et al. 2003). They suggested that the obtained exfoliated nanocomposites having enhanced thermal stability were attained by directly grafting of polymer chains on the surface of clay via hydroxyl-functionalized ammonium cations or these nanocomposites with high molecular weight were obtained via solid-state polymerization (Katiyar and Nanavati 2011). As sepiolite/PLA nanocomposites are less studied, the PLA nanocomposites melt-elaboration and characterization in the presence of Cloisite 30B and sepiolite was studied by Fukushima and coworkers (Fukushima, Tabuani, and Camino 2009).

Polylactide (PLA) nanocomposites were prepared by solution and melt mixing in the presence of carbon nanotubes (CNTs) for the studies of crystallization kinetics and morphology. Figure 1, represents the DSC cooling traces for nanocomposites cooled from the melt at various rates. Neat PLA showed very slow crystallization kinetics while with increasing CNT content faster crystallization kinetics are attained (Barrau et al. 2011).

Poly(lactic acid) (PLA) with organically modified montmorillonite (oMMT) in the presence of triallyl cyanurate (TAC), have been cross-linked by high-energy electrons in order to prepare its nanocomposites. TEM of PLA nanocomposites, Figure 2, revealed the internal structure of composites, like the dispersion position of the nanofiller in the matrix (Wang et al. 2012). Zheng (2009) prepared biocompatible (PDLLA)/magnetite (Fe_3O_4) nanocomposites by chemical co-precipitation and analysis of these were done by glass transition temperature (Tg), micro-surface morphology, mechanical properties, and functional groups change. Their shape memory effect was also reported in their studies.

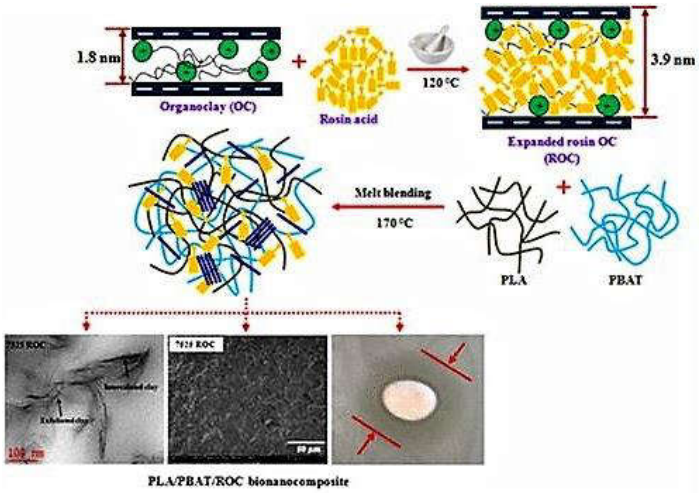


Figure 1. Synthetic scheme of PLA/PBAT/ROC bionanocomposite. Reprinted with permission from *ACS Appl. Mater. Interfaces, 2017, 9 (23), pp 20132–20141*. Copyright (2017) American Chemical Society.

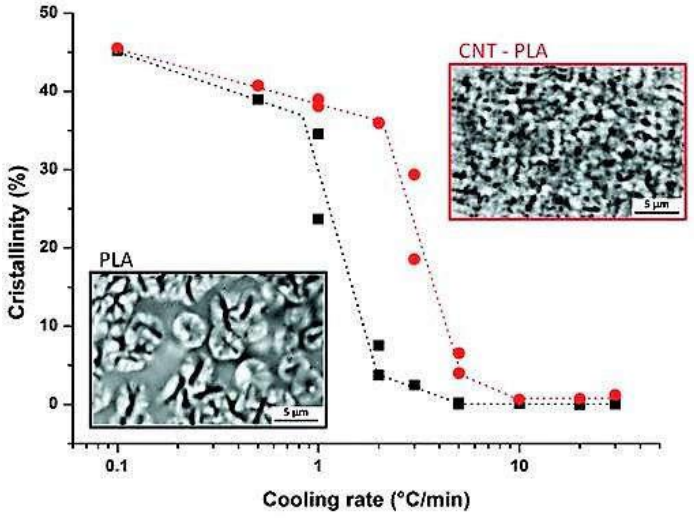


Figure 2. PLA crystal content versus cooling rate for NT0 (black squares), NT01 (green triangles), and NT1 (red circles). Reprinted with permission from *Macromolecules*, 2011, 44 (16), pp 6496–6502. Copyright (2011) American Chemical Society.

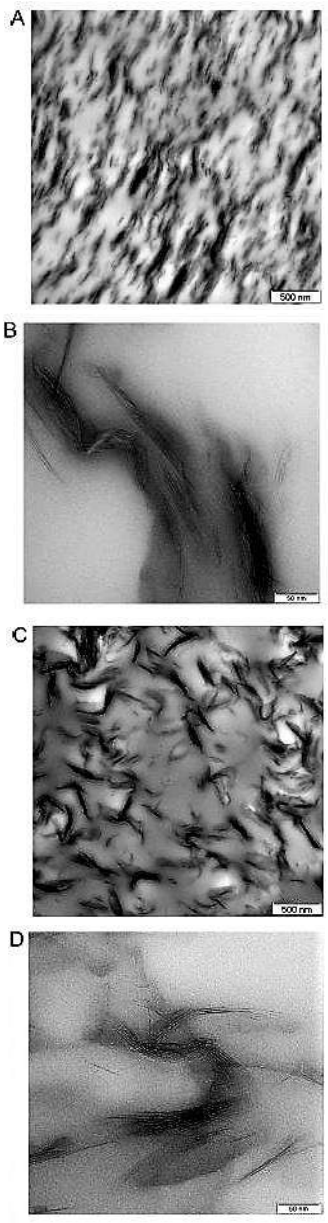
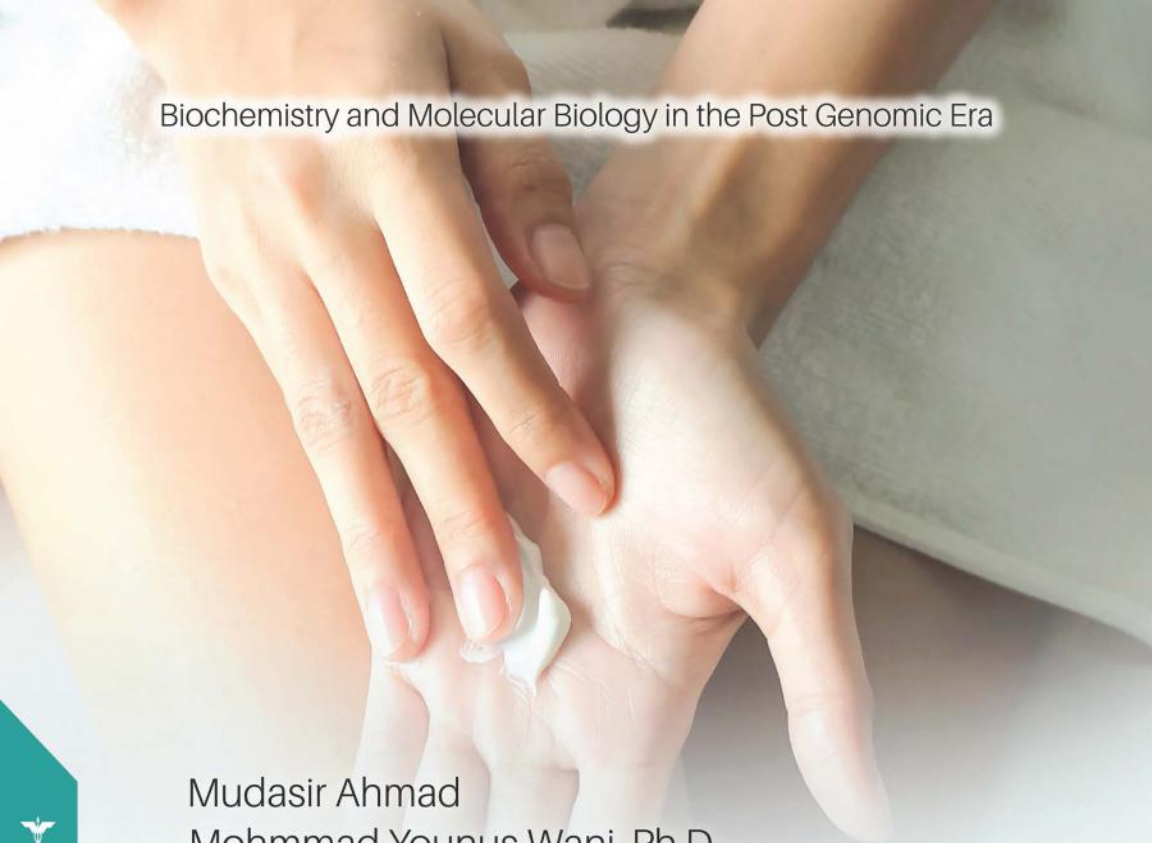


Figure 3. TEM patterns of PLA nanocomposites showing the nature of the dispersion of nanoclay in the matrix: (A, B) PLA-MMT-TAC 0kGy and (C, D) PLA-MMT-TAC 70kGy. Reprinted with permission from *Langmuir, 2012, 28 (34), pp 12601–12608*. Copyright (2012) American Chemical Society.



Biochemistry and Molecular Biology in the Post Genomic Era

Mudasir Ahmad
Mohmmad Younus Wani, Ph.D.
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Editors

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IN THE POST GENOMIC ERA

BIOCOMPOSITES IN BIO-MEDICINE

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Library of Congress Cataloging-in-Publication Data

ISBN: *978-1-53616-248-6 (ebook)*
Library of Congress Control Number:2019950487

Published by Nova Science Publishers, Inc. † New York

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PREFACE

Biocomposites are a classic types of materials obtained from a matrix (renewable and non-renewable resources) and reinforcement of natural fibers. It often resembles the compositions of a living material implicated with a definite biological process. Industrialists and researcher's interest in biocomposites is rapidly growing due to the great benefits they offer such as being renewable, cheap, recyclable and biodegradable. The high potential for exploiting natural biopolymers with their broad range of structural, functional and physicochemical properties in various applications has provided the stimulus for the search for new or modified biocomposites. At present, research and development efforts in this field are relatively small, but the growing use of biocomposites based materials in wound healing management, drug delivery, and orthopedics repair products has stimulated scientists, engineers, and government agencies to put more efforts in fostering greater collaboration and bringing more advanced biopolymer-based biocomposites to replace the synthetically derived materials in biomedical applications.

The book covers the advanced traces of Biopolymers such as lignin, cellulose-based nanocomposites for biomedical and pharmaceutical applications, gelatin, polysaccharides based nanocomposites for applications in antibacterial/microbial/biomedical engineering, drug delivery system and tissue engineering. Further, presents the opportunities and applications in the field of biocomposites highlighting recent advances

in areas commencing chemical synthesis and biosynthesis for end-user applications. This book will serve as a comprehensive literature guide for beginner researchers to grab the attention of biomedical researchers in both academia and industries to help streamline the efforts and understand the need to develop new biocomposites that could solve some of the most serious biomedical problems. The book is aimed to be a reference material for the academic and research community involved in biomedical research.

Finally, it is expected that this book will find a prominent place in the traditional universities and research institutions libraries where chemistry, biology technology, medicines as well as environmental studies, and other practical and theoretical mechanized topics are taught, studied and implemented.

In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 1

ENZYMATIC MODIFICATION OF BIOPOLYMERIC SURFACES FOR CO_2 SEQUESTRATION

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ABSTRACT

Due to the increased demand for energy, which underlies the projected increase in CO_2 emission, parallel to clearing of the forests which reduces the photosynthesis to CO_2 from atmosphere; resulting in the net increase of CO_2 concentrations higher than earlier. Carbon sequestration–capturing and storing carbon emitted from the global energy system – could be a major tool for reducing atmospheric CO_2 emissions. Over last decades, Biopolymers are considered as most encouraging and assuring materials for modification of their surfaces due to the presence of amino, hydroxyl, carboxyl, sulphydryl, etc. functional groups among the biopolymers which contributes possible interactions among pollutants and biopolymers. With growing concern of environmental sustainability and non-biodegradation

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of plastic waste, the biopolymers are emerging as the tool for the selective applications for reducing the pollution. Biopolymers are behind many important inventions of the past several decades, like 3D printing. So-called "engineering plastics," used in applications ranging from automotive to construction to furniture, have superior properties and can even help solve environmental problems; where the sequestration of CO_2 is in line with among the most prominent treatments. The arrays of biopolymers have been attempted with high precession and selectivity of CO_2 by many researchers. A series of modified biopolymer surfaces have been synthesized, to investigate the interaction between them with CO_2. The present chapter investigates and provides comprehensive information about the latest innovations in the biopolymers based renewable resources, along with the immobilization of different enzymes onto their surfaces to achieve the bio-mimicking for the above purpose.

Keywords: biopolymers, composite carriers, enzymes, modification of polymers, immobilization methods, applications

1. INTRODUCTION

From the earliest times, since life began Polymers have existed in natural forms such as DNA, RNA, proteins, and polysaccharides which play essential roles in plant and animal life. They are also known as macromolecules that are crucial to our very existence without which life seems very difficult. Large no. of single structural units called monomers are linked together in a regular manner by the chemical reaction known as polymerization give rise to the gaint molecule called "polymer". To form a molecule of high molecular weight, a chemical reaction occurs in which two or more substances coupled with or without an evolution of heat, water or any other solvents. With the growing advancements in the scientific and technological world, polymer chemistry plays an interesting role in providing solutions to the critical problems of food, cloth, shelter, education, air, health, energy resources, etc. As polymers serve comfort zone in the areas of medication, nutrition, communication, transportation, irrigation, recording history, buildings, etc.

In today's environment, renewability, recyclability, sustainability, triggered biodegradability all can make a huge difference. Eco-friendly composites, bio-composites derived from natural renewable resources having recycling capability and stability in their intended lifetime are called sustainable bio-based products. Cellulose, soy plastics, Microbial synthesized biopolymers i.e., polyhydroxyalkanoates (PHAs) polymers, starch is all the best-suited examples of biopolymers based on renewable resources.

Due to the presence of most preferable features in biomaterials such as molecular weight, material chemistry, shape and structure, solubility, lubricity, hydrophobicity, erosion mechanism, etc. they are perfectly considered for biomedical applications, tissue engineering scaffolds, and organ substitution. These materials improve the cell's performance in biological system since they exhibit bioactive properties and have better interactions with the cells. Numerous advantages are available for biodegradable polymeric materials over synthetic ones because of their versatile nature and have capability to not to accumulate or harm the environment. Some enlighten merits are the presence of important functional groups like amino, hydroxyl, Carboxyl on the surface of natural polymers which bear potential for tissue engineering and also less prone to produce toxic effects in the environment. Naturally, derived materials are biocompatible in nature and can be easily incorporated while synthetic ones are less compatible and get easily degraded into bio-products.

With the growing recent advances in biotechnology, various methods are employed for modification of biopolymer surfaces to achieve desired functional properties in such a way we are able to functionalize the surface of biopolymer by introducing some enviable functional groups so that it would be easy for biomacromolecules to interact with the surface of polymers. In this article, we are trying to familiarize the impact of recent advances in biotechnology as well as contemporary sciences of microbiology and interface between biotechnology and enzymology(S. Roller and 1. C. M. Dea. 1992). Before throwing the light on the impacts of biotechnology i.e., modification of biopolymers, the primary requirement is to figure out the concepts and the basic knowledge of biopolymers.

2. BIOPOLYMERS AS SUSTAINABLE RESOURCES

Biopolymers are acquired from plant and animal materials which can be grown indefinitely can be considered sustainable, and are always renewable. They are the guiding fundamentals for the polymers of next-generation which have nil impact, sustainability, eco-efficiency, and green chemistry. Over the last two decades, polymer chemistry has attracted the huge attention due to the extrusive or eye-catching apprehensions predominantly concern for the environment and secondly which is the major and most imperative reason i.e., recognition of synthetic materials or petroleum resources are finite that's why researchers nowadays fascinate towards the polymers which are renewable i.e., Biopolymers. The term "biopolymer" is also referred as organic polymer which is produced naturally by living organisms. Biodegradable or compostable polymeric materials can be derived from renewable resources under specific environmental conditions. One of the major blessings of biopolymer is that they are fully competent in biodegradation at accelerated rates, eco-friendly or used as green approaches by shattering down themselves into simple molecules such as carbon dioxide, methane or water by the action of microorganisms enzymatically in a limited period of time. Detailed classification of biopolymers on the basis of source or method of production given below:-

(i) Polymers such as polysaccharides or proteins which are directly extracted from biomass.
(ii) Polymers synthesized from renewable sources such as polylactic acid (PLA) by a classical chemical approach.
(iii) Polymers originated by genetical modification of bacteria such as polyhydroxyalkanoates (PHAs), bacterial cellulose, etc.

2.1. Natural Resources Derived from Fauna

2.1.1. Chitin and Chitosan

Chitin is the second most pervasive biopolymer present on the earth after cellulose (which comes under the category of fauna species and have

discussed later in this chapter) and it is mainly found in the tightly bound complexes with other substances in the cuticles of crabs and shrimps as well as in the internal structure of invertebrates. It occurs in the forms of three allomorphs viz. α-Chitin, β-Chitin & γ-Chitin (a combination of both) which can merely individuated by infrared and solid-state NMR spectroscopies together. From the studies of these crystallographic invariants of two isomorphs, conclusion revealed that in α-Chitin, two antiparallel molecules per unit cell are present but only one parallel orientation exists in β-chitin, Islem Younes and Marguerite Rinaudo. (2015). The chains of α-Chitin & β-Chitin are organized in sheets and held by intra-sheet hydrogen bonds. Chitin is composed of β(1-4)-linked 2-acetamido-2-deoxy-β-D-glucose (N-acetylglucosamine) and often considered as cellulose derivative although it does not present in cellulose producing organisms but is structurally identical to cellulose despite it has acetamide groups (-$NHCOCH_3$) at the C-2 positions (Pradip Kumar Dutta et al. 2004). Chitin and its derivatives can be tailored or functionalized via certain chemical modifications like nitration, xanthation, sulphonation, acylation, phosphorylation, hydroxyalkylation, Schiff base formation, alkylation, ionic reactions or the one which is the most promising pathway of tailoring the chitin and its derivatives are graft polymerization. It is becoming a very optimistic remarkable material in this 21 century because of its advanced perspective on the grounds of medical, pharmaceutical, food industry, bio-science related advancements, tissue and protein engineering and so on (Keisuke Kurita 2006). Many researchers or authors have reviewed the laxation of chemical structure of chitin and chitosan in order to improve their solubility in conventional organic solvents (M. Jalal Zohuriaan-Mehr. 2005). Other biopolymers can easily blend or crosslinked with cell walls of many organisms and plants made up of chitin and can be cast into sheets or films. Because of having strong positive charge on the chitin and its derivatives, this property of natural biopolymer (chitin) can be exploited in many ways as we have seen its abundant applications in biomedical era. Due to its film-forming properties, it has enough potential for packaging materials in food packaging, edible films or coatings (Elisabeta Elena TĂNASE et al. 2014). This fascinating polymer has a huge variety of applications as well as

chitosan which is a widely accepted biopolymer is extracted from chitin itself. On the other hand, Chitosan is a nitrogenous polysaccharide having amino group in its structural moiety called chitosan (poly-β-(1→4)-2-amino-2-deoxy-D-glucose) which is chiefly formed by deacetylation of chitin (George Z. Kyzas et al. 2015). Nowadays, Chitosan is becoming a very crucial topic especially in the fields of food, medical, protein or tissue engineering as well as in pharmaceutical applications. Chitosan is a marine polysaccharide that is widely used in biomedical research due to its encouraging properties like biocompatibility, biodegradability, low production cost, very little toxicity and highly abundant renewable material in the market. Its antibacterial activity has attracted wide attention to the researchers as this activity is affected by molecular weight and degree of acetylation where low molecular weight chitosan is harmless to the human body and has strong antimicrobial properties (Elisabeta Elena TĂNASE et al. 2014). Numerous natural polysaccharides of acidic in nature like cellulose, pectin, dextrin, alginic acid, agar, agarose are widely accepted or known to the researchers, among them, chitin and chitosan are the ones which are known for their basic nature due to the presence of amino groups which would be highly beneficial for chemical modifications. Now, moving towards to describe its preparation and its structural properties as chitosan is derived from deacetylation of α-chitin by giving aqueous alkali treatment i.e., 40 -50% at 120-150°C under heterogeneous conditions (Keisuke Kurita. 2006). This natural renewable polymer also is known as the deacetylated form of chitin. By repeated treatment of alkali, complete deacetylation of chitin can be achieved. The N-deacetylation of chitin can be implemented by homogeneously and heterogeneously approaches. Among these two, heterogeneous method can be considered best as it provides better results i.e., deacetylated up to 85-99% where homogeneous up to 45-55%. In heterogeneous method, chitin is treated with the hot concentrated solution of alkali NaOH during few hours which produced insoluble residue of chitosan. While in a homogeneous medium, chitin is dispersed in concentrated NaOH at 25°C for 3 hours or more than that, followed by dissolution in crushed ice around 0°C. This technique leads to the soluble chitosan with an average degree of acetylation of 48% - 55%. In nature, two

types of chitin are available α-chitin and β-chitin. From these two types β-chitin from squid pens are most responsive to deacetylation reaction because of comparatively weak intermolecular forces of attraction, in addition to this, it tends to produce chitosan in a light tan to brown color under similar conditions (Keisuke Kurita. 2006). By deacetylation of chitin (poly-β-(1→4)-N-acetyl-D-glucosamine) which is one of the most interesting natural biopolymers, is mainly found in marine media and specifically in the exoskeleton of crustaceans or cartilages of mollusks, cuticles of insects and cell wall of microorganisms (George Z. Kyzas et al. 2015). Due to the availability of primary amino and secondary hydroxyl group, it is easily derivatized by introducing several functional groups which are easily accessible for interaction with the enzyme. To scrutinize their full potential, special stress has been put on structural metamorphosis of chitin and chitosan (Keisuke Kurita. 2006). In further discussion, the tailoring pathways for the modification of chitosan as renewable resources are explained.

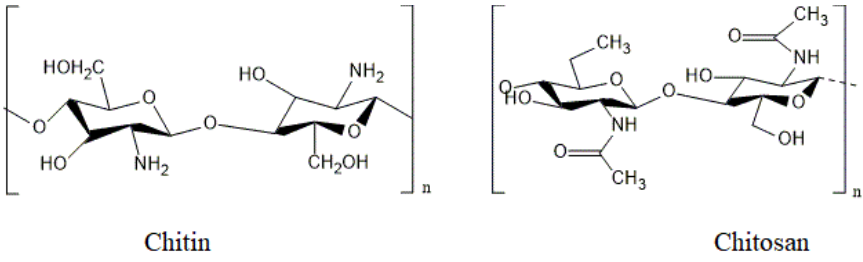

Figure 1. Chemical Structure of chitin and chitosan.

2.1.2. Collagen

Special attention should also be paid to *collagen*. As collagen proteins are chiefly found in extracellular matrices of vertebrate animals. Being a natural polymer, collagen is a major structural component of tendon, bone and connective tissues of animal hides and skins that provides mechanical support and structural organization of connective tissues. Due to its biodegradable and biocompatible nature, collagen has outstanding applications in the field of biomedical grounds like tissue engineering,

wound healing, drug delivery, and cosmetics. Moreover, for the improvement of the wound healing process, human tissues are replaced by animal-derived tissues because of the presence of collagen. It comprised of three polypeptide chains of triple helix and supramolecular structures are formed by all the members of the collagen family in extracellular matrix despite their variation in size, function and in tissue distribution (Figure 2) (K. Gelse et al. 2003). Collagen has been practiced for immobilization of tannase introducing glutaraldehyde as a cross-linking agent. Magnificent supporting matrix, Fe^{3+} collagen fibers have been proved beneficial for catalase immobilization as enzyme retains its significant activity even after 26 reuses (Sumitra Datta et al. 2012).

2.1.3. Alginates

Alginate is another natural polymer extracted from seaweeds that has gained tremendous interest in immobilization and microencapsulation technologies. It comprised of chains of alternating of α-L-guluronic acid and β-D-mannuronic acid residues (Figure 3). Carrier matrix of alginates is customarily built by crosslinking the carboxyl groups of α-L-guluronic acid with a solution of a cationic crosslinker such as barium chloride, calcium chloride and poly(L-lysine). Instability in the physiological environment or in the common buffer solutions with high concentration of phosphate and citrate ions that have ability to extract Ca^{2+} from the alginate matrices which are crosslinked with Ca^{2+} ions and liquefy the system is the major limitation of alginate matrices. In order to conquer the limitations of alginate as an immobilization material, numerous researchers or investigators have proposed to form microcapsule system or gel for protein immobilization by ionic complexation of chitosan (a positively charged material) and alginate (a negatively charged material). Several studies reveal that novel core-shell microcapsule technology for enzyme immobilization is proved to be very impressive technique in which enzyme is localized and protected in a core matrix, while the shell can regulate entry and exit of substrate and product. Chitosan crosslinked with sodium tripolyphosphate resulted in the phosphate ions diffusing into the Ca^{2+} alginate core and liquify it. Hence, we are in a condition to immobilize β-galactosidase in Ca^{2+} alginate (liquid

core) as well as in Ba^{2+} alginate (solid core) enveloped by the perm-selective chitosan shell (Ehab Taqieddin et al. 2003). One of the major disadvantages is the leaching of enzyme from the support matrix of alginate when used without combination of any divalent ions such as Ca^{2+} ions or without any crosslinker like glutaraldehyde. To boost the interactions between enzyme and support matrix, composite of chitosan and alginate proved to be more reliable with high porosity and good hydrophilicity for trapping of enzyme (Sumitra Datta et al. 2012). This may be attributed to the presence of both hydroxyl & amino groups present in structure for covalent binding of enzyme.

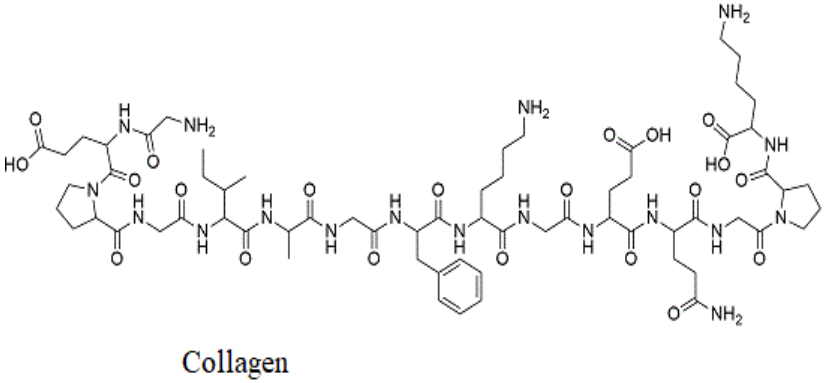

Figure 2. Chemical structure of collagen.

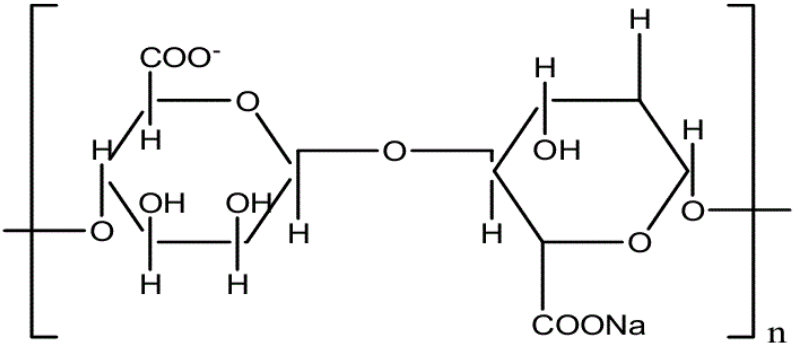

Figure 3. Chemical structure of alginate.

2.1.4. Gelatin

Gelatin is another renewable resource derived from natural resources like collagen taken from animal body parts which consist of many glycine residues, proline, and 4-hydroxy proline residues. The arrangement of the structure is Ala-Gly-Pro-Arg-Gly-Glu-4Hyp-Gly-Pro (Figure 4). It is most abundant polymer found in nature, possesses high hydrophilicity resulting in high swelling properties in aqueous media which helps in stabilizing in immobilizing the enzyme. It attracts attention for its use as a carrier matrix for an immobilized enzyme because it can be easily transformed into porous microcapsules. Earlier research papers revealed that gelatin would be used as a support matrix for the immobilization of glucoamylase (Exo-1,4-a-D-glucosidase) by cross-linking with glutaraldehyde followed by entrapment methodologies for the commercial process(J. F. Kennedy et al. 1984).

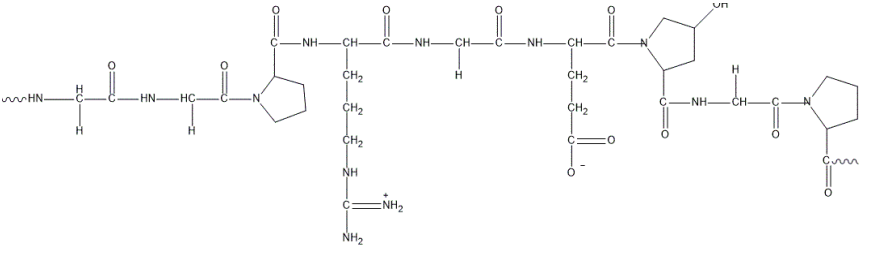

Figure 4. Chemical structure of gelatin.

2.2. Natural Resources Derived from Flora

2.2.1. Starch

Another striking and appreciating feature of biodegradable polymer is *Starch*. Due to its huge abundancy, cheaper and renewability, starch can minimize the use of synthetic polymers in plastic industries. Amylose and Amylopectin are the two main primary constituents of the starch. Although pure starch lacks mechanical strength despite this, it has been widely used in making biodegradable plastics (Elisabeta Elena TĂNASE et al. 2014). The hydrophilic nature of starch is the main limitation that inhibits its use in moisture environment. Entrapment of bitter-gourd peroxidase and surface

immobilization of enzymes was carried out by calcium alginate-starch hybrid supports. In the presence of denaturants like urea entrapped enzyme was more stable due to internal carbohydrate moieties. In order to obtain high yield of products, industrial techniques are widely accepted such as grafting of substances like acrylamide & dimethylaminoethyl methacrylate on to starch for the immobilization process (Sumitra Datta et al. 2012).

2.2.2. Cellulose

Another very important and interesting biopolymer falls under the light of renewable resources which is known as unlimited and sustainable natural polymeric raw material having wide applications in grounds of both industries and domestic purposes. This raw material is mainly present in the form of microfibrils with the helical organization on the various levels containing domains of amorphous and crystallinity appearances. It is chiefly found in the cell walls of superior plants (Elisabeta Elena TĂNASE et al. 2014). The structure of cellulose reveals that it consists of linear chains of homopolysaccharide comprised of β-D-glucopyranose units linked together by β-1-4-linkages with a degree of polymerization (DP) of approximately 15000 for native cellulose cotton and 10000 for cellulose chain (Figure 6 represents the chemical structure of Cellulose unit). Mostly natural resources are characterized as rigid and partially crystalline materials. Cellulose is considered as the main constituent of compounds present on the earth especially within wood and natural fibers such as kenaf, palm, hemp, flax, etc. It lacks solubility in water, this property of cellulose reveals that it comprised of strong inter and intramolecular hydrogen bonding within and among individual chains. Consequently, the exterior surface of the cellulose fibers exhibits hydrophobic nature which renders it an assuring material for enzyme immobilization. Moreover, presence of hydroxyl groups on the cellulose surface proves to be an ideal site for taking part in covalent bonding of enzyme immobilization and also capable of bringing almost all the chemical reactions. The stability of cellulose is due to the formation of well-ordered hydrogen bonds because of the presence of hydroxyl groups on its surface of moiety of each monomer unit which is also a special evident in the crystalline packing of cellulose (Safwan Sulaiman et al. 2014).

Carboxymethylcellulose (CMC), cellulose acetate (CA) and cellulose nitrate are the few known derivatives of cellulose which are used as a raw material in chemical and biological industries at a high commercial level due to their features like inexpensive, non-toxic, biodegradable, and biocompatible (Yue Liu and Jonathan Y Chen. 2014).

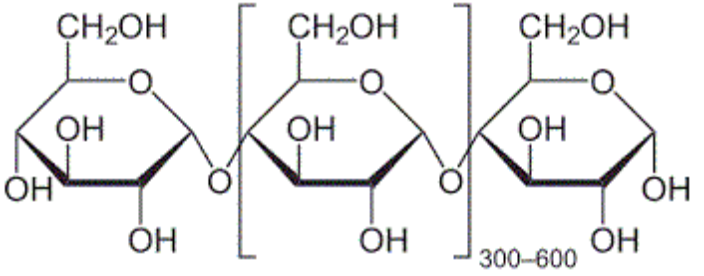

Figure 5. Chemical structure of starch.

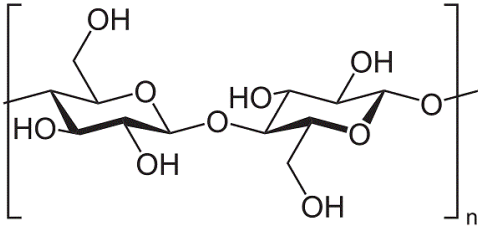

Figure 6. Chemical structure of cellulose unit.

2.2.3. Agar-Agar and Agarose

Agarose is one of the attractive biopolymer practiced in enzyme immobilization. Agar composed of two main components i.e., Agarose which is a linear neutral gelling heteropolysaccharide and Agaropectin is a heterogeneous mixture of smaller molecules. A major fraction of Agar i.e., agarose, a linear polymer consisting of two monosaccharide units i.e., (β-D-galactose) and (3,6-anhydrous-α-L-galactose) linked by glycosidic bonds β(1-4) & α(1-3) linkages. There are two repeating disaccharide units present in Agarose i.e., Agarobiose & neoagarobiose. Figure 7 represents the chemical structure of Agar-Agar & Agarose. 2 or 6 positions of 3,6-anhydrous-α-L-galactose residues can be substituted by $-OSO_3^-$,$-OCH_3$,

glucuronate or pyruvate residues. Because of the presence of favorable functional properties, both agar and agarose gels have been used as a carrier matrix for electrophoresis and protein immobilization. Highly ordered stable and rigid structures can result without addition of any ions into the agarose solution at the temperature below 35°C which described its superlative ability of gelation (Jakub Zdarta et al. 2018). The most tempting feature of agar and agarose is their ability to form stable and firm gels. Moreover, agarose is an extremely inert colloid and possesses an outstanding strong hydrophilic and lyophilic nature in aqueous solutions that provides an ideal site for enzyme immobilization (Paolo Zucca et al. 2016).

In addition to inertness and stiffness, beads based on agarose are highly porous, mechanically resistant, chemically and physically inert and sharply hydrophilic. Linear galactan polysaccharide agar belongs to the Rhodophyceae class and is extracted from seaweeds. Agar/Agarose gels are suitably advised for immobilization because having ability to form derivatives as each monomer agarobiose unit has four alcoholic functional groups in which three of them are secondary and one is primary functional group that is the main target of derivatizations. Though 100% derivation is neither accessible nor commendable, few chemical reagents such as amine, carboxyl, sulfonate, cyano and so on can be grafted along with the polymer chain. For example, Glyoxal agarose in which the primary hydroxyl group is etherified by glycidol to produce diols which further oxidized by sodium periodate to get glyoxal group has been proved an excellent covalent attachment with an enzyme.

2.3. Inorganic Composite Carriers

Inorganic matrixes are prudently contemplated for enzyme immobilization because of superlative features such as the highest degree of thermal and mechanical resistance, rigidity, porosity moreover these supports are completely resistant for bacterial and fungal growth. A comprehensive discussion about the properties of inorganic supports is

beyond the capacity of this chapter, therefore, we are presenting only some miscellaneous features of inorganic carriers for enzyme immobilization.

2.3.1. Silica-Based Supports

Silicon dioxide (SiO_2) exists as a 3-D polymer in which SiO_4 tetrahedra units are arranged by sharing their vertices and composed a rigid entity while the Si-O-Si angles are highly flexible which shows remarkable polymorphs of silica ranging from highly ordered crystalline forms to mesoporous amorphous solids. Quartz and cristobalite are the crystalline forms of SiO_2. Natural mineral viz. stishovite is another metastable form of SiO_2 obtained by applying high temperature and pressure conditions on silica solids where each silicon atom is hosted within an octahedral cluster of six oxygen atoms such as it appears as a rutile form of titania (TiO_2) is extremely compact and unreactive towards mineral acids. Silica-based materials have combination of both hydrophobic and hydrophilic sites on its surface having a high tendency to show hydrogen bonding which describes complex adsorptive properties of immobilizing enzymes onto the surface of silica. Glutaraldehyde or 3-aminopropyltriethoxysilane is the surface modifying agents that facilitate the enzyme attachment with the hydroxyl groups present on its surface (Paolo Zucca and Enrico Sanjust. 2014). Various enzymes like oxidoreductases, transferases, hydrolases or isomerases have been immobilized on sol-gel silica, fumed silica, colloidal silica nanoparticles with high catalytic retention and good thermal or mechanical properties. (Jakub Zdarta et al. 2018).

2.3.2. Ceramics

The phrase '*ceramics*' chiefly illustrates metal oxides or mixed metallic/non-metallic oxides based on inorganic and non-metallic materials. These materials are suitable for immobilizing proteins because of encouraging properties such as they exhibit extremely high resistance to temperature, pressure, and chemicals and also provide the highest degree of mechanical strength. The unique feature of these materials is when enzymes become catalytically inactive, they get easily regenerated and again used for the immobilization of new biocatalyst. Non-specific interactions are

possible due to the presence of hydroxyl groups on their surface which facilitates adsorption immobilization of enzymes. Alumina, Titania, Zirconia, Iron-oxide, Silica, and Calcium phosphate, Composite ceramic membranes (TiO_2/Al_2O_3) are several ceramic materials which have been used as a biomolecule carrier for immobilizing enzymes (Jakub Zdarta et al. 2018).

2.3.3. Alumina

Corundum being abundant in nature called Alumina i.e., Aluminium oxide (Al_2O_3) obtained from aluminum ores in hydrated form. Different crystalline forms of alumina could be prepared either by strong heating of Aluminium hydroxide ($Al(OH)_3$) or by applying the base treatment on aqueous aluminum salts. All these forms appear to have high porosity, high specific surface but can change into α-Alumina on heating above 1000°C which shows inert nature and devoid of any interest in the field of protein immobilization. Other crystalline forms (η & γ-Alumina) are obtained by moderate calculations called sandy alumina which could represent alternatives for silica-based supports. The surfaces of this alumina are coordinatively unsaturated and this feature is responsible for both catalytic and adsorptive properties and can seldom found as a support for enzyme immobilization (Paolo Zucca and Enrico Sanjust. 2014).

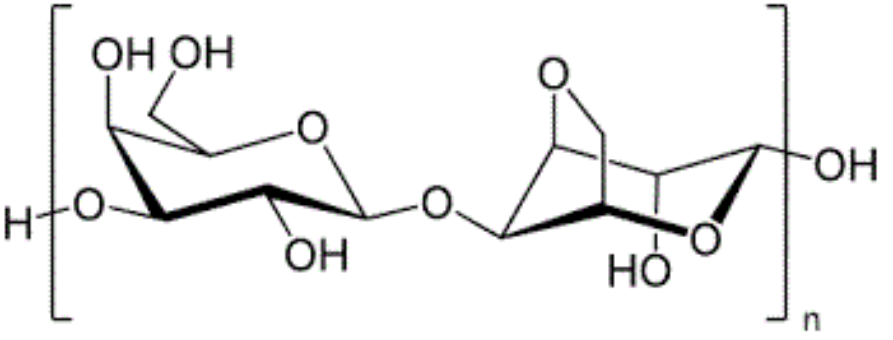

Figure 7. Chemical structure of agar-agar and agarose.

2.3.4. Carbon-Based Materials

During the last two decades, activated carbons, modified and unmodified charcoals are some prototypes of Carbon-based materials have been used as effective and valuable support materials in enzyme immobilization. The promising features of these materials are a presence of various functional groups, high adsorption capacity, well-developed porous structure having various sizes and volumes, high surface area (up to 1000 m^2/g), the minimal release of fine particulate matters make carbon-based materials suitable carriers for the adsorption immobilization of various enzymes. For instance, amyloglucosidase was immobilized on unmodified charcoal support.

2.4. Classic Materials

Both inorganic and Organic materials are termed as Classic materials used for enzyme immobilization have been described in the above sections. Silica-based supports, carbon-based materials, inorganic oxides, ceramics which have described under the category of Inorganic and Composite carriers are acknowledged for their good sorption properties, thermal and chemical stability as well as by excellent mechanical resistance. All these astonishing features ensure numerous contact sites for effective enzyme immobilization. Auxiliary materials such as biopolymers and synthetic polymers also assembled under classic materials endeavors various functional groups which facilitates even covalent binding of enzymes without cross-linking agents. With respect to synthetic polymers, biopolymers are consistently symbolized by high protein affinity as well as biocompatibility that restraint negative effects of the support on the structure of enzymes. Moreover, Classic materials are found lavishly in nature (mineral, biopolymers) and are effortlessly synthesize which makes them relatively cheap. These superlative facts of these materials play an imperative role as carriers for use for the immobilization of enzymes. Summarized form of Classic materials and types of enzymes that may be immobilized using these supports grouped with information about

immobilization type, cross-linking agents and binding group in tabular form is given below (Jakub Zdarta et al. 2018) (Table 1).

Table 1. Summary and selected examples of Classic materials of both inorganic and organic origin applied for enzymes immobilization

Support Material	Binding groups	Crosslinking Agents	Immobilization Type	Immobilized Enzyme
Inorganic Materials				
Activated Charcoal	-OH, C=O, COOH	-	Adsorption	Papain
Sol-gel Silica	-OH	-	Adsorption	Lipase from *Aspergillusniger*
Silica gel	-OH, C=O	glutaraldehyde	Covalent Binding	Commercial lipase
Commercial Activated Carbon	-OH, C=O	-	Adsorption	Cellulose from *Aspergillus niger*
Organic Materials				
Polyaniline	$-NH_2$, C=O	Glutaraldehyde	Covalent Binding	α-amylase
Polyvinyl alcohol	-OH, C=O	Glutaraldehyde	Covalent Binding	Laccase from *Trametes Versicolor*
Polystyrene	C=O, epoxy groups	Poly(glycidyl methacrylate)	Covalent Binding	lipase
Chitosan	-OH, $-NH_2$	Glutaraldehyde	Entrapment	Lipase from *Candida rugosa*
Agarose	-OH	-	Entrapment	α-amylase
Cellulose nanocrystals	-OH	-	Adsorption	Lipase from *Candida rugosa*

3. IMPACT MODIFICATION OF ENGINEERING BIOPOLYMERIC SURFACES AND BULKS

The unique proposition or the main agenda of this chapter is to bring out various modifications or functionalization of the surfaces of biopolymers and introduce some new functionality. Over the last few decades, researchers have focussed on the investigation and utilization of microbial cellulose in functional materials. Functional bacterial cellulose-based materials are enough capable to produce improved or new properties by mixing multiple constituents and exploiting synergistic effects such as electronic, optical, magnetic and catalytic properties. The performance of

biopolymers must be increased in order to extend its applications in immobilizing the proteins or other macromolecules. Alterations or fabrications are done by incorporation of fillers and reinforcements, blending, plasticization & impact modifications. The development of novel polymeric materials is the fastest method in tailoring the properties of polymers which consequently play a very crucial role in increasing the competitiveness and biocompatibility of biopolymers. Figure 8 describes all the possible techniques of surface modification.

3.1. Physically Modified Biopolymers

3.1.1. Biopolymer Composites

Biocomposites are the modified form of biopolymers which can be made by incorporation of fillers and reinforcements into a polymer matrix results in a heterogeneous system. Comprehensive work done by several researchers stated that under the effect of external load heterogeneities induce stress concentration, the magnitude of which depends on the geometry of the inclusions, on the elastic properties of the components and on interfacial adhesion. Overall performance of the composites, deformation and failed behavior is determined by heterogeneous stress distribution and local stress maximums initiate local micromechanical deformations. Another factor that must be taken into account during the analysis of micromechanical deformation processes is the interaction of the components. Characters and strength both factors are present in interactions. Secondary forces created by adhesive interactions are relatively weak. The coupling may result in covalent bonding between the components.

Most studies focus on the potential use of natural lignocellulose fibers i.e., wood flour, sisal, flax, etc. for modification of biopolymers. Biocomposite materials have wide applications in the building and automotive industry. Renewable and biodegradable based matrices are the leading carriers due to growing environmental concerns. PLA (polylactic acid) is one of the most important biopolymers which is frequently used for the production of fiber-reinforced composites.

Biocomposites are present in nanometre-scale called bio-nano composites possessing unique characteristics with respect to gas and water vapor permeability, thermal stability, fire resistance, mechanical and optical properties, etc. Alternatively, these characteristics can be modified using either natural nanofibers such as cellulose or inorganic nanofillers such as silica, layered silicates, etc. different combinations of properties are achieved. In order to achieve nanoscale dispersion, i.e., intercalated or exfoliated structure resulting in superior properties, nano clays must be modified with suitable organic compounds in order to promote the separation of the silicate layers (Paolo Zucca et al. 2016).

3.1.2. Blends

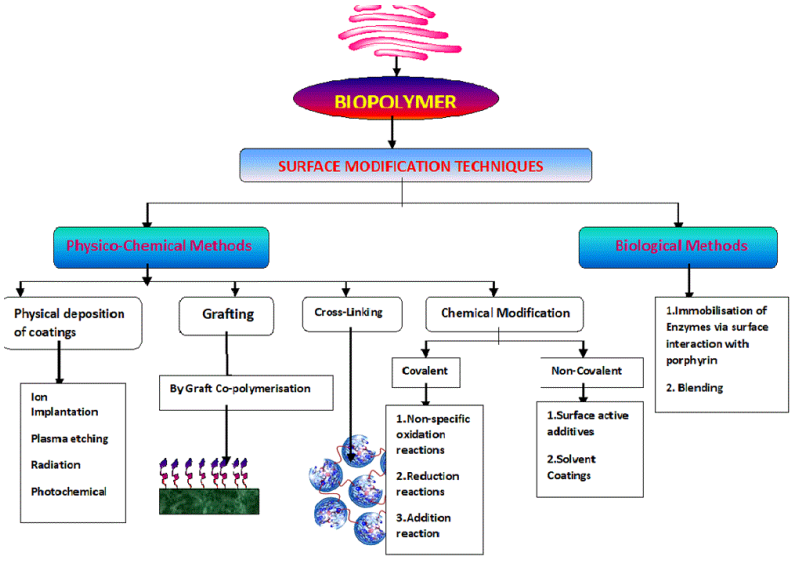

Figure 8. Surface modification techniques.

By Physical blending, we figure out that in fused state polymeric materials are simply fused or blend without causing any chemical reaction to occur. To create new materials with desired combination of properties, this is a satisfactory route. In this process, no extra investment is required and this process can be carried out by using conventional machinery which is a crucial aspect for industry. With the help of this technique, we can target

our application in a very short interval of time and at cheaper rates as compared to the development of new monomers and polymerization techniques. Polylactic acid (PLA), starch is the most often used material for physical blending process.

3.2. Chemically Modified Biopolymers

Another major approach for immobilization of macromolecules on the biopolymeric surfaces is “Chemical modification”. For this purpose, ample of chemical reactions and reagents have been explored. The procedure of surface tailoring begins with the surface activation, which creates desirable functionalities on the surface of polymer that enables the surface immobilization of ligands under mild conditions. Earlier, several methods have been proposed to create 3-D scaffolds of varying size, shape, and architecture, still are challenging situations. Alkali hydrolysis of aliphatic polyester surfaces is the most frequently used technique in chemical modification method. As alkali treatment is driven by small, highly mobile protons that can diffuse easily between the uncharged polymer chains and therefore has the capability to penetrate into porous 3-D scaffolds. New active functionalities are created after surface hydrolysis that causes the cleavage of ester bonds, which results in the formation of free hydrophilic carboxyl and hydroxyl functionalities that permits the covalent attachment of other biomolecules such as enzymes or proteins on the surface of the polymer. Mostly, ligands have a biological origin for improving cell interactions. After hydrolysis, biodegradable polymers like PLA (polylactic acid), PLGA (poly lactic-co-glycolic acid) undergo conjugation with primary amines are mostly accepted. Common diamines which are used in this procedure are ethylenediamine,1,6-hexane diamine, N-aminoethyl-1,3-propane diamine, etc. For instance, carboxylate groups can also be activated by the formation of a highly active species which are generated by carbodiimides after further reactions with amine nucleophiles that leads to the stable amide bonds. The most fascinating methodology is to introduce nitrogen and sulfur moieties with the help of N-hydroxysuccinimide (NHS)

or N-hydroxysulfosuccinimide (Sulfo-NHS) to form stable ester derivatives. Signaling proteins can then be immobilized on aminolysis matrices/ scaffolds with the help of these cross-linking agents (Jakub Zdarta et al. 2018).

3.3. Plasma Treated

The surface properties of the biomaterials can be altered without affecting their bulk properties by technique called Plasma. To enable the creation of glow discharge plasma, low-pressure gases such as argon, ammonia or oxygen are filled in the evacuated vessel. Energy sources such as electric discharge, heat, radio-frequency energy, alternating/direct current are able to excite the gas. Free radicals, ions, protons, electrons, gas atoms and molecules of different energies are generated by ionization of gases. Successive bombardment with these high energy species on biopolymer surfaces results in the transfer of energy from plasma to the substrate which consequently leads to chemical and physical changes on the surface of the substrate. A very interesting feature of plasma technique that these energetic species can interact with polymer surface ranges from several hundred angstroms to 10 microns without inducing any changes in their bulk composition. Cold or low-temperature plasma & hot or elevated temperature plasma are the two major types of plasma where hot plasma is generated by atmospheric pressure arcs while low-temperature glow discharge generates cold plasma. From these two types, cold or low-temperature plasma is often preferred over hot plasma because, in high-temperature plasma, thermal motion of surface molecules is high and is very difficult to maintain whereas plasma generated effects in low plasma are efficiently maintained. Earlier studies have been acknowledged the use of plasma techniques for surface modification of polymers. By using plasma techniques in functionalization and alteration of polymeric surfaces, various studies came across numerous attractive and fascinating qualities such as enhanced cell adhesion, surface wettability, improved biocompatibility, and molecular immobilization.

Moreover, this can also lead to improving surface hydrophilicity of the polymer.

3.4. Photochemical Modification

Surfaces of biopolymers can be modified photochemically through free radical polymerization which results in polymer cross-linking, photopolymerization of monomers or grafting of molecules. Free radicals are generated by highly energetic UV rays, X-rays, γ-rays or by photo-initiators to initiate the chemical reactions on the surface of the biopolymers. Thus, radicals which are generated then interacts with another monomer molecule that ultimately leads to the propagation of the reaction and polymer chain formation. Organic compounds such as alkyl hydroperoxides (R-OOH) or halogens are some common photo-initiators required in these modifications. It is very beneficial technique with respect to other modifications due to selective immobilization of the target species at specific regions of the biomaterial, forming graft layers. Established studies adopt protocols of photo-polymerization for creating functionalities for applications of tissue engineering. This chapter reveals introduction of various functional groups such as (-OH), (-COOH), and ($-CONH_2$) to activate the surface of biopolymer by applying photo-grafting treatment on hydroxyethyl methacrylate, methacrylic acid or acrylamide respectively. Presently, there are two approaches by which immobilization of proteins was performed. In the first one surface of biomaterials such as collagen and gelatin can be activated by methyl sulphonyl chloride followed by adsorption of proteins. And in second one, polymer film can be activated via EDAC treatment followed by immersion in gelatin and collagen solution. Consequently, wettability of the surface was improved. For tissue engineering applications, numerous photopolymerization studies have been conducted on polymeric films and have produced astonishing results (Jakub Zdarta et al. 2018).

4. APPLICATIONS OF BIOPOLYMERS: GLOBAL SCENARIO

4.1. In Biotechnology

In the above sections, we have discussed physical adsorption, chemical modification, treatment through photochemically and via plasma methodology for protein immobilization. This portion briefly debates on protein immobilization having focus on the development of protein delivery systems as an approach towards tissue engineering. Numerous carrier matrix based on renewable biomaterials has been explored over the last two decades such as protein encapsulated hydrogels. Several published articles disclosed that although physical adsorption or entrapment/encapsulation are the leading methods for immobilization of proteins studies also revealed that bioactivity of enzymes is lost due to their random orientations, over-crowding and rapid desorption of adsorbed proteins or due to the short half-lives of signaling proteins combined with reduced bioavailability. For these reasons, protein delivery systems based on adsorption or entrapment are restraint. So, the concept of covalent immobilization of proteins is achieving higher heights for tissue engineering applications. This technique implements oriented immobilization with minimum structure losses, conformation and protein spreading. Minimum spreading permits immobilized protein to become more realistic and quantized. Moreover, immobilization through covalent binding diminishes the amount of signaling/therapeutic protein essential for provoking an appropriate function as compared to adsorption techniques. Protein can be readily used for covalent binding with polymeric surfaces due to the presence of a variety of functional groups such as amino groups, carboxyl groups, hydroxyl and thiol moieties on the surface of proteins.

4.2. For Enzyme Immobilisation

There are two approaches by which proteins can be covalently immobilized on biopolymeric surfaces i.e., (i) By tailoring the structures of

proteins and polymers or (ii) By chemically crosslinking between protein and polymer surfaces. Random and oriented covalent attachments are the two broad categories of Covalent attachments.

Previous papers revealed that a known hormone called insulin was successfully immobilized onto the polymers with the help of water-soluble carbodiimides as a cross-linking agent that is capable to form a covalent bond between the carboxyl group of the polymer and the amine terminals on proteins.

Another approach is also implemented in industries known as Oriented covalent immobilization where protein activity is critical and has the ability to reuse immobilized protein multiple times. Several reagents and cross-linkers that have been used as degradable and non-degradable have published for specific modifications of protein and biomaterial attachment. Prognosis about polymer and protein attachment still remains a challenge because of extreme diversity, sensitivity, and complexity of signaling/ therapeutic proteins. Moreover, threat is consistently maintained for protein denaturation due to the use of chemicals and crosslinkers. Therefore, the urgent contribution is required for improving the performances that can overcome these limits (Jakub Zdarta et al. 2018, Paolo Zucca et al. 2016, Paolo Zucca et al. 2014).

4.3. For CO_2 Sequestration

In order to reduce the level of carbon dioxide released in the atmosphere, biomimetic sequestration of carbon dioxide is one of the proposed methods comes under the various studies. To alleviate the challenges of carbon dioxide, biodegradable, biocompatible and thermostable biopolymers such as (Polyhydroxyalkanoates (PHAs) are introduced into the system as they are capable of fixing atmospheric CO_2 into useful products like calcium carbonate ($CaCO_3$). Biopolymer such as chitosan contains large no. of amino functional groups which can be chemically modified to undergo intermolecular hydrogen bonding that facilitates the acidic CO_2 molecule to

get adsorbed on to the surface of the polymer. CO_2 uptake capacity increases by crosslinking and functionalization of biopolymers.

Moreover, carbonic anhydrase enzyme which is mainly present in the red corpuscles in the human blood is capable of inter-conversion of CO_2 into harmless products; such as bicarbonates and hydrogen ions. Similarly, enzymatic systems are designed for sequestration or biomineralization of atmospheric CO_2 into solid carbonates or in the production of commodity fuels and chemicals.

CONCLUSION AND FUTURE ENDEAVOURS

Surface or bulk modifications of biopolymers via immobilizing or covalently attached proteins, carbohydrates, lipids, and any other species is incredibly important for several reasons. It is well known that a series of interactions occur between the surfaces of biopolymers and the chemical ligands after they have been implemented into a particular environment. Hence biopolymers surfaces are playing an extremely important role in the response towards artificial medical devices to the biological environment. To transform any surface, to be hydrophilic or hydrophobic, there are lots of possibilities. In the presented chapter, comprehensive literature is compiled for the functionalization of polymer surface properties via protein/peptide immobilization. In this compilation, the enzyme (carbonic anhydrase) has been given special attention in various researches for carbon dioxide sequestration. The performance of immobilized carbonic anhydrase has been greatly improved when it was immobilized on polyester polymer via covalent method. Furthermore, this article provides an insight into the development of the new natural polymer-based materials for environmental applications particularly in carbon dioxide capture and its biomineralization and biotransformation. To characterize the operating life span of both native carbonic anhydrase and the enzyme mimics particularly after immobilization, however, more work needs to be conducted and new elaborative research needs to be focused on the methods of immobilization

that would immobilize enzyme especially carbonic anhydrase (CA) for CO_2 sequestration that will control Global warming to the larger extent.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 2

CELLULOSE BASED NANOCOMPOSITES FOR BIOMEDICAL AND PHARMACEUTICAL APPLICATIONS

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ABSTRACT

In recent years cellulose-based nanocomposites have gained attention owing to the enhanced mechanical, thermal, high strength and stiffness, renewability and biodegradability, along with their production and application in the expansion of composites. These are emerging renewable nanocomposites that hold potential in many different applications such as food, chemicals, personal care, packaging and products, automotive, construction, electronics and furniture along with. High-performance nanocomposites can be prepared by appropriate modification of cellulose fibers as reinforcement material, resulting in improved physical, chemical as well as biological properties. The chapter provides an overview of cellulose nanocomposites focusing on the processing, properties, and applications in pharmaceutical and biomedical fields.

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Keywords: cellulose, nanocomposites, pharmaceutical, biomedical

1. INTRODUCTION

Cellulose is the most plentiful form of living terrestrial biomass material in nature (Crawford 1981) which is a common plant biopolymer, complex polysaccharide or carbohydrate comprising of 3,000 or more glucose units with 33 percent of all vegetable matter and the annual production is estimated to be around 10^{11} tons. It is a natural polymer, which is a long chain macromolecule and made by the linkage of smaller molecules. In the cellulose chain, the links are made by consisting of sugar, β-D-glucose (Dorée 1947). These sugar units are connected when water is removed by merging the H and –OH group. Above two of these sugars linkage results, a disaccharide is known as cellobiose (Kalia et al. 2011). Cellulose is most profuse of all naturally existing organic compounds and it is the basic structural component of the cell wall. In 1980, *Anselm Payen* (Payen 1838) first recognized the existence of cellulose as the communal material of plant cell walls. Several natural fibers like cotton and higher plants have cellulose as their main component. It comprises of long chains of anhydrous-D-glucopyranose units (AGU) and is insoluble in water as well as most common solvents. Therefore, chemical modification of cellulose is performed to enhance processability and to yield cellulosic (cellulose derivatives) so that they can be tailored for specific industrial applications. Cellulose has been widely investigated due to its advantageous properties, like low-cost, hydrophilicity, non-toxicity, biocompatibility, biodegradeability, low density, combustible and nonabrasive (Fu et al. 2019).

Composites are a combination of two or more different components with knowingly different chemical and physical properties. They have improved mechanical performance along with new functionalities. Generally, a composite contains a stiff and strong component known as the reinforcement which is embedded in a softer constituent, the matrix. In this way, the composite has advantageous properties of reinforcement and the matrix. Composites can be classified into three categories in terms of matrix used

are (1) ceramic matrix composites (2) metal matrix composites (3) polymer matrix composites. There are many thermoplastic polymers like poly (ethylene) (Lu, Lin, and Chen 2007), poly (ethylene oxide) (Chen and Tsubokawa 2000) and poly (vinyl chloride) (Chazeau et al. 1999) while thermosetting polymers like phenolic resin (Zárate, Aranguren, and Reboredo 2008), unsaturated polyester (Vilay et al. 2008), rubber (Setua and De 1984) and epoxy resin (Zhou et al. 2006). With increased awareness on environmental protection and sustainability, researchers have been shown interest in yield biodegradable polymer composites based on starch (Kvien et al. 2007) poly (lactic acid) (Bondeson and Oksman 2007) and cellulose (Gindl and Keckes 2005). Composites achieve the properties of both reinforcement and matrix with enhanced properties of compressive and strengths. Booker and Boysen (2005) presented special efforts towards nanotechnology and gave a high expectation for researchers. A nanoparticle is usually considered when as a minimum one of the linear dimensions is lesser than 100 nm (Henriksson et al. 2007). The perspective of nanocomposites in several areas of research and application is auspicious and attracting. Nanocomposite materials have many advantages properties like their superior mechanical, thermal, and barrier properties at low reinforcement levels along with their transparency, low weight, and better recyclability when compared with conventional composites (Oksman et al. 2006; Sorrentino, Gorrasi, and Vittoria 2007). Loads of research works have been carried out all over the world for the preparation of various types of nanocomposites by using cellulose fibers as a reinforcing material. The main reason to utilize cellulose nanofibers in composite materials is that one can potentially exploit the high stiffness of the cellulose crystal for reinforcement. This can be done by breaking down the hierarchical structure of the plant into individualized nanofibers of high crystallinity, with a reduction of amorphous parts.

2. METHODS

2.1. Cellulose Nanocomposite Processing

Processing of nanocomposites of cellulose makes them suitable candidate for low-cost engineering material with plant fiber reinforcement in industry (Berglund and Peijs 2010) along with its cheaper, renewable and low abrasive nature, impressive mechanical properties, abundance, low weight, and biodegradability of cellulose nanocrystals (Azizi Samir, Alloin, and Dufresne 2005; Oksman et al. 2002; Hornsby, Hinrichsen, and Tarverdi 1997; Bledzki, Reihmane, and Gassan 1996). In determining the composite properties, processing condition plays an important role such as Glass fibers have high strength when freshly drawn whereas the condition was altered i.e., exposed to humid air then fibers absorb water surfaces of fibers become damaged because of rubbing action during processing, the strength decreases. The temperature of processing is also restricted for specific materials like for lignocellulosic materials, it is controlled to about 200°C due to their degradation temperature starts from 230°C (Hamad 2013). Cellulose nanocomposites can be processed using conventional processing methods. Before processing, drying of fibers is the key point as the water content in the fiber can outcome in weak adhesion in between fiber and polymer or it may cause voids in the nanocomposite when the water evaporates during processing.

Nishino, Matsuda, and Hirao (2004) reported the two typical routes for the preparation of cellulose nanocomposites, one-step and two-step methods (Figure 1). In this method, cellulose is firstly dissolved in a solvent which was followed by regeneration of the cellulose in the existence of another cellulose component which was undissolved. Vallejos, Peresin, and Rojas (2012) synthesized all-cellulose composites by electrospinning cellulose acetate (CA) solution having dispersed cellulose nanocrystals (CNC) to yield precursor CA/CNC composites. However, in the one-step method, cellulosic fibers are slightly dissolved in a solvent and then redeveloped in situ to obtain a matrix around the undissolved part. Cellulose composites are prepared using different composites manufacturing techniques like injection

molding, resin transfer molding (RTM), compression molding and vacuum bagging. Rånby (1951); Ranby (1952) firstly synthesized cellulose nanocrystals by hydrolysis of cellulosic biomass in mineral acid (hydrochloric or sulfuric). Processing starts with milling the pulp for small uniform particles followed by acid hydrolysis of the cellulose raw material for removing the bonded polysaccharides on cellulose fibril surface and a disordered or amorphous portion of cellulose that separates the fibrils (Revol et al. 1992). Acid hydrolysis is terminated by acid's rapid dilution, followed by the removal of acid via dialysis or centrifugation. Some mechanical forces like sonication are applied to terminate the aggregation of cellulose fibrils in order to yield cellulose nanocrystals having high crystallinity (Guo and Catchmark 2012). Cellulose nanocomposites show the different appearance from different sources, Figure 2 (Azizi Samir, Alloin, and Dufresne 2005).

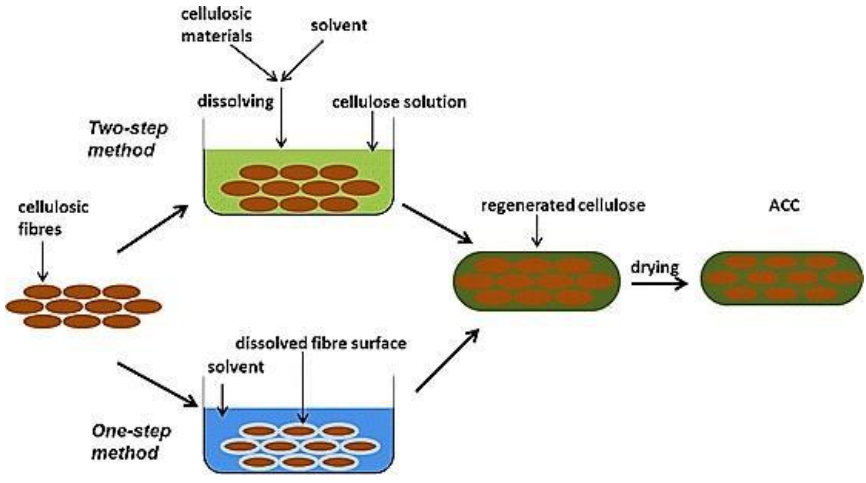

Figure 1. Schematic representation of the two-step (top) and one-step (bottom) preparation methods of ACCs Reprinted with permission from *(*Miao and Hamad 2013) Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262.

Favier (1995) first published the preparation of cellulose nanocrystals-reinforced polymer nanocomposites by using a latex which was achieved by the copolymerization of butyl acrylate (poly (S-co-BuA) and styrene and

tunicin whiskers (the cellulose mined from tunicate-a sea animal). Numerous studies have been furnished on isolation and characterization of cellulose nanofibers due to in the development of nanocomposites, cellulose nanofibers have a great potential to be used in a various different area as reinforcement from various sources. These nanofibers can be extracted by only chemical or both chemical and mechanical methods from the cell walls (Alemdar and Sain 2008) Compatibility of fibers and polymers is a very common problem in cellulose fiber-based composites due to high polarity and hydrophilic nature of fibers but non-polar and hydrophobic nature of polymers. To overcome this problem surfaces of fibre can be treated using various methods such as physical (stretching (Haig Zeronian, Kawabata, and

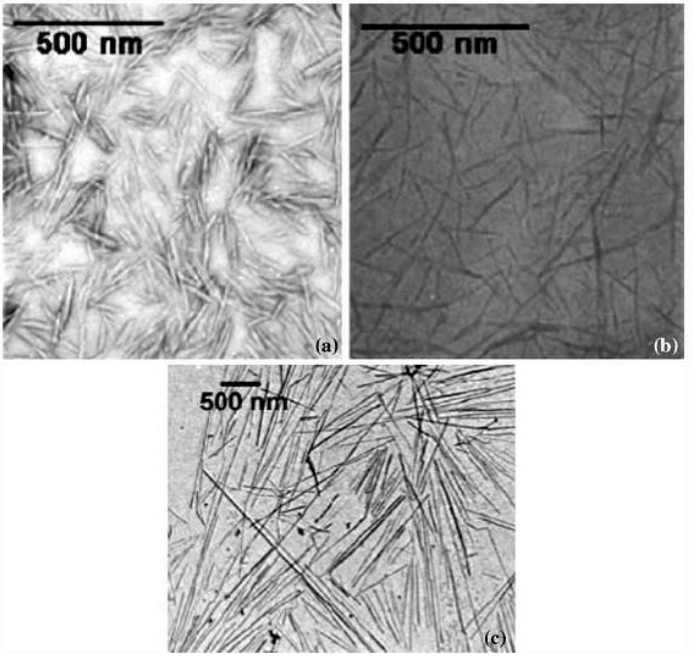

Figure 2. TEM images of CNC from different sources. a Cotton, b sugar-beet pulp, and c tunicin (the cellulose extracted from tunicate, a sea animal) Reprinted with permission from *(*Miao and Hamad 2013) Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262.

Alger 1990), calendering (Semsarzadeh 1986) and thermo-treatment Ray, Chakravarty, and Bandyopadhaya (1976), Physico-chemical (Takacs et al. 1999; Uehara and Sakata 1990; Carlsson and Stroem 1991; Kato et al. 1999; Kolar et al. 2000) and chemical methods (Belgacem and Gandini 2005). Various techniques can be used to characterize the modified fiber surface including scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), Fourier transform infrared spectroscopy (FT-IR), contact angle measurements, confocal laser scanning microscopy (CLSM), elemental analysis, inverse gas chromatography (IGC), nuclear magnetic resonance (NMR) and atomic force microscopy (AFM) (Belgacem 2005; Mohanty, Misra, and Drzal 2001). Processing of cellulose nanofibers-reinforced nanocomposites by extrusion methods are explored rarely. The synthesis of cellulose nanocomposites by melt extrusion was prosecuted by injecting the suspension of nanocrystals into the polymer melt throughout the extrusion process (Oksman et al. 2006).

2.2. Properties of Cellulose Nanocomposites

2.2.1. Thermal Stability

Azizi Samir (2004) and Samir (2004) performed thermogravimetric analysis (TGA) experiments inspect the thermal degradation and stability of tunicin whiskers/POE nanocomposites and suggested that there was no effect of cellulosic fibers on POE nanocomposites degradation temperature. Choi and Simonsen (2006) suggested the effect of cotton cellulose nanocrystals content on the thermal behavior of CMC plasticized with glycerin revealed a close connotation between the filler and the matrix.

2.2.2. Mechanical Performance

Hajji (1996) studied the effect of preparation methods on the mechanical properties of a CNC-based nanocomposite. Nishino, Matsuda, and Hirao (2004) synthesized the cellulose nanocomposite films with cellulose I and II in the different ratio by the slight dissolution of microcrystalline cellulose powder in N, N-dimethylacetamide /lithium chloride and subsequent film

casting and the structure and mechanical properties of these films were characterized by XRD and tensile strength. The resulting films are transparent to visible light, isotropic, highly crystalline having different amounts of undissolved cellulose I crystallites. By varying the cellulose I and II ratio, the mechanical recital of the nanocomposites can be tuned. studied The consequence of preparation or processing methods on the mechanical properties of a CNC-based nanocomposite was studied by Hajji (Hajji et al. 1996). He suggested that the composite film synthesized by water evaporation reveals the best mechanical property due to less impact on the orientation of CNC, offers better dispersion of CNC in matrices which safes CNC structure from damage. Hence, Table 1 shows the importance of processing methods and even dispersion of the reinforcement in the matrix on nanocomposite properties.

Table 1. Mechanical properties of CNC based nanocomposites processed by different methods (Miao and Hamad 2013) Reprinted with permission from Springer Nature, Cellulose, Cellulose reinforced polymer composites and nanocomposites: a critical review, Miao et al. 20 (2013) 2221-2262

CNC content (wt%)	E		HP		XP	
	Modulus (MPa)	Tensile strength (MPa)	Modulus (MPa)	Tensile strength (MPa)	Modulus (MPa)	Tensile strength (MPa)
0	0.2	0.15	0.2	0.12	0.2	0.12
1	0.6	0.49	0.5	0.31	0.4	0.23
6	32.3	5	5.2	1.63	1.5	1.06

The factors which affect the mechanical properties of cellulose nanocomposites are compatibility of polymer resin and CNC, the molecular structure of the matrix, the aspect ratio of CNC particles and composite preparation procedure.

3. APPLICATIONS

Application in the field of development of composites by cellulose nanofibers is a comparatively new research area. Eichhorn (2009) incorporated uses of cellulose-based nanocomposites in reinforce adhesives for making optically transparent paper designed for electronic display and to produce DNA-hybrid materials, to create hierarchical composites aimed to use in foams, aerogels and for improved coupling between fiber and matrix. Cellulose nanocomposites have proven to be an unusually multipurpose biomaterial that may be used in an extensive variety of applied scientific endeavors like electronics, paper products, acoustics, automotive industry and most important in pharmaceutical and biomedical devices.

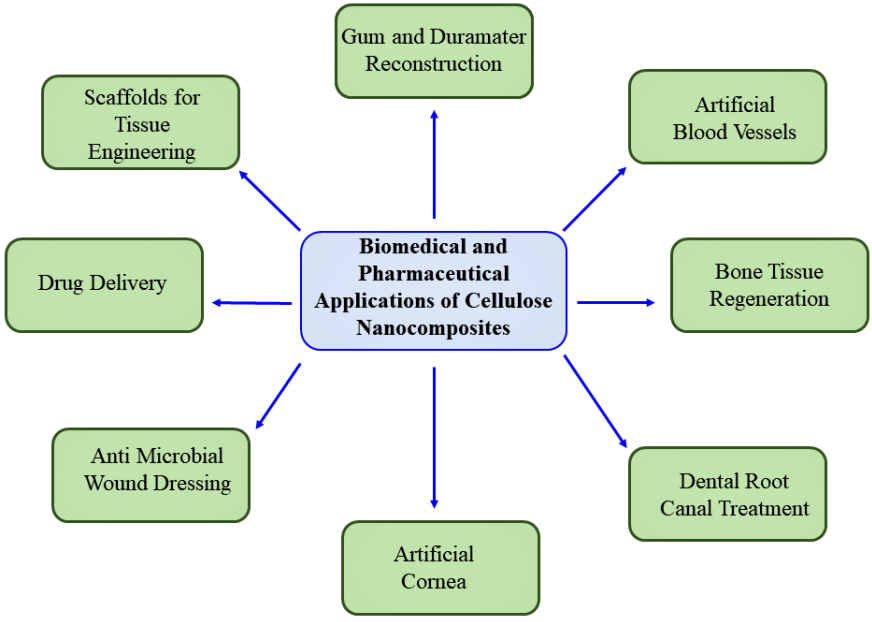

Figure 3. Biomedical and pharmaceutical applications of cellulose nanocomposites.

3.1. Pharmaceutical

Cellulose-based nanocomposites are highly useful in the pharmaceutical industry as cellulose has an outstanding property of compaction which blended smoothly with excipients in order to drug-loaded tablets form condensed matrices suitable for the oral management of drugs (Longer and Robinson 1990; Alderman 1984). Various potential advantages as a drug delivery excipient are offered by crystalline nanocellulose (Baumann et al. 2009; Watanabe et al. 2002). A large number of drugs can be found on the surface of cellulose nanocomposites due to high surface area along with the negative charge, makes them a potential candidate for high payloads and optimal control of dosing and it is also suitable because of established biocompatibility of cellulose. The hydroxyl groups present on the surface of crystalline nanocellulose offer a place for the surface amendment of the material with a wide range of chemical groups via many different methods. Modification of surface can be used to modulate the drug loading and release that would not normally tie to nanocellulose i.e., hydrophobic and nonionized. (Lönnberg et al. 2008; Shaikh et al. 2007).

3.2. Medical

Nowadays, eyes of biomaterial term has been used for nanocellulose because of its high applications in biomedical industry including drugs releasing system, skins replacements for wounds and burnings, nerves, blood vessel growth, scaffolds for tissue engineering, gum and dura mater reconstruction, stent covering and bone reconstruction (Mello et al. 2001; W. K. Czaja et al. 2007; Negrão et al. 2006; Klemm et al. 2001). Odontology is defied to find novel materials to substitute the bones in numerous procedures like facial deformities, maxillary, bone malformation and the loss of alveolar bone is the biggest challenge in this. Nanocellulose with appropriate porosity that provides the mat an infection barrier, painkiller effect, loss of fluids and allows medicines to be effortlessly applied and also works on purulent fluids by absorbing it during all inflammatory phases,

ousting it later on in a painless and controlled manner (W. Czaja et al. 2006). Cellulose nanocomposites have all types of properties like physical, mechanical and chemical along with huge superficial areas that give outstanding water absorption capacity and also elasticity shows characteristics of an ideal healing bandage. Barud (2009) have developed a biological membrane with cellulose nanocomposites to standardized extract of propolis, it has several biological properties with anti-inflammatory and antimicrobial activities which makes the membrane for good treatment for chronic wounds and burns. Raghavendra (2013) reported the antibacterial activity of the cellulose nanocomposites against Escherichia coli which was done by inhibition zone method, suggested that the synthesized CSNCFs can function effectually as anti-microbial agents and can be used for tissue scaffolding.

3.3. Others

Other applications of nanocellulose composites are mainly focused on paper and packaging products as well as furniture, automotive, electronics, electroacoustic devices, construction, cosmetics, and pharmacy. Additionally, they are applied in ultrafiltration membranes (water purification), additives for a high-quality electronic paper (e-paper), membrane for combustible cells (hydrogen) and membranes used to retrieve mineral and oils (Brown 1998). The high stiffness and strength along with the small dimensions of nanocellulose may enhanced properties to composite materials reinforced with cellulose fibers and these could afterward be used in wide range of applications. Cellulose nanocomposites have been used in audio diaphragms due to its property to bear two essential properties that are low dynamic loss and high sonic velocity. It is stated that the sonic velocity of films was virtually equivalent to those of titanium and aluminum (Iguchi, Yamanaka, and Budhiono 2000). Jonas and Farah (1998) reported that SONY had already been using it in headphones diaphragm. In Kyoto University, researchers prepared strong but enhanced transparent composite material by isolating nanofibrillated cellulose structure by

improving the dispersion of nanofibers in the matrix and on this basis, an organic display system is being developed recently (Shimazaki et al. 2007; Iwamoto et al. 2005).

CONCLUSION

Cellulose nanocomposites are unique nanomaterials derived from most abundant natural polymer, cellulose, which is made from superfine fibrils in nanoscale diameters. It has been observed that from last 15 years there has been steady progress in the field of cellulosic nanocomposites. Cellulose nanofibers have exciting potential to be used as reinforcement in nanocomposites as these are non-toxic, sustainable, renewable and biocompatible nanomaterials. The present chapter gives an overview of the use of cellulose fibers as reinforcement material in polymer matrices. The aim of chapter is to provide knowledge of cellulose nanocomposites for further research and studies. The chapter also summarizes the effect of processing methods and other parameters on thermal and mechanical properties of nanocomposites. The potential mechanical properties of cellulose nanocomposites vie well with other engineering materials and devices. Processing methods, properties, and applications in various fields such as pharmaceutical, medical and others are well discussed in the chapter.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 3

APPLICATION OF GELATIN IN BIOMEDICAL FIELD

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ABSTRACT

Gelatin is remarkably known for its various merits like biodegradability, biocompatibility, availability at low cost and ease of processing, because of these properties it has been widely used in pharmaceutical formulation, tissue engineering and in cell culture. In addition, gelatin can also be used for ocular applications, bio-adhesives, and bio-artificial grafts. These different applications have diverse physical, chemical and biological requirements and this has prompted research into the modification of gelatin and its derivatives. It differs from other hydrocolloids because most of them are polysaccharides, whereas gelatin is a digestible protein containing all the essential amino acids. In this chapter, we discuss the uses of gelatin in various biomedical fields.

Keywords: gelatin, biomedical, tissue engineering, artificial grafts

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1. INTRODUCTION

Gelatin is a natural, biodegradable, biocompatible and multifunctional biopolymer. It is extracted mainly from cattle bones, hide, pork skin and fishes. Depending upon the method of collagen hydrolysis they are of two types “type A and type B”. Type A gelatin is obtained by acid hydrolysis of gelatin. Acid processing barely affects the amide groups of glutamine and asparagine, resulting in a higher isoelectric point (IEP), i.e., 7-9 (Patel et al. 2008). Type B gelatin derived by alkaline hydrolyzes of asparagine and glutamine to aspartate and glutamate, respectively. Thus it possesses a greater proportion of carboxyl groups, rendering it negatively charged and lowering its IEP (i.e., 4.5 - 6.0) (Ninan et al. 2011). As a protein, gelatin exhibits an amphoteric behavior due to the presence of both acidic and basic functional groups, as a result of existence of amino acid functional groups and terminal amino and carboxyl groups. It differs from other hydrocolloids because most of them are polysaccharide, whereas gelatin is a digestible protein containing all the essential amino acids except tryptophan (Mariod et al. 2013). It contains approximately 20 amino acids which are linked together in a partially ordered fashion. Four groups of amino acids are predominant in the gelatin molecule. In every 1000 residues of gelatin’s amino acid residues, 330 are glycine, 132 are proline, 112 are alanine, 93 are hydroxyproline and the rest are other residues (Schrieber et al. 2007). The triple helical structure of gelatin is due to Glycine X-Proline, where X represents the amino acids like lysine, arginine, methionine, and valine. Glycine, being dominant component, is the smallest amino acid as its lateral group is hydrogen. Pro and Hypro—with rigid lateral pyrrolidine rings—display steric hindrances (Hoque et al. 2015). A typical structure of gelatin shows Ala-Gly-Pro-Arg-Gly-Glu-4Hyp-Gly-Pro- arrangement (Figure 1). Moreover, chemical composition and distribution of particular amino acids may affect rigidity of gelatin chain. Each amino acid chain may have a molecular weight between 10,000 and several hundred thousands of Daltons, depending upon the raw material and conditions of the conversion of collagen into gelatin. The surface property of gelatin is a polyampholyte.

However, the gelatin is negatively charged at higher pH and positively charged at lower pH.

Gelatin is remarkably known for its various merits which makes it a versatile natural biopolymer like it is cheap, widely available, denatured product and it is much less antigenic than collagen. The gelatin chains contain abundant amino sequences that modulate cell adhesion, thereby improving the final biological behavior over polymers that lack these cell-recognition sites (Wang et al. 2012). The diverse and accessible functional groups of gelatin allow for chemical modifications, such as coupling with cross-linkers and targeting-ligands. It also provides intermediate structural support when blending with other material constituents (Tang et al. 2012). At temperature > 35 - 40°C gelatin-water mixture exists as a sol (Tanaka et al. 2003). At further lower temperature the intramolecular hydrogen bonding induces a transition from sol to a structured three-dimensional gel, at concentration higher than approximately 1% (Gao et al. 2014). Lower concentration does not have sufficient molecules to support an infinite three-dimensional gel network (Parker and Povey 2012).

Being a versatile natural polymer, gelatin is widely used in food, photographic, medical, cosmetic and pharmaceutical products. In the food products, it is utilized as a film former, the gelling agent providing texture and shape to food (Cheng et al. 2014; Hanani et al. 2014). In the medical field and pharmaceutical fields, gelatin is currently used as in tissue engineering (Su and Wang 2015) as a matrix for implants, device coatings and as a stabilizer in vaccines against measles, mumps, rubella, Japanese encephalitis, rabies, diphtheria and tetanus toxin (Burke et al. 1999; Fooxand Meital2015). It is also used in intravenous infusions, hard and soft capsules, plasma expanders, wound dressings, tissue bio-adhesives, hemostats, sealants and in drug delivery systems (Karimand Bhat 2009; Panduranga 1996; Pollack 1990; Saddler and Horsey 1987). Due to its innate properties it has gained new interests in drug delivery systems (Santoro et al. 2014) such as hydrogels (Cui et al. 2014), films (Li et al. 20140, microcapsules (Prataand Grosso 2015), nanoparticles, etc. (Abrams et al. 2006; Rajan and Raj 2013; Azimi et al. 2014; Khan 2014).

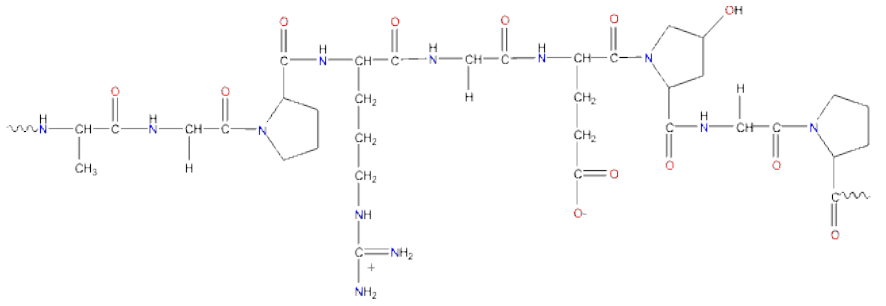

Figure 1. Structure of gelatin representing; Ala-Gly-Pro-Arg-Gly-Glu-4Hyp-Gly-Pro units.

2. APPLICATION OF GELATIN

Gelatin dissolves rapidly in the water at 37°C, non-immunogenic, and fully absorbable polymer. These properties have attracted the researchers to use gelatin in biomedical field. In this chapter we focused on the various applications of gelatin in the biomedical field.

2.1. Cardiovascular

Gelatin is an attractive biopolymer and has been used as a suitable scaffolding biomaterial for cardiovascular tissue engineering. Recent advances in the tissue engineering field have attracted significant attention in creating cardiac tissue concepts. Hydrogels, porous and fibrous frameworks are used in cardiac tissue engineering (Raneand Christman2011). For example, commercially available gelatin-based foams (e.g., Gelfoam®, water-insoluble gelatin sponge) have been planted with cells derived from fetal rat ventricular muscle to form functional cardiac grafts (Li et al. 1999). The results of this study show that the cells are able to grow and instinctively exhausted within the 3D microenvironment of the gelatin matrix, in both *in vitro* and *in vivo* (implantation) studies. Gelatin has been also mixed with other synthetic biomaterials such as polycaprolactone (PCL), polylactic acid (PLA), and poly (glycerol-sebacate) (PGS) for

creating frameworks with adjustable degradation rate and desired mechanical properties to control cellular organization and impersonator the grading of the native cardiac tissue (Li et al. 2000; Ozawa et al. 2004; Ifkovits et al. 2009; Kharaziha et al. 2013; Nerurkar et al. 2007; Tamayol et al. 2013). Since gelatin is an insulating biopolymer, conductive nanoparticles such as carbon nanotubes (CNTs) have been incorporated into photo cross-linkable GelMA hydrogel to enhance the electrical and mechanical properties of the tissue matrix and improve spontaneous beating of cardiomyocytes as compared to pure gelatin hydrogel.

By using photolithography a highly organized endothelial cord-like structures within GelMA hydrogel can be created (Nikkhah et al. 2012). It is also proven that the dimensions of the micropatterned features significantly affected proliferation, alignment, and cord formation of the encapsulated endothelial cells. In another study, co-culture of mesenchymal stem cells (MSCs) and endothelial progenitor cells (EPCs) inside Gel-MA (Methacrylated gelatin) hydrogel of different methacrylation degrees resulted in the extensive formation of biomimetic capillary networks (Chen et al. 2012). An electrospun scaffold made with the blend of gelatin, poly (lactic-co-glycolic acid) (PLGA) and elastin has also shown a great promise as suitable biomaterials for vascular tissue engineering (Han et al. 2010).

2.2. Drug Delivery

Gelatin has been extensively investigated as a drug delivery carrier due to its properties and history of safe use in a wide range of medical applications. Gelatin's properties can be modified and adjusted to maximize drug loading and efficiency of release for many classes of drugs. Incorporating bioactive molecules into appropriate carriers offers many advantages compared to conventional dosage forms. It can improve patient compliance and convenience by reducing possible toxic side effects of the drug. The release profile from gelatin carriers were shown to be optimized by changing the gelatin source, its molecular weight and the degree of its crosslinking. The amount of loaded drug and the type of interaction between

the drug and the carrier depending on the chemical structure of the drug and the carrier and the conditions of the drug-loading procedure. Gelatin microparticles and nanoparticles have been widely used for encapsulating many bioactive molecules. Microparticles have a relatively large surface area and can, therefore, serve as vehicles for cell strengthening and in distribution of large bioactive molecules to the desired site. Nanoparticles have a higher intracellular uptake and are better suited for intravenous or drug delivery in different areas in the body. Due to their unique design, liposomes have the ability to incorporate both hydrophilic and hydrophobic drugs, protect them from degradation, target them to the desired site and reduce the toxicity or side effects of those molecules. Embedding liposomes into a gelatin-based system resulted in an improvement in their stability and viscosity and in the half-life of the loaded drug and the liposome. As a drug carrier, gelatin fibers contain a high surface area to volume ratio, high porosity, and controllable pore size and can, therefore, accelerate the solubility of the drug in the aqueous solution and enhance the drug's efficiency. Gelatin hydrogels can trap molecules within the gaps between the polymer crosslinks. In the body, due to direct contact with water, they swell and the gaps between the polymer crosslinks increase, allowing the drugs to diffuse into the bloodstream. However, work is continually being carried out in order to improve gelatin release technology by modification of gelatin to allow the release of a wider variety of biomolecules from gelatin carriers for a broad range of applications (Foox and Zilberman 2015).

2.3. Bone Tissue Engineering

Bone is a hard, solid connective tissue that provides structure and protection to the body. To support external loading and absorb shocks, bone has a unique structure and chemical composition. Bone formation is a highly complex and dynamic process, (Hoque et al. 2015) which initially starts with recruitment of osteoprogenitor cells. The bone structure is composed of two layers of different density of bones. The outer layer is compact bone and the inner layer being spongy bone. Bone is always undergoing dynamic

remodeling carried out by two different cell types, the osteoblast for building bone and the osteoclast for digesting bone (Bose et al. 2012). Bone defects are common diseases and the number of patients suffering from this condition keeps increasing. Scaffolds utilizing natural and synthetic polymers combined with bone cells are seen as a promising approach to overcome the limitation of the conventional treatment for bone defects. A study shows that (Pereira et al. 2014) the osteogenic differentiation and proliferation of human adipose-derived stem cells (hASCs) on the mineralized PCL-GE (Polycaprolactone- Gelatin) scaffolds are considered to be of great importance in bone tissue engineering. In another study, (Wen et al. 2013) found that the umbilical cord-derived mesenchymal stem cells (hUC-MSCs) exhibited bone regeneration potential with strong expression of specific osteogenic markers *in vitro*. Moreover, the hUC-MSCs also displayed faster proliferation which provides a larger number of cells in short time period to meet the needs of bone tissue engineering. In other words gelatin-based scaffolds and microspheres were meant for sequential release of growth factors to initiate bone regeneration and improve vascularization at the injury site (Kempen et al. 2009; Patel et al. 2008). Alternatively, others have proposed the use of gelatin hydrogels for ex vivo gene transfer aiding bone regeneration (Kim et al. 2004). Beyond these applications, gelatin-based scaffolds have been used to decrease bacterial bone infections through the sustained release of antibiotics and antimicrobial agents post-fracture or implantation (Kuijpers et al. 1998; Di Silvio and Bonfield, 1999; Yaffe et al. 2003).

2.4. Cosmetics

Skin is the largest tissue covering the body and provides physical and chemical protection of the body from harmful sources such as heat and microbial organisms (Li 2007). The skin has two layers; the epidermis or outer layer, which is constantly regenerated, and the dermis on the inner layer that provides mechanical support for the dermis (Hench and Jones 2005). Gelatin, which is a denatured derivative of collagen, has been shown

to be a promising biomaterial for creating skin grafts (Metcalfe and Ferguson 2006). For instance, gelatin has been extensively used alone (Lee et al. 2005; Perng et al. 2008; Powell and Boyce 2008) or in combination with other natural and synthetic biomaterials. Few studies showed, a good affinity of the human dermal fibroblast (HDF) on the pure gelatin scaffolds even after treated with GTA (Glutaraldehyde) (Zhang et al. 2006). However, initial inhibition of cell proliferation was observed, possibly due to the existence of residual GTA. The blend of gelatin with other natural polymer has been demonstrated in many studies to promote the cell growth and proliferation of the HDF. It is found that the blends of gelatin with natural polymers exhibit better support for cell attachment, adhesion, and proliferation (Vatankhah et al. 2014). On the other side, the higher concentration of gelatin in the blend is unfavorable for growth of fibroblasts. It was found that high concentration of gelatin reduced the scaffold porosity which eventually unfavorable for cell growth (Enrione et al. 2013). To improve on the cell growth, have impregnated collagen-gelatin scaffold with basic fibroblast growth factor (bFGF) to accelerate skin regeneration (Ayvazyan et al. 2011). However, blends of gelatin-natural polymer display poor mechanical properties, especially under wet conditions. Whereas, the blend of gelatin and synthetic polymers were found to enhance the biomechanical properties of the scaffold. When human keratinocytes seeded on gelatin-PCL (polycaprolactone) scaffolds showed good biocompatibility and found to accelerate the wound closure progress (Morimoto et al. 2013). Collagen type I when incorporated on the surface of gelatin-PCL scaffold, the cell adherence, proliferation, and migration of the fibroblast was greater (Duan et al. 2013). Another polymer that is frequently blended with gelatin is a PHB (Poly (3-hydroxybutyric acid) a hydrophobic polymer-supported the adhesion and proliferation of HDFs and keratinocytes with a prolonged half-life *in vivo* (Gautam et al. 2014; Nagiah et al. 2013).

2.5. Wound Dressings

Wound care materials should provide a warm and moist environment for a rapid healing process; in addition, they should prevent the proliferation of

bacteria around the wound area (Winter 1962; Barnett and Irving 1991; Choi et al. 1999). Consequently, wound dressing hydrogels with biodegradability, good fluid absorbance, transparency, and optimal water vapor permeability are preferred over the preformed dressings (e.g., commercial dressings in the forms of membranes and sheets) for the wound healing process (Jaipan et al. 2017). Oxidized alginate- and gelatin-based hydrogel when used for wound dressing application via *in vivo* study in a rat model shows promising results with relatively low water vapor transmission rate compared with commercially available wound dressing products and good water absorptivity. The improved water retention facilitated the development of a moist environment that is conducive to wound healing; the alginate- and gelatin-based hydrogel was shown to enhance cell migration and re-epithelialization (Balakrishnan et al. 2005). Dextran dialdehyde cross-linked gelatin hydrogel is also used for wound dressing material (Draye et al. 1998). Gelatin-based hydrogel sheets with high antibacterial efficacy have also been fabricated from gelatin, honey, and chitosan (Wang et al. 2012). *In vitro* and *in vivo* studies demonstrated that these sheets did not exhibit toxic and irritant side effects while their bacterial resistance was superior to chitosan, honey, and gelatin when used separately (Wang et al. 2012).

2.6. Ocular Tissue Engineering

Gelatin-based materials have been most successful in ocular tissue engineering as cell sheet carriers, with effective delivery of both corneal endothelial sheets to the posterior cornea (Lai et al. 20130, and also RPE (Retinal pigment epithelium) sheets to the sub-retinal space (Silverman and Hughes1989). Gelatin offers an excellent, low-cost starting substrate. Crosslinked gelatin scaffolds make up a small but important part of the ocular tissue engineering. If crosslinked using appropriate methods it could provide lower antigenic and immunogenic risk than its parent material. Gelatin and its derivatives have been used as potential scaffolds for corneal epithelium (Wang et al. 2012), corneal endothelium (de la Mata et al. 2013) and retinal pigment epithelium (Lai 2013), as a bio-artificial corneal stroma

(Lai 2013) and as a potential bio-adhesive in treatment of retinal detachment (Yamamoto et al. 2013). The range of crosslinking options used to strengthen gelatin scaffolds in this field. There is good evidence to suggest that cross-linkers may be preferable in terms of both cell compatibility and biocompatibility (Lai and Li 2010). Whilst there may be uses for glutaraldehyde to crosslink matrices, such as fragile electrospun matrices which are short-lived in aqueous solutions (Sisson et al. 2009), the risk of cell toxicity of excipients could be a potential issue. Gelatin methacrylamide offers a gel-based system with tunable matrix stiffness, which can be controlled without significantly changing the chemical composition, this material would be an effective tool in determining the optimum material properties for application in ocular tissue engineering. The utility of dehydrated gelatin discs in ocular tissue engineering has been dominated by application as a cell sheet carrier in the delivery of either endothelial cell sheets to the posterior cornea (Hsu et al. 2013), or retinal pigment epithelial cells to the sub-retinal space (Lai et al. 2013; Rose et al. 2014). The application of photo cross-linkable gelatin in corneal stromal tissue engineering is also foreseen.

CONCLUSION

Among the natural polymeric materials, gelatin offers great practical potential as a composite material in the biomedical field. The resulting gelatin-based materials from various processing techniques exhibit excellent biocompatibility, biodegradability, and porous structure. Gelatin has been developed in different forms including films/foams, porous scaffolds, and hydrogels. So far, there has been significant progress in tuning the physical and chemical properties of gelatin through changing the crosslinking process and blending it with other natural and synthetic biomaterials for specific applications. Gelatin blends with other polymers always produce high efficacy matrices with improved biomechanical and bio-affinity of the scaffolds.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 4

POLYLACTIDE (PLA) BASED NANOCOMPOSITES FOR APPLICATIONS IN ANTIBACTERIAL/MICROBIAL AND BIOMEDICAL ENGINEERING

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ABSTRACT

For the last few decades, there has been growing interest in bio-based polymers and nanocomposites open an opportunity for the use of new, high-performance material. The use of biodegradable polymers and nanocomposites are of great importance currently in many applications, Polylactide (PLA) represents the best polymeric substitutes in the framework of environmentally friendly and sustainable processes and products for several petropolymers due to its renewability, bio-compatibility, ease of surface chemistry modification, biodegradability, good thermomechanical and optical properties. Having the above properties polylactide (PLA) nanocomposite shows immense potential in food packaging, antimicrobial as well as in pharmacology and biomedical engineering areas.

Keywords: polylactide (PLA), nanocomposites, food packaging, biomedicine

INTRODUCTION

Polylactide (PLA) is a thermoplastic that can be derived from renewable sources and degrades to nontoxic compounds in landfills (Martin and Averous 2001; Tsuji and Ikada 1998). Polylactide (PLA) has been the leader in all biopolymers due to its outstanding mechanical properties, biodegradability, renewability, and relatively low cost and also justify environmental concerns of greenhouse gas emissions, environmental pollution and the depletion of fossil resource (Auras, Harte, and Selke 2004; Kümmerer 2007; Jenck, Agterberg, and Droescher 2004). It is a polymer of monomer lactic acid, which may be easily produced by carbohydrate feedstock's fermentation. Hence, PLA provides more disposal options and its production is less environmentally burdensome in comparison to other traditional petroleum-based plastics (Doi and Steinbüchel 2002; Lunt 1998). Low molecular weight PLA was firstly prepared by *Pelouze* in 1845 by the action of condensation of l-lactic acid followed by removing of water continuously (Carothers, Dorough, and Natta 1932). To substitute the conventional petroleum-based plastics, Polylactic acid (PLA) has been explored recently by researchers or polymer scientists as potential biopolymer (Sinha Ray, Maiti, et al. 2002; Sinha Ray et al. 2003; Ray and Okamoto 2003). PLA, in comparison to some other polymers, is stiff and brittle with low impact strength and low deformation at break (Jacobsen et al. 1999). In recent, PLA has grabbed attention as of biodegradable polymers, though, as packaging material, the use of PLA is still a barrier due to its high cost and low performance as compared to other commodity polymers. The most important limitation is its low gas barrier properties for the application of PLA in food packaging. For applications in various fields, PLA suffers some other limitations like heat distortion temperature, low thermal resistance, and rate of crystallization, while some other precise properties are essential by different end-use sectors such as antistatic to

conductive electrical characteristics, flame retardancy, antibacterial, anti-UV or barrier properties, etc.

Polymer nanocomposites have grabbed a lot of attention from the last few years. These are low cost and high-performance materials for applications in various fields from tissue engineering to automotive to food packaging have become enchanting to researchers around the world (Vaia and Giannelis 2001; Alexandre and Dubois 2000; Giannelis 1996). Nanocomposites technology has the great potential to enhance polymer properties and inflate the applications of PLA, therefore, by adding nanofillers in PLA represents an interesting way to outspread and to enhance the properties of PLA (Raquez et al. 2013; Thellen et al. 2005; Rhim, Hong, and Ha 2009; Sinclair 1996). A number of researchers have been worked on PLA-based nanocomposites with layered silicates so as to mark highly exfoliated structures. *Bordes* et al. (Bordes, Pollet, and Avérous 2009) reported routes for the synthesis of PLA/layered silicate nanocomposites which was based on solvent intercalation, melt-intercalation and in situ intercalation.

METHODS

Preparation and Properties of Polylactide (PLA) Nanocomposites

Sinha Ray and Maiti (2002) synthesized polylactide (PLA)/layered silicate nanocomposites by simple melt extrusion of PLA with organically modified montmorillonite. These intercalated nanocomposites revealed outstanding enhancement of materials properties in both melt and solid states in comparison to PLA matrices without clay. Cabedo (2006) reported nanocomposites of amorphous PLA and chemically modified kaolinite and noticed good interaction within polymer and clay led to an increase in oxygen barrier properties of about 50%. They also studied the addition of plasticizers to conquer the inherent brittleness of PLA. Schmidt, Shah, and Giannelis (2002) developed many poly(l-lactic acid) (PLA) nanocomposites

which were based on different layered inorganics. These nanocomposites exhibited enhanced mechanical properties with higher moduli in compare to pure PLA. The increment was above T_g, by which work temperature was enhanced and this enhancement did not hinder biodegradation. In nanocomposites, the rate of biodegradation was enhanced six to ten times and it was cleared by marine respirometry and crystallinity measurements in solution pretending a physiological environment. PLA/PBAT bio-nano composites were prepared by *Moustafa* and coworkers for their application in antimicrobial natural rosin for green packaging. They used green modification method of organoclay, non-toxic reinforcing material makes the material to maintain its green character. The attained results revealed the outstanding possibility of using expanded OC modified PLA/PBAT polymer blends in which green material antimicrobial natural rosin was added, for their applications in food packaging and biomembranes (Moustafa et al. 2017).

Table 1. Comparison of material properties between neat PLA and PLACN4 reprinted with permission from Nano Letters, 2002, 2 (10), pp 1093–1096. Copyright (2002) American Chemical Society

Material properties	**Neat PLA**	**PLACN4**
Storage modulus/GPa at 25°C	1.63	2.32
Flexural modulus/GPa at 25°C	4.8	5.5
Flexural strength/MPa at 25°C	86	134
Distortion at break/%	1.9	3.1
HDT/°C	76.2	94
O_2 gas permeability coefficient ($mL.mm.m^{-2}.day^{-1}.MPa^{-1}$)	200	177

Ray and coworkers developed polylactide (PLA)-layered silicate nanocomposite and studied material properties and biodegradability. They found that material properties were increased after nanocomposite formation in comparison to neat PLA, Table 1 (Sinha Ray, Yamada, et al. 2002). D. R. Paul and Robeson (2008) reported that the addition of montmorillonite increased the biodegradation of PLA under compost. In these conditions, PLA firstly fragmented and followed by a biodegradation process, when PLA underwent fragmented to about 10,000 g/mol.

Sabet and Katbab (2009) prepared PLA based nanocomposites with improved biodegradability and abridged oxygen permeability via melt hybridization of poly (lactic acid) (PLA) and organomodified clay which showed a correlation between the structure of nanocomposites and rate of biodegradation.

Preparation of Poly(L-lactide)/layered aluminosilicate nanocomposites in the presence of two organo-modified montmorillonites by ring-opening polymerization was reported by Paul and coworkers (M. A. Paul et al. 2003). They suggested that the obtained exfoliated nanocomposites having enhanced thermal stability were attained by directly grafting of polymer chains on the surface of clay via hydroxyl-functionalized ammonium cations or these nanocomposites with high molecular weight were obtained via solid-state polymerization (Katiyar and Nanavati 2011). As sepiolite/PLA nanocomposites are less studied, the PLA nanocomposites melt-elaboration and characterization in the presence of Cloisite 30B and sepiolite was studied by Fukushima and coworkers (Fukushima, Tabuani, and Camino 2009).

Polylactide (PLA) nanocomposites were prepared by solution and melt mixing in the presence of carbon nanotubes (CNTs) for the studies of crystallization kinetics and morphology. Figure 1, represents the DSC cooling traces for nanocomposites cooled from the melt at various rates. Neat PLA showed very slow crystallization kinetics while with increasing CNT content faster crystallization kinetics are attained (Barrau et al. 2011).

Poly(lactic acid) (PLA) with organically modified montmorillonite (oMMT) in the presence of triallyl cyanurate (TAC), have been cross-linked by high-energy electrons in order to prepare its nanocomposites. TEM of PLA nanocomposites, Figure 2, revealed the internal structure of composites, like the dispersion position of the nanofiller in the matrix (Wang et al. 2012). Zheng (2009) prepared biocompatible (PDLLA)/magnetite (Fe_3O_4) nanocomposites by chemical co-precipitation and analysis of these were done by glass transition temperature (Tg), micro-surface morphology, mechanical properties, and functional groups change. Their shape memory effect was also reported in their studies.

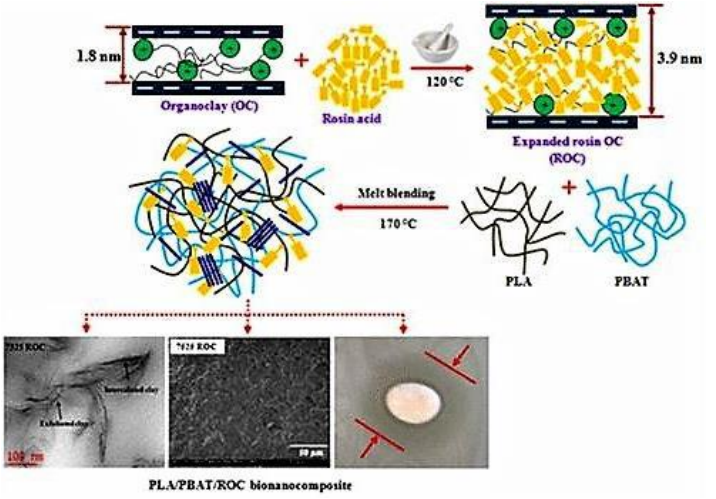

Figure 1. Synthetic scheme of PLA/PBAT/ROC bionanocomposite. Reprinted with permission from *ACS Appl. Mater. Interfaces, 2017, 9 (23), pp 20132–20141*. Copyright (2017) American Chemical Society.

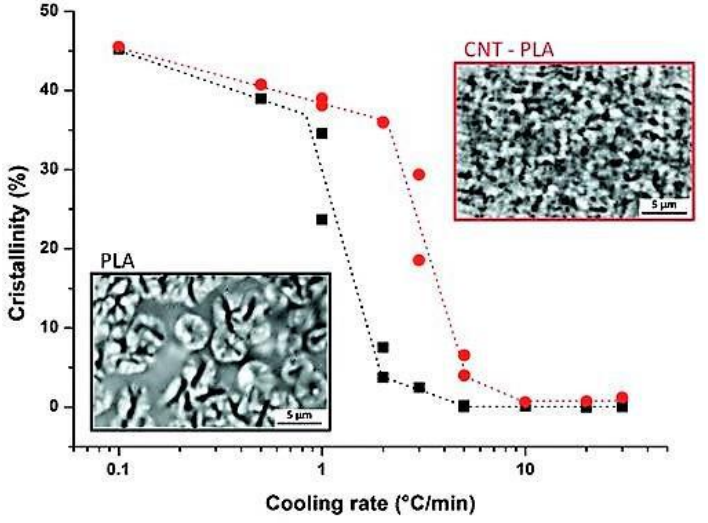

Figure 2. PLA crystal content versus cooling rate for NT0 (black squares), NT01 (green triangles), and NT1 (red circles). Reprinted with permission from *Macromolecules*, 2011, 44 (16), pp 6496–6502. Copyright (2011) American Chemical Society.

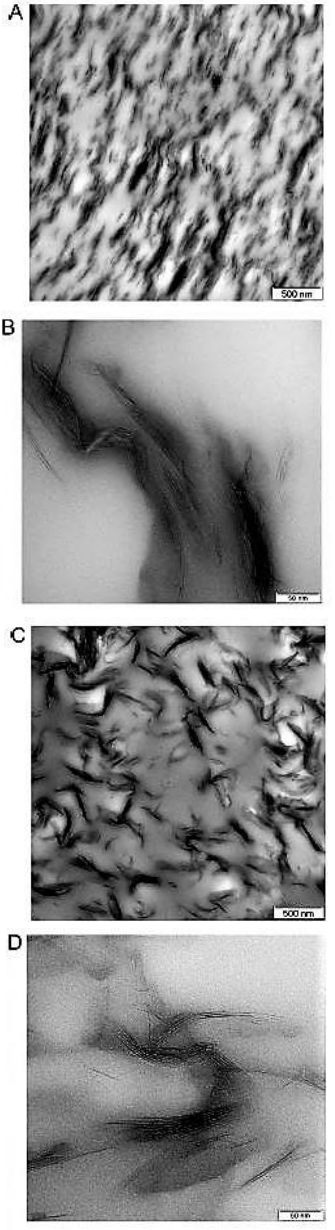

Figure 3. TEM patterns of PLA nanocomposites showing the nature of the dispersion of nanoclay in the matrix: (A, B) PLA-MMT-TAC 0kGy and (C, D) PLA-MMT-TAC 70kGy. Reprinted with permission from *Langmuir, 2012, 28 (34), pp 12601–12608*. Copyright (2012) American Chemical Society.

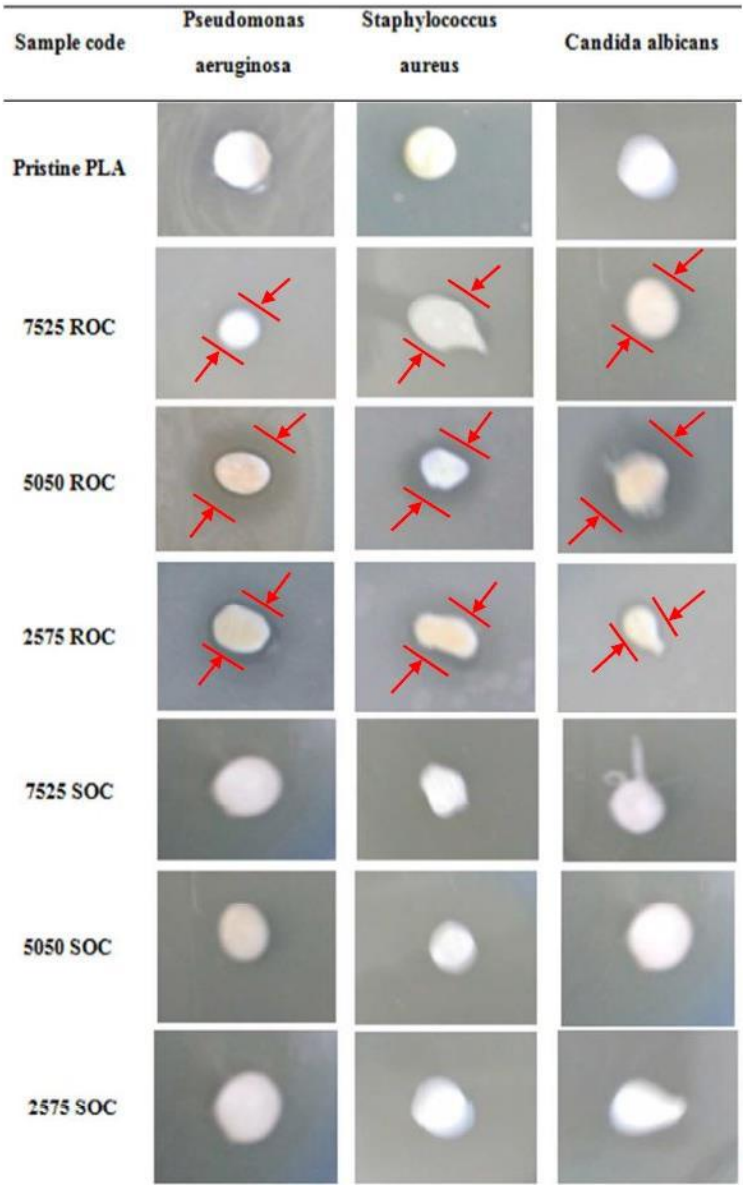

Figure 4. Antimicrobial activity for pristine PLA and its blends with different ratios of PBAT containing 2.5 w% of ROC or St. Acid against Pseudomonas Aeruginosa, Staphylococcus aureus, and Candida Albicans. Reprinted with permission from *ACS Appl. Mater. Interfaces, 2017, 9 (23), pp 20132–20141*. Copyright (2017) American Chemical Society.

Applications

As a biodegradable polymer, PLA has numerous applications in the biomedical field because of its biocompatibility features as well as good thermal plasticity, mechanical properties and is eagerly fabricated made it a promising polymer for several end-use application (Ray et al. 2003).

Biomedical

Kim, Lee, and Knowles (2006) developed PLA based nanocomposites in which in the suspension of biopolymer poly(lactic acid) (PLA) bioceramic hydroxyapatite (HA) was kept with the aim to insert a surfactant hydroxystearic acid (HSA) between the hydrophobic chloroform-dissolved PLA and hydrophilic HA powder. These nanocomposites were found useful in tissue engineering applications, mainly as three-dimensional substrates for bone growth. Nanocomposites of PLA was prepared by accumulating anticancer drug daunorubicin on PLA nanofibers and TiO_2 nanoparticles combination. Studies suggested that the above drug molecule is easily assembled in nanocomposites surface and can enable the drug infiltration and buildup on the target leukemia K562 cells. These nanocomposites having ease of surface chemistry modification, good biocompatibility, and very high surface area makes it a suitable candidate for biomedical engineering areas and pharmacology (Chen et al. 2007). Boccaccini (2010) reviewed various nanocomposites including poly(lactic acid) and suggested their mechanical, physicochemical and biological properties of introducing nanoscale bioactive in that type of biodegradable nanocomposites and revealed the chances of these materials in biomedical applications. Nanocomposites of polylactic acid/starch/poly ε-caprolactone (PLASCL20) were prepared via melt blending by mixing abovesaid with nanohydroxyapatite (nHA). The addition of 3% nHA in these nanocomposites enhanced the hydrophilicity, antibacterial activity, hydrolytic degradation, and the drug release as compare to PLASCL20. These were found suitable as antibacterial contenders for several medical applications along with the least side effects because of the controlled release of triclosan (Davachi et al. 2017).

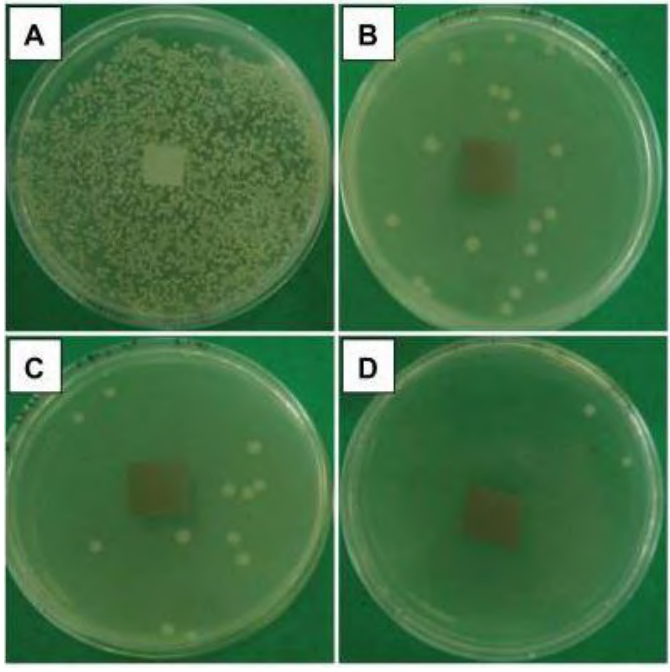

Figure 5. Comparison of inhibition zone test for Vibrio parahaemolyticus between PLA (A), Ag/PLA-NC content 8 (B), 16 (C), and 32 (D) wt% respectively.

The development of silver/poly (lactic acid) nanocomposite (Ag/PLA-NC) films was done by *Shameli* and his coworkers. They investigated that silver nanoparticles were synthesized via chemical reduction method into biodegradable PLA in diphase solvent in which sodium borohydride was used as a reducing agent. Silver nitrate acted as a polymeric matrix and sodium borohydride acted as a precursor in the PLA nanocomposite preparation. Ag/PLA-NC films revealed antibacterial activity, Figure 5, against Gram-positive bacteria (Staphylococcus aureus) and Gram-negative bacteria (Escherichia coli and Vibrio parahaemolyticus) by diffusion method using Muller–Hinton agar and the results revealed that these films can be used as an antibacterial scaffold for medical application and tissue engineering (Shameli et al. 2010). Nieddu (2009) reported PLA nanocomposites with different layered silicates nanoclays like fluorohectorites and montmorillonites with or without organic modifiers for their application in biodegradation in blood plasma. Development of sol-gel

bioactive glass/poly(l-lactide) nanocomposite scaffolds were reported by *El-Kady* and coworkers. In vitro bioactivity studies of these were found potentially applicable in bone engineering (El-Kady, Ali, and Farag 2010).

Others

Nanocomposite composed by PLA and montmorillonite layered silicate may lead to barrier properties suitable for food packaging applications (Thellen et al. 2005). In the chain, Rhim, Park, and Ha (2013) reported the applications of PLA nanocomposites in food packaging as these nanocomposites to have the potential of improvement of packaging performance as well as their biodegradability, mechanical, thermal and antimicrobial properties are perfect for the food packaging. PLA/Cloisite 30B composite film films were prepared for the improvement in their tensile strength, water vapor barrier, and antimicrobial properties. Tensile strength, elongation at break and water vapor permeability of nanocomposites were found $3.0 \pm 0.1\%$ and 1.8×10^{-11} gm/m^2 s Pa respectively and bacteriostatic function against *Listeria monocytogenes* (Rhim, Hong, and Ha 2009). The nanocomposite of PLA and montmorillonite-layered silicate was found useful in food packaging material due to its good barrier properties (Shibata et al. 2006). Sinha Ray and coworkers reviewed recent developments and properties of nanocomposites including PLA (Ray and Bousmina 2005). Studies of photodegradation of PLA-TiO_2 nanocomposites under UV light was done by *Nakayama* and coworkers and suggested that nanocomposites photo degradability can be efficiently promoted and their application in food packaging (Nakayama and Hayashi 2007).

CONCLUSION

The evolution of layered silicate-based PLA nanocomposites fruitfully created a sustainable material with improved thermal, physical, and chemical properties, to be an alternative to petroleum-based materials. Primarily, most of its applications were limited to short-time uses like the

packaging but now it is expanded to the biomedical sector due to its biodegradable property. Fascinatingly, due to the reduction of petroleum resources, PLA is now perceiving more and more attention as a valuable sourced polymer alternative in longstanding applications like electronics and automotive. Hence, the present chapter highlights the main developments and researches in PLA-based nanocomposites during this last decade.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 5

POLYSACCHARIDES BASED NANOCOMPOSITES FOR DRUG DELIVERY SYSTEM

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ABSTRACT

The design and synthesis of biomaterials with a novel combination is expected to expand the scope of drug-delivery systems in the future. This chapter will focus on the chemical nature of biomaterials as well as the methods used to characterize them with regard to drug delivery. Recent developments in biomaterials capable of intracellular delivery are surveyed to highlight the frontier areas of drug delivery.

Keywords: polysaccharides, drug release system, nanomaterial

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1. INTRODUCTION OF POLYSACCHARIDES

Saccharides are generally recognized as carbohydrates. The most simple carbohydrates are *monosaccharide*, which contains a small chain of aldehydes and ketones having hydroxyl groups that have formula $(CH_2O)_n$ where n is three or more monosaccharides are glucose, fructose, and glyceraldehyde (IUPAC 1997). Monosaccharides are the structure blocks of disaccharides that contain a chain of sucrose and lactose. An oligosaccharide is having a small number (3 to 9) sugar or (mono-saccharides). *Oligosaccharides* can have many features, they are normally found on the plasma membrane of animal cells.

Polysaccharides contain more than ten monosaccharide units. Polysaccharides have a general molecular formula of $C_x(H_2O)_y$ where x is usually a large number between 200 and 2500. These repeating units in the polymer backbone are often six-carbon monosaccharides. *Polysaccharides* are having polymeric carbohydrate structure, formed by repeating units of monosaccharides and disaccharides which joined together by glycosidic. They have a structure of monosaccharide from linear to highly branch.

Polysaccharides are an important branch of biological polymers. The function of polysaccharides in living creatures is usually either structure or storage polysaccharides.

- *Storage polysaccharides:* this type of polysaccharide contains starch and glycogen in plants and found in the form of both amylose and the branched amylopectin. In case of animals, found the structurally similar glucose polymer is the more densely branched glycogen, which known as animal starch. Glycogen properties permitted it to be metabolized more quickly, which outfits the active lives of moving animals. Starch and glycogen polysaccharides are called storage polysaccharides because they are stored in the muscles and liver, are converted to energy body functions. Starch is obtained from plants whereas glycogen is obtained from animals.
- *Structural polysaccharides*: this type of polysaccharide contains cellulose and chitin. Cellulose is said to be the most abundant

organic molecule on earth and is used in the cell walls of plants and other organisms (IUPAC 1997). It has wide applications such as paper and textile industries and is also used for the production of rayon, celluloid, cellulose acetate, and nitrocellulose. Chitin has the same structural formula but has nitrogen-containing side branches, that why it increases strength. Chitin found in arthropod exoskeletons and cell walls of fungi. It also has multiple uses, including surgical threads. Callose or laminarin, chrysolaminarin, xylan, arabinoxylan, mannan, fucoidan, and galactomannan are also found in polysaccharides.

Polysaccharides are generally heterogeneous, covering minor modifications of the repeating unit. Depend on the structure; these macromolecules can have different properties from their monosaccharide arrangement. They may be amorphous or even insoluble in water (Metthews 1999). When polysaccharide is having the same type of monosaccharides, this type of polysaccharide is called *homopolysaccharide* or *homoglycan*, but when a different type of monosaccharide is present they are called *heteropolysaccharides* or *heteroglycans* (Campbell 1996; Varki 1999).

Nutrition polysaccharides having common sources of energy. Some micro-organisms can basically degrade starch into glucose but cellulose or other polysaccharides like chitin and arabinoxylans cannot metabolize easily. These polysaccharides can be metabolized by bacteria and protists. These multi-faceted polysaccharides are not digestible, they provide important dietary elements for humans. Depend on these properties it's also called dietary fiber, these carbohydrates type polysaccharides enhance digestion among other benefits (Martin and David 2005). Soluble fiber binds to bile acids in the small intestine, restricted them enter the body, that why turn lowers cholesterol levels in the blood (Weickert and Pfeiffer 2008). After eating, soluble fiber also decreases the absorption of sugar and normalizes blood lipid levels, once fermented in the colon, and produces short-chain fatty acids as byproducts with different physiological activities. Although insoluble fiber is allied with reduced diabetes risk (Scientific Opinion 2010).

Dietary fiber is most important for the diet, with a regulatory establishment in many developed countries (Anderson et al. 2009; Jones and Varady 2015). Dietary fibers are a family of biopolymers, nucleic acids, proteins, and polysaccharides (Weickert and Pfeiffer 2008). Mostly polysaccharides are found easily, expensively recovered natural and produced as energy storage or structural biopolymers by microbes, plants, and animals (Scientific Opinion 2010). Polysaccharides have number of advantages over nucleic acids and proteins for applications in materials science. Polysaccharides are generally more stable than nucleic acids and proteins and are usually not irreversibly denatured on heating (Scientific Opinion 2010).

2. FUNCTIONS OF POLYSACCHARIDES

2.1. Homopolysaccharides

- **Starch:** starch is known as storage polysaccharide and found in plant cells shown in Figure 1. It's having two forms, first is amylose is the helical form of starch comprised only of alpha-1,4 linkages and second is amylopectin that has a structure like glycogen except that the branched alpha-1,6 linkage is present on only about one in 30 monomers.

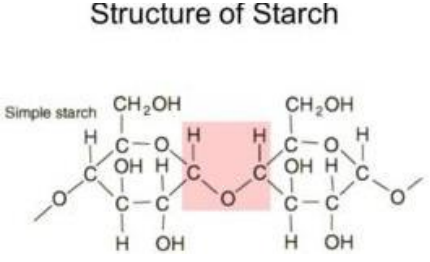

Figure 1. Structure of starch.

- **Glycogen:** Glycogen is also known as storage polysaccharides and it's found in animals (Figure 2). It is composed of alpha-1,4-

glycosidic bonds with branched alpha-1,6 bonds present at about every tenth monomer. It is mainly produced by the liver and muscles, but it can also be made during a process called glycogenesis.

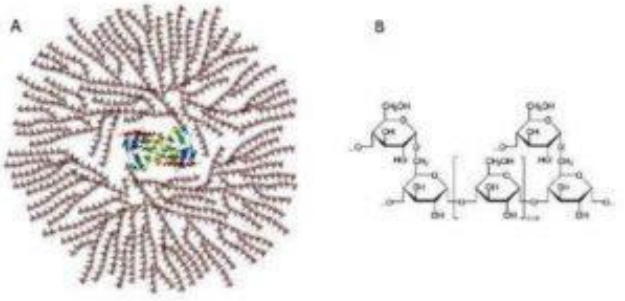

Figure 2. Structure of glycogen.

- **Cellulose:** Cellulose is a structural polysaccharide that is found in the cell wall of plants and when consumed, it acts as a dietary fiber. Cellulose is known as at most plentiful organic molecule on earth. Wood paper and cotton are common forms of cellulose.

2.2. Heteropolysaccharide

Heteropolysaccharides are found in different structural and functional roles in the human body.

- **Dermatan sulfate:** Dermatan sulfate is originated mainly in the skin, and also present in vessels, heart, lungs. It may be related to coagulation and vascular diseases and different conditions.
- **Hyaluronic Acid:** Hyaluronic acid acts as a lubricant and its presence in the synovial fluid of joints.
- **Heparin:** Heparin presents as an anticoagulant in the blood.

- **Chondroitin Sulfate:** Chondroitin sulfate contributes to tensile strength and elasticity of different parts such as walls of the aorta, cartilages, ligament, and tendons.
- **Keratan sulfate:** Keratan sulfate present in the cornea, bone, cartilage and a variety of other body parts such as hair and nails.

In this way, different type of polysaccharides that are present in the human body is glucose-amino-glycans or mucopolysaccharides that are created by the endoplasmic reticulum. Polysaccharides from important material such as connective tissues, collagen, and elastin.

3. DRUG DELIVERY SYSTEM

The drug delivery system is medium for transporting a pharmaceutical compound (drug) in the particular part of body as desirable to safely release its needed target site with therapeutic effect (Jones and Varady 2015). Drug delivery technologies adapted drug release profile, distribution, absorption, and elimination for the advantage of refining product safety, and efficacy, as well as patient compliance and convenience. Drug release is from diffusion, degradation, swelling, and affinity-based mechanisms. In present time polysaccharides nanoparticle has most attention as a potential drug release system, it's applicable for controlled release of drugs in target site (Aminabhavi et al. 2001). Some of the polysaccharides such as chitosan and deacylated product of chitin have shown best drug release properties. It is insoluble at natural and alkaline pH values but forms salt with inorganic and organic compounds. Upon dissolution the amino groups of chitosan get protonated then polymer became positive charged (Neil 2010). Peptides, antibody, protein, gene and vaccine-based drugs, may not be transported by above routes because due to molecular size and charge issues they cannot be absorbed into the systemic circulation efficiently for therapeutically effective. In this way, many proteins and peptide drugs have to be transported by injection or a nano-carrier technique (Wang and von Recum 2011).

The drug release system can be made by slowly degradable, stimuli reactive (temperature and pH-sensitive) by conjugating them. The targeted drug release system is the ability to direct interest with the drug-loaded system. Two major mechanisms addressing the desired site for drug release (Reddy 2010). Colloidal drug release systems like as micellar solutions, liquid crystal dispersion, Vesicle and nanoparticle dispersion obtain a small particle in the range of 1-400 nm show ideal drug delivery system. This system also modified and achieved goal for drug release systems with optimized drug loading and release properties, long shelf-life and low toxicity (Mueller 2004). Present research in the field of drug delivery includes the development of different types of drug delivery, such as targeted delivery in which the drug is only active in the target area of the body such as in cancerous tissues (Mueller 2004). Sustained drug release, in which the drug is released over a period of time in a controlled way, and methods to enhanced survival of oral agents which must pass through the acidic environment of a stomach (Bertrand and Leroux 2005). Different types of sustained-release formulations were investigated such as include liposomes, drug-loaded biodegradable microspheres, and drug-polymer conjugates and hydrogel (Staff 2015).

4. CLASSIFICATION OF DRUG DELIVERY SYSTEM

Different types of drug delivery systems were investigated, which are following.

- Magnetic drug delivery
- Thin-film drug delivery
- Biodegradable polymer-based drug delivery system
- Bovine submaxillary mucin coatings
- Acoustic targeted drug delivery
- Self-micro emulsifying drug delivery system
- Neural drug delivery systems

5. POLYSACCHARIDES BASED DRUG DELIVERY SYSTEM

The field of drug delivery has given a solution to the limited efficacy and high toxicity of many drugs. Nano-sized drug carriers are popular because their size allows for selective accumulation in the diseased area. Polysaccharides are non-toxic and biodegradable natural polymers that can serve as the basis for these nano-sized carriers. Polysaccharide with strong hydrophilicity that may reduce uptake by the reticuloendothelial system and prolong drug circulation.

5.1. Starch-Based Nanoparticle for Drug Delivery System

Starch is a naturally occurring polymeric material, it's extracted from seeds, tubers or roots. Starch shows the chain structure of glucose which linkage by glycoside. It has two forms are amylase which is linear and other is amylopectin's which have branched. In the present time, starch-based hydrogel represents best in drug delivery, tissue engineering, and other biomedical applications (Sa-Lima et al. 2010) developed injectable hydrogels of starch and encapsulated the starch-based gels derived stromal cells for the regeneration of articular cartilage. Chitosan β-glycerophosphate starch hydrogels can be investigated use of chondrogenic and differentiation of ADSC for cartilage regeneration. Hydrogels of starch have found their use in wound dressing (Pal et al. 2006). Investigated transparent starch-based hydrogel membranes, and it's prepared by cross-linking of polyvinyl alcohol with heat-treated corn starch suspension. Nanoparticles intercalated hydrogel matrix shows the unique physicochemical characteristic properties of hydrogels such as thermal, mechanical, barrier, optical, sound, electric simulations, etc. (Schexnailder and Schmidt 009). The aggregation properties are shown by nanoparticles, which are neither stabilized nor charged. Charged nanoparticles may occur exfoliation in water, due to the colloidal interactions of silicates and stabilize the gel formed. Literature review and some new publications covers the synthesis, characterization, and applications of hydrogels of polymer nano-composite covering

magnetic and inorganic nanoparticles (Razmjou et al. 2013, Hou et al. 2008, Takahashi et al. 2005) has shown that a modified polyethylene dioxide–laponite system can be investigated for a drug delivery system at physiological situations. A broader variety of applications is mentioned for starch made from nanoparticulate bentonites (natural layered silicate) and PEO polymer. Metal nanoparticles dispersed within hydrogels of polymer nanocomposites can enhance anti-microbial properties and electrical conductance (Murali et al. 2007, Kozlovskaya et al. 2008). Gaharwar (2011) were investigated Polymer–magnetic nanocomposites, with particles in the polymer matrix dispersed within cross-linking polymer chains (Gaharwar et al. 2001). PEG and silicate nanoparticles synthesized nanocomposite hydrogel. Recent research demonstrated the potential of silicate-PEG nanocomposite hydrogels in craniofacial, orthopedic and dental applications. Viscosity measurements for the function of shear rates represented in Figure 3.

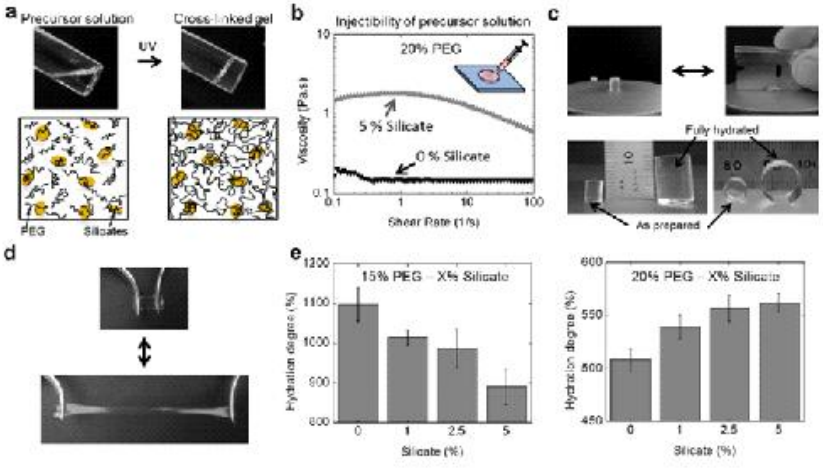

Figure 3. Transparent PEG–silicate nanocomposite hydrogels.

Synthesized nanocomposite observed the result that nanocomposites were used for sustaining the extreme mechanical deformation. The swelling characteristics of the nanocomposites were affected by the ratio of silicate nanocomposites. Many other aspects of polymer nanocomposites are

currently being investigated, such as the effects of nano-filler on chain dynamics, and it depends on the final properties and degree of dispersion. Ideal hydrogels have been synthesized by direct dissolution of chitin at low temperatures. A clear transparent solution in a mixture of 8wt%NaOH/4wt% urea aqueous solution by freeze/thawing method to prepare transparently (Chang et al. 2011). The chitin hydrogels may find wide use in bio-applications, as a result of the more stable structure and better compatibility of chitin than its derivatives (Chang et al. 2011). Hydrogel nanocomposites are also being investigated as pressure-sensitive adhesives for skin contact applications. Monodisperse polystyrene nanoparticle used as a filler on the network formation, rheological properties and adhesion performance of hydrogel nanocomposites (Bait et al. 2011). Organically modified phyllosilicate form organoclay, which derived from the naturally occurring clay mineral. Polydimethylsiloxane (PDMS) intercalated organoclay shows the results in the formation of pressure-sensitive adhesives. Shaikh (2007) obtained the partially exfoliated nanocomposites of PDMS. It was shown that different ratios of the organo-silicate additive to the polymer matrix, nanocomposites enhanced the drug release kinetics and the adhesive properties of the matrix (Shaikh et al. 2007). Present emphasis is to develop transdermal formulations, which are based on natural polymer matrix and for better release technologies in, which the dispersion of the drug is uniform within the transdermal layer (Brown et al. 2006; Naik et al. 2000).

5.2. Cellulose Based Drug Delivery System

Cellulose is mostly known as naturally occurring polysaccharides and its derivatives have been broadly used in the pharmaceutical field as drug delivery. Hydroxyl propyl cellulose was synthesized and modifying by some of the cellulose hydroxyl groups with propylene oxide to enhance the cellulose solubility and control drug release (Kamel et al. 2008). Which improves the oral delivery of hydrophobic drugs, which often have less bioavailability after administration, Winnik (2003) Modified hydroxyl propyl cellulose with hydrophobic hexadecyl or octadecyl groups through

polyoxyethylene linker of variable length (Francis et al. 2003). Five hydrophobic molecules were attached to one hydroxyl propyl cellulose chain, the critical micelle concentration was 65–135 mg/L while with ten hydrophobic chains, the critical micelle concentration dropped to 15–22 mg/L. Less water-soluble immunosuppressant (Cyclosporin A), was used as ideal drug. The maximum loading was 0.025 mg CyA/mg micelle was observed with lower hydrophobic modification, while, as anticipated, with higher modification and loading capacity increased to 0.067 mg CyA/mg micelle. PEO-C16 provided an improved solubilizing environment for CyA relative to PEO-C18 with the same quantity of hydrophobic moieties. The polymeric micelles size dropped from 78–90 nm to 44–74 nm by the encapsulation of CyA. Presumably, the encapsulation of CyA enhances the hydrophobic interactions in the core and produces more compact particles. In vitro-studies showed HPC-PEO-C16 micellar system had high affinity to mucus and could enhance the permeability of entrapped therapeutics across intestine epithelial-Caco-2 cells (Xiong et al. 2012; Chayed et al. 2003; Francis et al. 2005; Enomoto-Rogers et al.2011; Clagett et al. 1998; Francis et al. 2003; Francis et al. 2005; Yuan et al. 2006; Xu et al. 2006; Houga et al. 2009; Daoud-Mahammed et al. 2009). These studies demonstrated the great potential of cellulose-based micelles for improved oral delivery of hydrophobic drugs. A literature review has focused on the design and synthesis of cellulose-based micelles; such systems include HPC-polycaprolactone (Discher and Ahmed. 2006) and cellulose-C15-pyrene micelle. Micelles prepared from cellulose-C15-pyrene with longer cellulose chains and smaller in size relative to those prepared from short-chain cellulose and shows multilayer micelle (Chen et al. 2006). *Galkina* et al. synthesized TiO2 modified nanocomposite based on cellulose nanofibers and loaded three types of medicines, diclofenac sodium, penicillamine-D, and phosphomycin. Diclofenac released was observed fast and highest about 90% within 70 minutes (Enomoto-Rogers et al. 2011).

Many researchers are also developing as promising polysaccharides carriers for drug delivery systems with the present improvement and breakthrough of the nanocellulose modification techniques, at present time nano cellulose are drawing wonderful attentions in drug delivery systems

and continue to grow positive result (Galkina et al. 2015; Peng et al. 2011; Habibi et al. 2010). Das (2012) synthesized cellulose nano-whiskers for a novel drug delivery system (Das et al. 2012). That was adapted for the controlled delivery of enzymes, proteins and amine-containing drugs with the selection of desired linker molecules. Representing the processes exist between sources of bacterial cellulose and its drug delivery system in Figure 4.

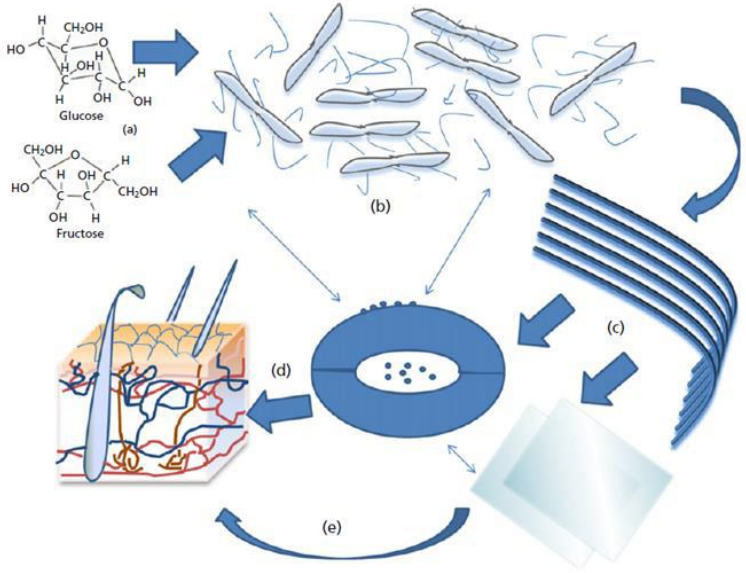

Figure 4. Representation of processes ranging between sources of bacterial cellulose and its drug delivery system.

5.3. Chitosan Based Drug Delivery System

In current times chitosan and its derivatives have been most broadly investigated composites for drug delivery due to valuable properties. Many researchers have focused on chitosan-based drug delivery systems (Figure 5) for improvement of hydrophobic drug delivery. Most of these systems were developed by chitosan and its derivative with hydrophobic moieties such as stearic acid (Xie et al. 2006; Du et al. 2011; Hu et al. 2009; Hu et al.

2008; Hu et al. 2012), deoxycholic acid (Hu et al. 2012; Jin et al. 2012; Lee et al. 2012; Wang et al.2012), glycyrrhetinic acid (Tian et al. 2012), polycaprolactone (Zhang et al. 2011; Chen et al. 2011). Modified chitosan can lead to the formation of self-assemble spherical nano and macro composites with a range of 20–500 nm in aqueous solution. Modification percentage of higher hydrophobic moieties usually gives rise to a smaller composite diameter due to stronger hydrophobic interactions. Several anti-tumor therapeutics such as paclitaxel (Sahu et al. 2011; Mo et al. 2011; Lian et al. 2011), doxorubicin (Huo et al. 2012; Jin et al. 2012; Du et al. 2011; Du et al. 2011; Srinophakun and Boonmee. 2012; Du et al. 2012), and camptothec in Du (2012), have been used as ideal drugs which encapsulated by chitosan modified composite. The chitosan modified nano and micro composite enhanced the solubility of the hydrophobic drugs and these composites showed controlled or sustained release of the hydrophobic drugs. A higher degree of substitution usually specified slower drug release despite insignificant changes in the loading efficiency. The therapeutic-loaded nano and micro composites showed significantly higher toxicity to tumor cells for in vitro compared to free drugs due to improved drug internalization. Chitosan-based composites have been used to improve oral drug delivery due to muco and bioadhesive nature of chitosan. Chitosan-based composites were established to inhibit the activity of P-glycoprotein 1 ATPase (Jiang et al.2011). Chitosan has opened the tight junctions between cells, in this reason it has greater drug absorption capacity. The chitosan-based composites were characterized by low CMCs, for high stability (Sonaje et al.2011) and resistance to the harsh environment of the gastrointestinal tract. N-octyl-O-sulfate chitosan can improve the oral bioavailability of PTX (Srinophakun and Boonmee .2012).

Chitosan-based materials were established to be a relatively safe vehicle of a drug for oral formulation (Lin et al. 2011). Chitosan-based drug release systems have also been examined for applications in antivirus (Sonaje et al. 2011), anti-thrombogenicity (Lin et al. 2011), and anti-platelet aggregation release (Jiang et al. 2011).

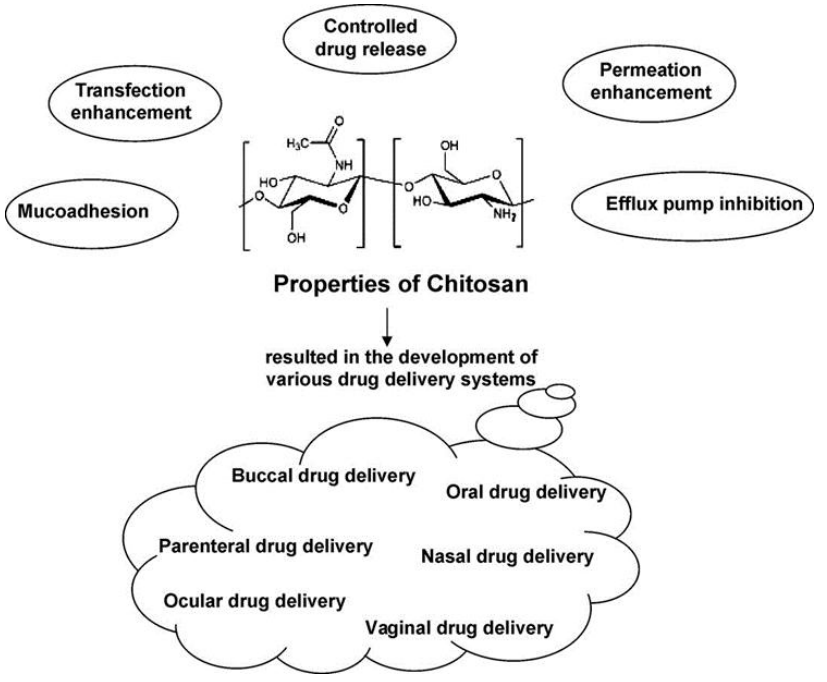

Figure 5. Chitosan-based drug delivery systems.

CONCLUSION

Polysaccharides based drug delivery systems have shown potential improvement of drug and protein delivery by enhanced solubility, stability, and controllable drug release properties. Polysaccharide-based drug release system was also shown prolonged circulation and favorable pharmacokinetics in several models, indicating the potential for translation to clinical research. Polysaccharide-based drug delivery system forms a clear trend towards more complex and controllable systems, which will possess higher targeting and specificity to further improve therapeutic efficacy and reduce undesired side effects. Polysaccharide possesses some very extraordinary properties which make it a very useful biomaterial for drug delivery includes its biocompatibility, absorbability on biological membranes, no antigenicity, low toxicity, synergism with other bioactive

compounds, etc. This advantage will value the future development of biomaterial for drug delivery.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 6

POLYVINYL ALCOHOL (PVA) BASED NANOCOMPOSITES FOR BIOMEDICAL AND TISSUE ENGINEERING APPLICATIONS

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ABSTRACT

PVA is a synthetic polymer that has been widely used for the last 30 years in the medical, clinically, non-clinically and other fields. In the field of nanocomposites, current research and development are much focused on polymer matrix-based nanocomposites. The aim of the chapter is to explore the synthesis, properties and biomedical applications of polyvinyl alcohol (PVA) based nanocomposites. Such nanocomposites have outstanding thermal stability, mechanical properties, noncarcinogenicity, non-toxicity, biocompatibility, and flexibility. These properties of PVA based nanocomposites makes them a suitable candidate for medicinal and biomedical applications such as drug delivery, wound dressings, soft

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biomaterial implants and bone tissue engineering. Special focus is given to the biomedical applications of PVA based nanocomposites.

Keywords: polyvinyl alcohol, properties, biocompatibility, biomedical application

INTRODUCTION

Polyvinyl alcohol (PVA) is a synthetic polymer that has been essentially derived from the saponification process of polyvinyl acetate through hydrolysis (Pal, Banthia, and Majumdar 2007; Hill and Le 2001), has been used throughout the first half of the 20th century worldwide. In water, it is a solubilized crystalline structure polymer that is easily degradable by biological organisms having a wide range of applications in commercial, industrial, medical and food areas. Along with these applications, it has been also used in producing end products like food packaging materials, resins, lacquers, surgical threads, etc. PVA is also used as a blending with other polymers having hydrophilic properties (Lee et al., 2004; C. Zhang et al., 2005; Mansur, Oréfice, and Mansur 2004; Xu et al., 2009; Salavagione, Gomez, and Martinez 2009; Hyon, Cha, and Ikada 1989; Mansur et al., 2008; BUNN 1948). It has been also used in many industrial applications for enhancing mechanical strength due to its compatible and hydrophilic nature (Limpan et al., 2012; M. Liu et al., 2007; DeMerlis and Schoneker 2003; Razzak and Darwis 2001) along with its use in nanofillers and crosslinked product (Qiu and Netravali 2013, 2012).

Polymer nanocomposites, ceramic nanocomposites, and metal nanocomposites are the main groups of nanocomposites. Current studies revealed that polymer nanocomposites can be used in several medical areas along with aerospace, packaging, construction, optoelectronic devices, etc. Nanomedicine is the field of diagnosing, curing, treating, preventing diseases as well as dealing with an excruciating injury, alleviating pain and protecting human health with the help of molecular tools and health of the human body (Feldman 2016; Tiwari et al., 2012). A wide variety of nanocomposites based on PVA have been prepared by taking it as a matrix

or nano reinforcement like layered silicate. The method of synthesis of these nanocomposites is generally in situ polymerization or solution casting. The first nanocomposite of PVA with a complete range of MMT loading was PVA/MMT nanocomposites. PVA nanocomposites, alpha-chitin whisker reinforced, were prepared with or without heat treatment (X. Zhang et al., 2003; Liang et al., 2009; Roohani et al., 2008; Strawhecker and Manias 2000).

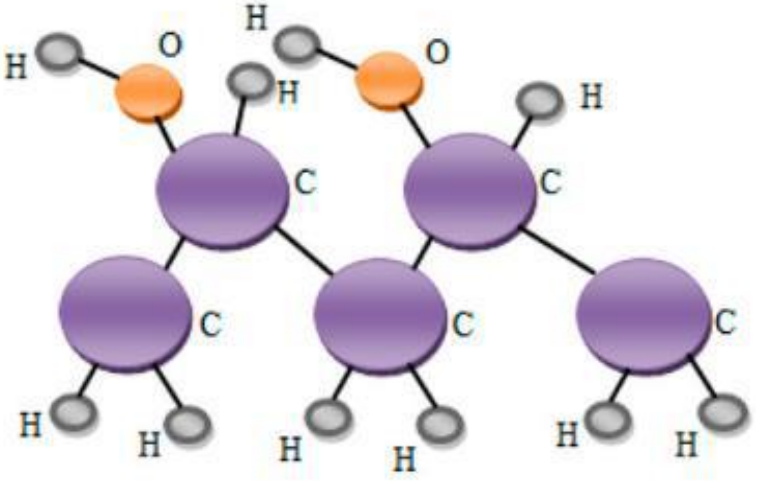

Figure 1. Structure of polyvinyl alcohol (PVA).

METHODS

1. Synthesis of PVA Based Nanocomposites

Ferrite-polymer nanocomposite based on PVA was synthesized by Sindhu (2006) by direct mixing of the PVA and ferrite, followed by sonication. Polyvinyl alcohol (PVA) nanocomposite hydrogels were synthesized by different loading of hydrophilic natural Na-montmorillonite nano clay. Dehydration tests of these nanocomposites were performed and found the direct dependency of these on the dehydration temperature (M

Sirousazar et al., 2011). Nanocomposites of polyvinyl alcohol (PVA) with starch-containing some montmorillonite were prepared by (Spiridon et al., 2008). The enzymatic degradation studies of the above nanocomposites were performed on the basis of determinations of mass loss and the reducing sugars.

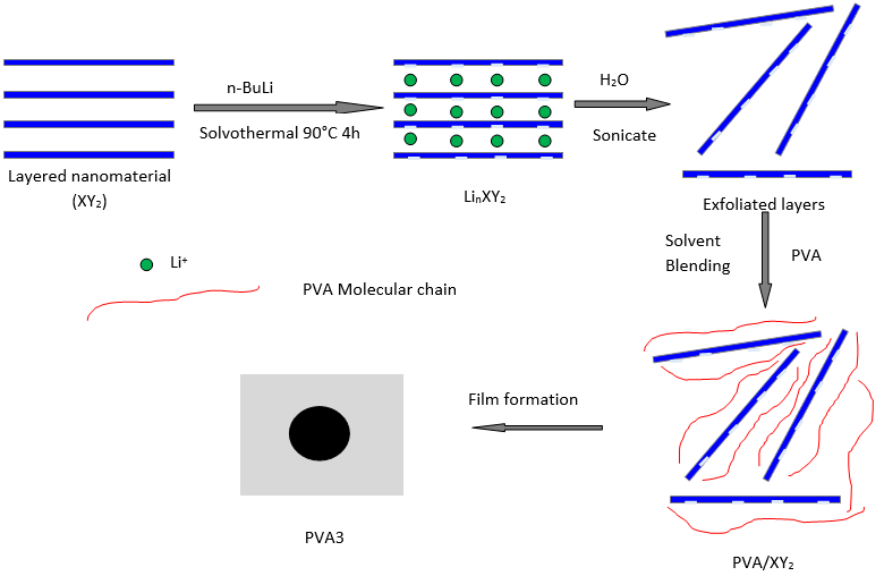

Figure 2. General preparation process of PVA nanocomposites.

2. Properties of PVA Nanocomposites

Recently, K. Zhou (2012) reported that the addition of 1−5 wt. % exfoliated molybdenum disulfide nanosheets in polyvinyl alcohol (PVA), resulted in a nanocomposite with ≈28% enhanced storage modulus with ≈24% increment in the tensile strength. Molybdenum disulfide (MoS_2)/polyvinyl alcohol (PVA) nanocomposites are prepared by Zhou and coworkers (K. Zhou et al., 2012a) via solvent blending method and found the enhancement in the mechanical properties, fire resistance properties and thermal properties which revealed the good dispersion of MoS_2 in PVA and strong interactions between them. Nanocomposites obtained from polyvinyl

alcohol (PVA) and cellulose whiskers (CWs) revealed outstanding improvement in mechanical properties (Jalal Uddin, Araki, and Gotoh 2011)

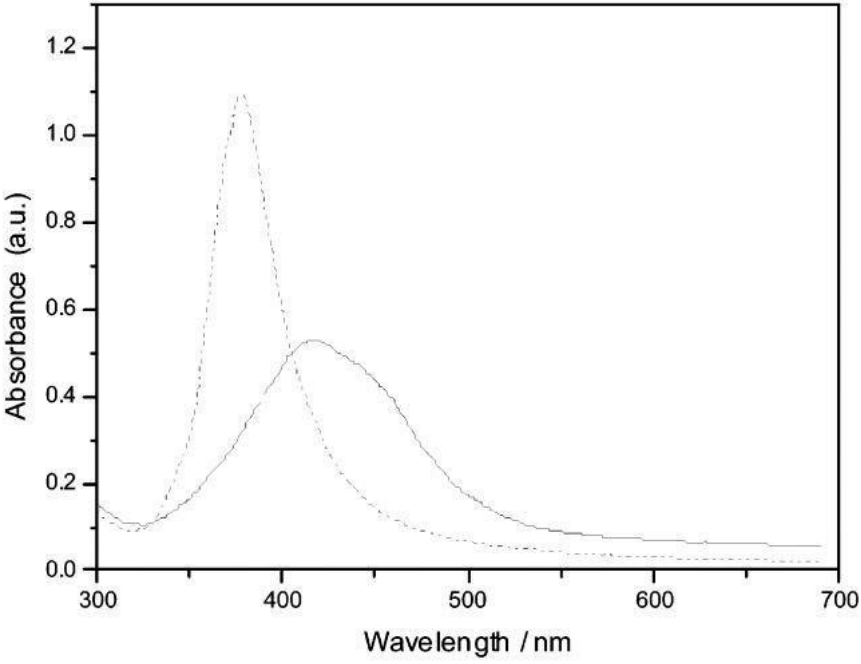

Figure 3. Absorption spectra of as-prepared silver colloid (dashed line) in water and PVA-Ag nanocomposite film (solid line) with 0.33 wt % of Ag, Reprinted with permission from Chem. Mater., 2003, 15 (26), pp 5019–5024, Copyright (2003) American Chemical Society."

Mbhele (2003) prepared PVA-Ag nanocomposites, optical studies suggested that a broad surface plasmon absorption band was found at 420 nm wavelength in PVA-Ag nanocomposite films while in pure form it was found at 380 nm revealed Ag nanoparticles embedded in PVA matrixes. The water vapor permeability of poly(vinyl alcohol)/Na^+ montmorillonite nanocomposites was measured, figure 4, and found that the improvement in the water permeability instigates from the boosted modulus of the PVA matrix in the nanocomposites (Strawhecker and Manias 2000).

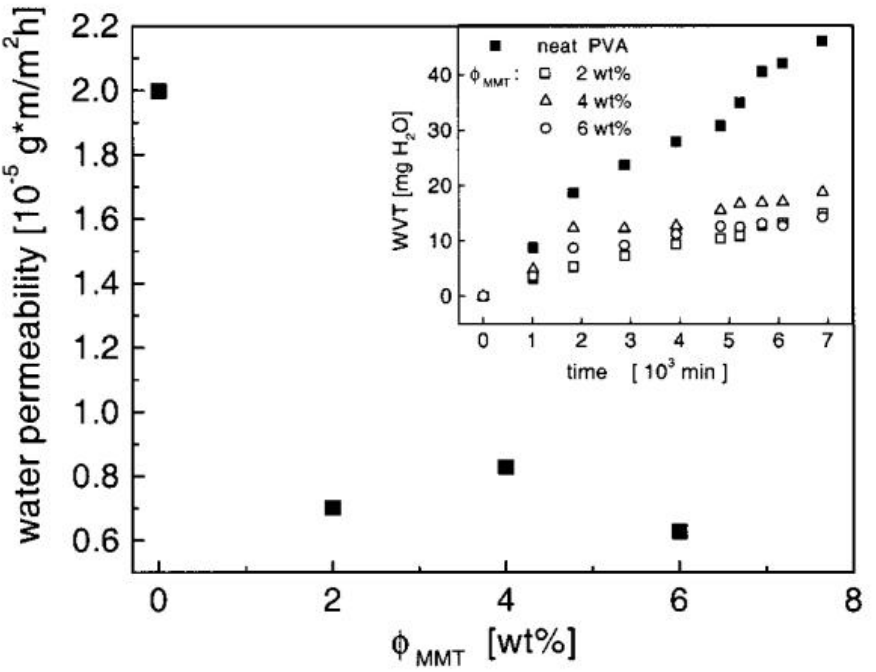

Figure 4. Water vapor permeability for the neat PVA and several PVA/MMT nanocomposites. The inset shows the water vapor transmission raw data collected for each composition, which were used to calculate the water permeabilities. Reprinted with permission from Chem. Mater., 2000, 12 (10), pp. 2943–2949 Copyright (2000) American Chemical Society.

GO/PVA composite hydrogel with enhanced mechanical properties via solution mixing and freezing/thawing was prepared (J. Liu et al., 2012) and unveiled that in PVA chains strong physical cross-linking effect was observed due to hydrogen bonding.

3. Applications

PVA has been used for its compatibility in biomedical applications (Paradossi et al., 2003). Nanocomposites of PVA are used in various biomedical fields like manufacturing of artificial heart surgery contact lenses, wound dressings and drug delivery systems as it has highly favorable

properties like biocompatibility, non-carcinogenic, nontoxicity, bioadhesive properties, and swelling characteristics. Polyvinyl alcohol (PVA) reinforced with multi-walled carbon nanotubes and glutaraldehyde is excellent to be used as biomedical applications in an alternative of traditional materials (Mohammad Mahdi Dadfar, Kavoosi, and Mohammad Ali Dadfar 2014).

DRUG DELIVERY SYSTEM AND CANCER DIAGNOSIS

Polyvinyl alcohol and SPION nanocomposites were found useful in drug delivery of popular drug ciprofloxacin [30]. Li, Wang, and Wu (1998) prepared poly(vinyl alcohol) (PVA) hydrogel nanoparticles by the technology of water-in-oil emulsion plus the process of cyclic freezing-thawing for their use in protein (Bovine Serum Albumin)/peptide drug delivery and release of BSA followed diffusion-controlled mechanism. Polyvinyl alcohol (PVA)/halloysite (HNTs) bionanocomposite films were fabricated by solution casting and crosslinking of glutaraldehyde (GA). They exhibited applications in drug delivery systems as well as bone tissue engineering (W. Y. Zhou et al., 2010). PVA-coated indomethacin-loaded PLGA nanocomposites were prepared with an about 100 nm diameter size by emulsification and the solvent evaporation method for their application in iontophoretic transdermal drug delivery (Tomoda et al., 2014). Kalia (2014) reviewed super magnetic iron oxide nanoparticles with PVA in magnetic resonance imaging (MRI) of cancer cells for cancer diagnosis and chemotherapy.

TISSUE ENGINEERING

Nowadays, bone tissue engineering has become one of the auspicious areas because it has the potential to repair diseased/damaged bone tissue by joining osteogenic cells, osteoconductive scaffolds and osteoinductive biological signals organized in an arranged way for bone tissue regeneration (Hou et al., 2007; Bártolo et al., 2009). In order to applications in tissue

engineering, Sionkowska and Kozłowska (2010) suggested that nanocomposites processed from collagen type I and PVA showed morphological characteristics for potential use as bone TE soft scaffolds. Polyvinyl alcohol (PVA)/ waterborne polyurethane (WPU)/ TEMPO-oxidized cellulose nanofibers (TOCNs) nanocomposite were prepared (Dai et al., 2014) and they were non-toxic, hydrophilic and biocompatible so could be used for filtration materials, tissue scaffolding and medical fields as wound dressing materials. *Yoshii* and coworkers prepared polyvinyl alcohol (PVA) hydrogel by electron beam irradiation and acetalization of PVA. Heat resistance of these was checked by mechanical properties. Its application as a wound dressing was assessed by attributing to a wound or burn of the back skin of marmots and found homogeneous adhesion to the infected parts along with easy removal with no damage to rehabilitated skin as well as a little rapid rate of regeneration of the injured skin (Yoshii et al., 1995). In the series fabrication of polyvinyl alcohol (PVA) scaffold for bone tissue engineering via selective laser sintering was done by *Shuai and coworkers* (Shuai et al., 2013). They suggested that the porosity of the above was found 67.9 ± 2.7% which was suitable for the prerequisite of micro-pores of the bone scaffolds as tissue engineering (TE). For wound dressing on animals, nanocomposites of polyvinyl alcohol (PVA) with organically-modified montmorillonite as nano clay was prepared by the freezing-thawing cyclic method. In vivo studies of these were performed which unveiled an enhanced healing process in wounds as compare to sterile gauze and in vitro studies helped to determine cytotoxicity and biocompatibility of synthesized nanocomposites. In studies, these were found non-toxic and biocompatible for their use in wound dressing in practical wound management (Mohammad Sirousazar, Kokabi, and Hassan 2011). Preparation of nanocomposites of polyvinyl alcohol- chitosan (PVA-CS) and graphene oxide (GO) was done by casting their stable aqueous mixture. These new nanocomposites revealed enhanced thermal stability as well as they were found mechanically strong. Their cell viability and cytotoxicity studies unveiled that MC3T3-E1 mouse osteoblastic cells can attach and fabricated on PVA-CS/GO nanocomposite films and makes them a suitable candidate for tissue engineering (Pandele et al., 2014). Nanocomposites of

PVA and chitosan prepared by gamma radiations revealed good biodegradability, biocompatibility, and hemostatic properties and due to this, they can be used in wound dressing (El Salmawi 2007).

OTHER BIOMEDICAL APPLICATIONS

Polyvinyl alcohol (PVA) functionalized cobalt ferrite nanocomposites were successfully prepared by the combustion method and surface modified by (Salunkhe et al., 2013) for biomedical applications. These were characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), Fourier transforms infrared (FTIR) spectroscopy, dynamic light scattering (DLS) and thermogravimetric analysis (TGA) and revealed decrement of contact angle suggested the conversion of hydrophobic nature to hydrophilic. In vitro cytotoxicity results revealed less cytotoxicity of these on mouse fibroblast L929 cell line. A novel nanocomposite polyvinyl alcohol/polyaniline/ Ag (PVA/PANI/Ag) was developed by exposure of Ag nanoparticles on the PVA/PANI composite. These nanocomposites showed outstanding antibacterial activity against Gram-positive bacteria *Staphylococcus aureus* and Gram-negative *Escherichia coli* with the help of a paper disk diffusion method (Ghaffari-Moghaddam and Eslahi 2014). Nanoparticles of $Zn_{0.5}Co_{0.5}Al_{0.5}Fe_{1.46}La_{0.04}O_4$ remove dye up to 76% while the $Zn_{0.5}Co_{0.5}Al_{0.5}Fe_{1.46}La_{0.04}O_4$/PVA nanocomposites removed the dye up to 90% suggested its potential application in industrial wastewater purifying and recycling (Ahmed et al., 2013).

CONCLUSION

Over the past few decades, polymeric nanocomposites are in high demand due to its unique properties that can be attained with these materials. These nanocomposites revealed a wide and versatile range of properties and other beneficial characteristics at adequate cost and biodegradation rate, thus can be applied in a broad range of applications. The alternative polymeric

medical devices are popular and have also increased substantially around the world. As a host for different kinds of nanofiller in these nanocomposites, poly(vinyl alcohol) (PVA) plays an important role as it is a water-soluble polymer. The introduction of nanosized particles into the PVA enhanced its properties and makes it an outstanding tool for biomedical uses. This chapter provides an overview of recent advances in polyvinyl alcohol (PVA) based nanocomposites and its applications in different medical fields such as drug delivery, wound healing, bone replacement, tissue engineering, and others.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 7

BIOPOLYMERS AND THEIR ROLE IN BIOMEDICINE

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ABSTRACT

Biopolymers are obtained from biowastes or natural origin from various sources used for various industrial applications such as wastewater treatment, photocatalysis, and biomedical applications. Various types of biopolymers are available for biomedical applications due to their inherent properties like antimicrobial activity, biocompatibility, biodegradability. Biopolymers play a vital role in the medical field due to presence of the various functional groups. These functional groups are easy to modify for various applications such as drug delivery, wound healing, and tissue engineering.

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Keywords: biopolymer, classification PLA, chitosan

INTRODUCTION

Biopolymers derived from natural resources are renewable, biodegradable and non-toxic in nature. These polymers are also produced from biological diversity such as plants, animals, and microorganisms. These biopolymers are also synthesized chemically from biological materials such as sugars, starch, natural fats, etc. The use of polymers in medical applications has been used from ancient times. These polymers offered a good design for the materials to make it more biocompatible. In recent years the biological functions of polysaccharides attain a great biomedical application. There are a number of applications of the biopolymers including the food additives, clothing fabrics, water treatment chemicals, packaging of medical materials. There are basically three types of biopolymers which include polysaccharides, proteins, and polynucleotides. The use of the biopolymers in the development of therapeutic devices such as three dimensional porous structures as scaffolds for tissue engineering, controlled release drug delivery and applications like suturing, fixation or adhesion which are developed from the biopolymers whose degradation products are not immunogenic (Niaounakis . 2015, Onar.2014, Reddy et al. 2015). The biopolymers are basically alternative to petroleum-based polymers and their properties depend on the polymer structure.

CLASSIFICATION OF BIOPOLYMERS

The three main groups of the biopolymers are classified in Table 1 on the basis of their origin.

BIOPOLYMERS FOR BIOLOGICAL APPLICATION

Polylactic Acid (PLA)

It is a biopolymer that can be produced from natural sources such as corn starch, potatoes. It can be made into consumer items as diverse as disposable plates and cups, packaging and clothing and some properties of PLA are similar to that of synthetic polymers (Mukherjee et al. 2011). The monomers used for polymerization of lactides are synthesized from glycolic acid, DL lactic acid. PLA (Polylactic acid) comes from fermented plant starch (mostly from corn) and is often referred to as corn starch plastic. It is becoming popular very quickly because corn-based plastic is a more environmentally-friendly alternative to traditional plastics, which are petroleum-based. There are two methods for manufacturing polylactic acid (PLA) from lactic acid: the first method uses the cyclic lactic acid dimer called lactide as an intermediate stage; the second method is direct polymerization of lactic acid. Polylactic acid is formed from the corn which is first fermented to the lactic acid, the lactic acid is then polymerized to make polylactic acid. It is the first bio-plastic which is still used today, these bio-plastics make many contributions to the reduction of CO_2 in the environment and these are also biodegradable substances by which it protects the environment. The bio-plastic materials are used in automobile interiors, for packaging of food items, for agriculture sheeting and other household appliances (Auras et al., 2010, Benninga 1990, Xiao et al. 2012).

Advantages of Corn

(a) Comes from corn, which is a renewable resource
(b) Does not contain toxins
(c) Producing this kind of plastic creates much less greenhouse gas emissions than conventional plastic production.
(d) Less energy is needed to produce corn-based plastic than to produce conventional plastics.

(e) Polylactic acid is more competitive than conventional plastic in terms of cost.
(f) Polylactic acid is safer since there is no danger of explosions in its production.

Table 1. shows the classification of various biopolymers

Classification	Origin	Biopolymers
Polysaccharides	Plant/algal	Starch, Cellulose, Alginate, Carrageenan, Pectin, Konjac
	Animal Bacterial	Chitosan, Hyaluronic acid
	Fungal	Pullulan, Elsnan, Yeast, glucans
	Lipids/Surfactants	Acetoglycerides, waxes, surfactants, Emulsion, Elastin, Resin, Adhesives
Proteins		Wheat gluten, casein, serum albumin
Polyesters		Polyhydroxyalkanoates, polylactic acid
Specialty Polymers		Shellac, Poly-gamma glutamic acid, natural rubber, nylon from castor oil

Chitosan

Chitosan is a cationic polysaccharide (Figure 1) found in the exoskeleton of crustaceans which is produced by deacetylation of chitin by obtaining from the alkalizing process at high temperature. It is a biodegradable polymer, used in different forms and have various applications in industrial and biomedical areas. The important application of the chitosan is in the cell attachment and cell growth and skin regeneration (Balan et al. 2014) used a coating of chitosan and heparin and in order to increase the mechanical properties and acceleration of re-endothelization and the healing process [Meng et al. 2009]. Chen (2009) developed a polymeric stent that is made from chitosan-based films fixed by genipin due to its high oxygen permeability chitosan is used as a material for contact and intraocular lenses[Chen et al.2009].

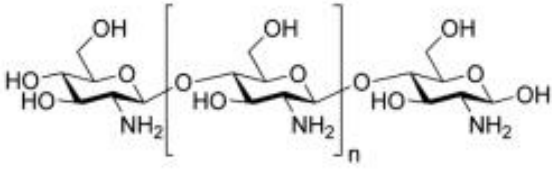

Figure 1. Chemical structure of chitosan (Ahmed et al. 2015, Ahmed et al. 2016).

Biological Properties of Chitosan

- Act as biocompatible (Biodegradable, safe and non-toxic)
- Haemostatic
- Spermicidal
- Antitumor
- Accelerate bone formation
- Central nervous system
- Fungistatic
- Anticholesteremic
- Immunoadjvant.

Application

- Tissue engineering
- Cosmetics
- Ophthalmology
- Artificial Skin
- Wound dressing
- Drug delivery.

Calcium Alginate Biopolymer

This biopolymer is water-soluble, gelatinous and cream-colored substance that can be made by the addition of calcium chloride to the aqueous sodium alginate and gives the artificial flavor and the colors create a tastier edible slime. Calcium alginate is also used in forming the artificial

seeds in plant tissue culture. The cell wall of the brown algae is composed of the alginate biopolymer in the sodium salt form of alginic acid (Figure 2).

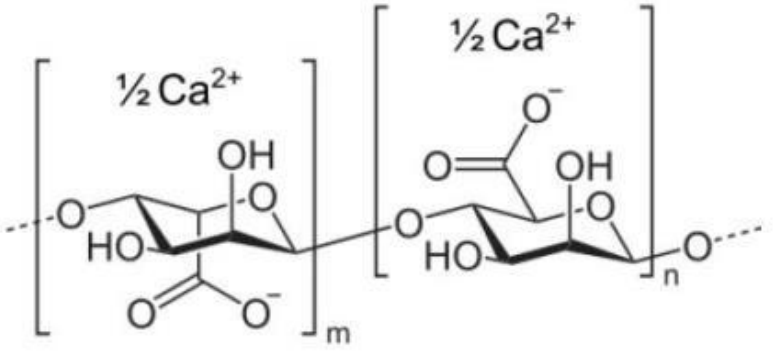

Figure 2. Chemical structure of calcium alginate (https://en.wikipedia.org/ wiki/ Calcium_alginate).

Applications of Calcium Alginate

a. For producing the insoluble artificial seeds.
b. For immobilizing enzymes
c. To produce an edible substance
d. Incorporated into wound healing

Collagen and Gelatin

Collagen protein is mostly found in connective tissues and beneath the skin. These proteins present in animals are generally hard and become soft when cooked and it breaks into gelatin which is called cooked collagen, which provides an effective way of absorbing the collagen-boosting amino acids. Gelatin and hydrolyzed collagen which is made from animal collagen and has same profile of amino acid. Some differences in their structure and properties are:

- Hydrolyzed collagen is broken down into smaller units of protein which are easy to digest.
- Hydrolyzed collagen dissolves in both hot and cold water but gelatin does not dissolve.
- Gels of Gelatin can be prepared, but hydrolyzed collagen gels cannot be prepared.

Functional Properties of Collagen and Gelatin

a. The gelling properties that are associated with collagen and gelatin include gel formation, texturing and water-binding capacity.
b. The properties related to the surface behavior (emulsion, foam formation, stabilization, adhesion, cohesion, and film-forming capacity) are possibilities of fish collagen as a functional material.

Biological Applications

- The collagen sheets are non-inflammatory and facilitate the migration of fibroblasts and microvascular cells.
- They have low antigenicity and have minimal biodegradation.
- They are non-toxic and helps in minimizing scarring.

CONCLUSION

Biopolymers are an important class of materials that have important applications. Of all these medical applications is an important one. The importance of new medical textiles biopolymers increased day by day due to its versatility, biocompatibility and non-cytotoxicity make these materials excellent for use. New types of polymers like polylactic acid, collagen, chitin, and such others have been used in today's technological period.

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In: Biocomposites in Bio-Medicine ISBN: 978-1-53616-247-9
Editors: Mudasir Ahmad et al.

Chapter 8

LIGNIN: A WONDERFUL BIOPOLYMER

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ABSTRACT

Many years of cumulative research has been conducted on the usage of fiber-reinforced composites for biological, environmental and biomedical applications. For potential applications, full advantage must be taken of the material properties and the manufacturing techniques The three main areas have been addressed and discussed. First, a comprehensive and comparative survey of biocomposites from the existing literature obtained from various sources and their importance in various medical fields has been presented. Second, mechanical designs, manufacturing and exploring aspects of various fibrous polymer matrix composites are explained and described. The third area concern over examples of the design, development, and use of several medical devices and implants using polymer composites. However, being renewable, cheap, recyclable, and biodegradable, they have witnessed rapidly growing interested and attention in terms of industrial, biological, environmental and fundamental applications. So keep the whole in view, the present

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chapter focuses on fiber-based polymer lignin applied to biomedical and environmental applications and presents a comprehensive survey of lignin from the existing literature and its various biomedical and environmental applications. This chapter is the first of its kind to present all the contents together related to lignin that are generally limited to their fundamentals, different methods of synthesis and applications. Lignin is a class of complex organic polymers that form important and vast structural materials in the support tissues of vascular plants and some algae. Lignins are particularly important in the formation of cell walls especially in wood and bark because they lend rigidity and support and do not rot easily. Chemically, lignin is a cross-linked polymer with molecular masses in excess of 10,000 u. It is relatively hydrophobic and rich in aromatic subunits. The degree of polymerization is difficult to measure since the material is heterogeneous in nature. Different types of lignin have been described depending on the means of isolation and structure.

Keywords: biocomposites, biomedical, lignin, biodegradable, polymer

1. INTRODUCTION

Wood is composed of many chemical components, primarily extractives, carbohydrates, and lignin, which are distributed non-uniformly as the result of the anatomical structure of plants and trees. The term lignin is derived from the Latin word Lignum which means wood (De Candolle et al. 1821). Lignin is a complex organic polymer that forms a significant structural material in the support tissues of vascular plants and is one of the most abundant organic polymers on Earth after cellulose. The cellulose walls of the wood become impregnated with lignin. It greatly increases the strength and hardness of the cell and imparts necessary rigidity to the tree. This is essential to woody plants in order that they stand erect (Rouhi et al. 2001). Out of all polymers found in plant cell walls, lignin is the only one that is not composed of carbohydrate (sugar) monomers. In recent years, because of the application of modern methods and availability of techniques and instruments for chemical analysis, the lignin field has developed dramatically. Natural lignin is an amorphous, irregular, random and three-dimensional network of cross-linked co-polymer that containing both

aromatic and aliphatic entities (Norstrom 2012). Since the knowledge of lignin has evolved over one hundred years and the importance of lignin has been widely recognized since the early 1900s (Glasser et al. 2000). But however, our understanding of lignin is still limited due to its complex structure. Lignins are highly functionalized biomacromolecules possessing primarily alkyl-aryl ether linkages, aliphatic and aromatic hydroxyl groups and low polydispersity, which offer the potential for higher value-added applications in renewable polymeric materials development. About two-thirds of the lignin bonds are of ether type and about one-third is carbon-carbon linkages but the most common linkage is the ß-o-4′ linkage which is susceptible to pulping and bleaching and biodegrading reactions whereas the covalent carbon-carbon bonds are more stable (Sjortrom 1993). That is why it is undesirable in most chemical papermaking fibers and is removed by pulping and bleaching processes easily.

1.1. Source

Lignin is a natural resin that fills spaces between plant cells and strengthens cell walls by covering cellulose micro-fibrils. So, it is the main component of plant biomass including cellulose and hemicelluloses. Hence, it can be derived from various sources such as cereal straws, bamboo, bagasse, and wood. In terms of weight, the lignin content in wood is the highest (20 – 35%) while only 3 – 25% in other sources (Smolarski 2012).

1.2. Composition and Structure

Lignin is an amorphous, random and three-dimensional network of cross-linked copolymer of long chains of different types of phenyl propane monomers (lignols) which are considered to be essential lignin precursors (Figure 1). The three main building blocks of lignin preparation are derived from phenylpropane: 4-hydroxy-3-methoxyphenylpropane, 3,5-dimethoxy-4-hydroxyphenylpropane, and 4-hydroxypropane.

These three basic structural monomers include p-phenyl monomer (H type) derived from coumaryl alcohol, guaiacyl monomer (G type) derived from coniferyl alcohol, and syringyl monomer (S type) derived from sinapyl alcohol. The structure of lignin is highly complicated composed of phenylpropane units linked to each other by the irregular coupling of C–C and C–O (Qiu et al. 2006). Ether bonds in lignin include phenol-ether bonds, alkyl-ether bonds, dialkyl, and diaryl ether bonds, and so on. Lignin in softwood and hardwood mainly contains aryl glycerol-β-aryl-(β-O-4) ether bonds. In the C–C bonds of lignin, the dominant coupling type is β-5, β-β linkage, followed by β-1, β-2, 5–5, and so on (Tao et al. 2003)**.** Because the types and positions of functional groups lignins are different with different chemical characteristics.

The polymerization of lignin macromolecules by phenylpropane units is dehydro-oligomerization. The German eminent scientist Freudenberg produced first synthetic lignin by coniferyl alcohol and laccase under aerobic conditions. Later, peroxidase (POD) was found to catalyze this polymerization reaction effectively. In this process, redox shuttles of Mn_3C-Mn_2C played an important role in lignin biosynthesis. There have been several different hypotheses to explain lignification- one is a random coupling model, which proposed that lignol molecules are gradually connected to the lignin polymer by oxidative coupling. The random coupling hypothesis is reasonable because it explains the plasticity of lignin biosynthesis in mutants and transgenesis research. Another hypothesis involves the dirigent-like protein model, which considered that the lignified process is strictly under the manipulation of dirigent-like protein by controlling the formation of particular chemical bonds of the lignin molecules. The hypothesis showed that the metabolism of lignin should be an orderly life process, which explains the large numbers of *O*-4 linkages in lignin molecules. The formation of sinapyl alcohol and coniferyl alcohol was a relatively independent process by which enzymes involved in sinapyl alcohol synthesis were associated with each other to form a multienzyme complex. The synthesis of coniferyl alcohol is conducted in the cytoplasm another way. The phenylalanine ammonia-lyase (PAL), caffeoyl CoA methyltransferase (CCOMT), CCR, and CAD distribute in the cytoplasm,

catalyzing the synthesis of coniferyl alcohol. Peroxidase is widespread in plants with multiformity. So, how it participates in lignin monomer polymerization needs further studies. So far, it remains uncertain whether the POD or laccase catalyzes the polymerization of lignin monomers in the plant or if they work synergistically (Jiang 2001).

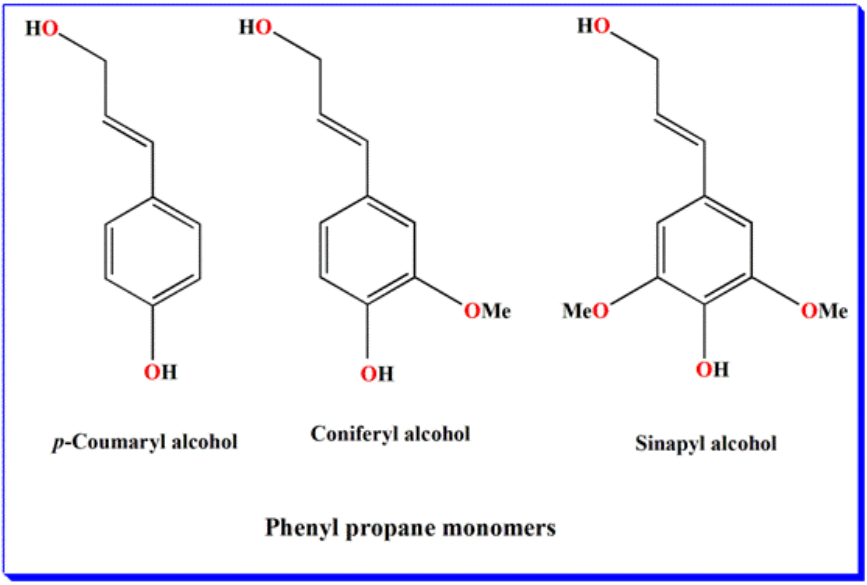

Figure 1. Phenyl propane monomers of lignin.

2. PROPERTIES

The physical, as well as chemical properties of lignin, are revealed as under:

2.1. Physical Properties

The physical properties of the lignin are given as below:

(a) *Molecular weight and polydispersity*
Under the effect of mechanical action, enzymes, or chemical reagents, the three-dimensional net structure of lignin is degraded into different size lignin fragments leads to its molecular weight polydispersity.

(b) *Solubility*
The presence of hydroxyls and many polar groups in the lignin resulting in strong intramolecular and intermolecular hydrogen bonds and making the intrinsic lignin insoluble in any solvent. But however, the presence of phenolic hydroxyl and carboxyl makes the lignin able to be dissolved in alkaline solution.

(c) *Thermal properties*
Lignin is an amorphous thermoplastic polymer. It has slight friability under high temperature and cannot form the film in a solution. It also has glassy transfer properties. The softening temperature of absolutely dried lignin ranges from 127 to 129°C, which remarkably decreased with increased water content, indicating that water acts as a plasticizer in lignin

(d) *Color*
Intrinsic lignin is a white or nearly colorless substance; the color of lignin we can see is the result of the separation and preparation process.

2.2. Chemical Properties

The chemical properties of lignin include nitration, halogenation and oxidation reactions on the phenyl ring of the lignin. It can also undergo benzyl alcohol, the aryl ether bond, and an alkyl ether bond and lignin-modified chromogenic reaction. The chemical reactions of the lignin structural unit are divided into two major categories:

(a) Chemical reactions due to side chain of the lignin
(b) Chemical reaction due to aromatic ring in the lignin structure

(c) Lignin chromogenic reaction

(a) Chemical Reactions Due to Side Chain of the Lignin

Reactions on the lignin side chains are associated with pulping and lignin modification due to nucleophilic reaction. The following reagents can conduct nucleophilic reactions with lignin:

(i) In alkaline medium, the effect of HO^-, HS^-, and S^{-2} nucleophilic reagents leads to the cleavage of the main ether bond, fragmentation and partial dissolution of macromolecule lignin. Hence, the phenol type structural unit is separated into phenolate anions and leads to the activation of *ortho*- and *para*- positions and thereby affects the stability of the CO bond and aryl ether bond is cleaved.
(ii) In a neutral medium, reaction with nucleophile HSO_3^- or SO_3^{2-} leads to breaking of the ether bond and brings and also degradation of lignin fragments.
(iii) In acidic medium, the lignin fragmentation reaction pulping process id carried out. SO_2 aqueous solution leads to the breakage of phenol-type and non-phenolic aryl ether bonds. The sulphonation of carbon may increase the lignin's hydrophilicity. Phenol-type and nonphenolic alkoxy ether bonds may also have a similar type of chemical reaction (Gao et al. 1996; Tao et al. 2003).

(b) Chemical Reaction Due to Aromatic Ring in the Lignin Structure

Chemical reactions of the aromatic ring of lignin are closely related to the lignin-bleaching process and have been divided into electrophilic and nucleophilic reactions:

(i) Electrophilic substitution reaction: Electrophilic reagents include chlorine, chlorine dioxide, oxygen molecule, ozone, nitro cation, nitroso cation, and so on. The electrophilic reagent replacement breaks the side chains of lignin and leads to the oxidative cleavage of "-aryl ether linkages. The aliphatic side chain is oxidized into a carboxylic acid and the aromatic ring is oxidized into the compound

of the o-quinone structure, which will finally be oxidized into dicarboxylic acid derivatives.

(ii) Nucleophilic reaction: Nucleophilic reagents that can react with the aromatic ring of lignin include hydroxide ions, hypochlorite ions, and hydrogen peroxide ions. These nucleophilic reagents can react with the chromophoric groups in the degraded lignin fragments, breaking the chromophoric structure to some extent.

(c) Lignin Chromogenic Reaction

The lignin can undergo the formation of a colored compound by the treatment of different types reagents revealed and discuss as under:

(i) ***Mäule chromogenic reaction:*** When the Hardwood lignin is treated with $KMnO_4$ and HCl and then ammonia, reddish-violet color is obtained. This is because of the syringyl ring of lignin which generates methoxy o-dihydroxybenzene under the treatment of KMnO4 and HCl. A purple methoxy-o-quinone is obtained after ammonia treatment.

(ii) ***Cross-Bevan reaction:*** Timber without extractives is treated with chlorine in the wet state; the lignin present will be converted into chlorinated lignin. After sulphonic acid and sodium sulfite treatment, the lignin of hardwood turns into red-purple (Jiang 2001).

3. CHEMICAL ANALYSIS OF LIGNIN

The conventional method for lignin quantitation in the pulp industry is the Klason lignin and acid-soluble lignin test, which is standardized according to TAPPI or NREL(Sluiter et al. 2008) procedure. According to the procedure, The cellulose is first recrystallized and partially depolymerized into oligomers by keeping the sample in 72% sulfuric acid at 30 C for 1 h.

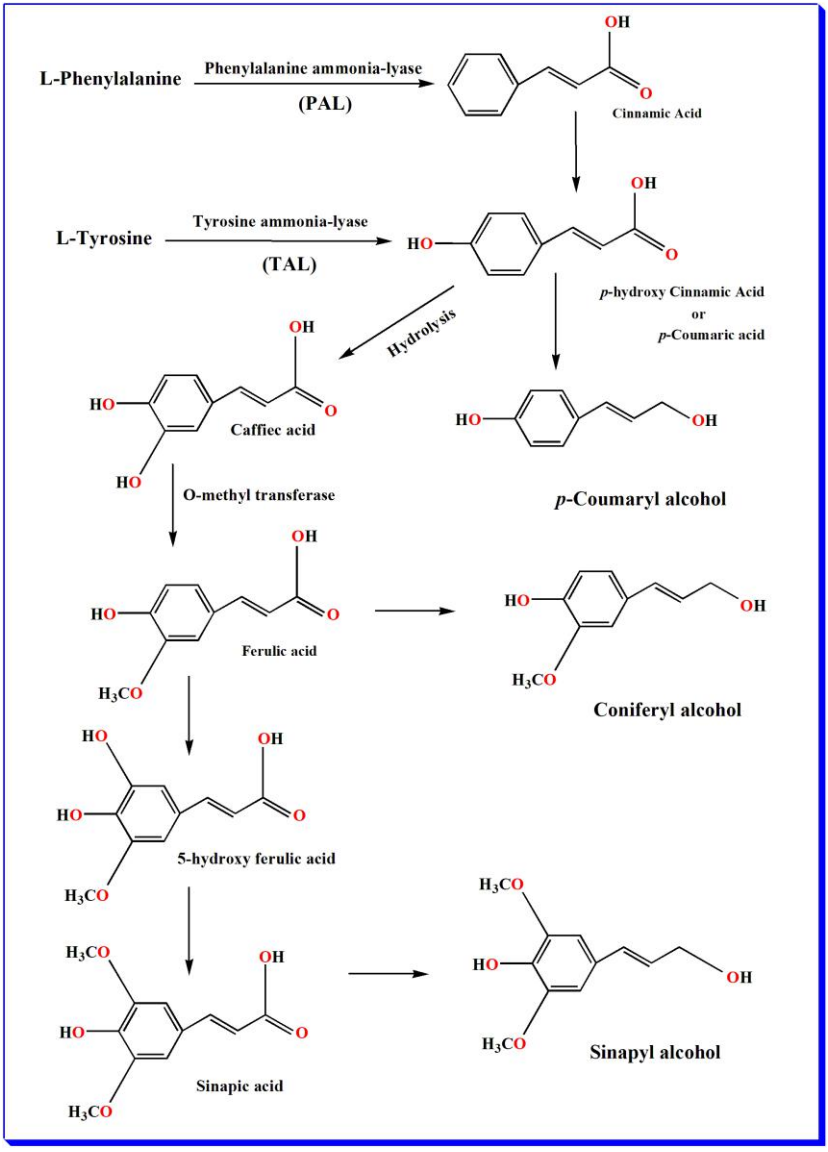

Figure 2. General biosynthesis pathway of monomers of lignin.

Then, the acid is diluted to 4% by adding water, and the depolymerization is completed by either boiling (100°C) for 4 h or pressure cooking at 2 bar (124°C) for 1 h. The acid is washed out and the sample dried. The residue

that remains is termed Klason lignin. A part of the lignin, acid-soluble lignin (ASL) dissolves in the acid. ASL is quantified by the intensity of its UV absorption peak at 280 nm. The method is suited for wood lignins, but not equally well for varied lignins from different sources. The carbohydrate composition may be also analyzed from the Klason liquors, although there may be sugar breakdown products (furfural and 5-hydroxymethylfurfural).

A solution of hydrochloric acid and phloroglucinol is used for the detection of lignin (Wiesner test). A brilliant red color develops, owing to the presence of coniferaldehyde groups in the lignin (John 1966).

Thermochemolysis (chemical break down of a substance under vacuum and at high temperature) with tetramethylammonium hydroxide (TMAH) has also been used to analyze the ratios of lignols with fungal decay as well the ratio of the carboxylic acid to aldehyde forms of the lignols. Increases in the lignol value indicate an oxidative cleavage reaction has occurred on the alkyl lignin side chain which has been shown to be a step in the decay of wood by many white-rot and some soft rot fungi.

Solid-state ^{13}C NMR has been used to observe at the concentrations of lignin as well as other major components in wood e.g., cellulose and its change with microbial decay. However, many intact lignins have a cross-linked with a very high molar-mass fraction that is difficult to dissolve even for functionalization.

4. BIOSYNTHESIS

Lignin biosynthesis is a very complex network that is divided into three processes: (i) biosynthesis of lignin monomers (Figure 2) (ii) transport and (iii) polymerization. After a series of steps involving methylation, deamination, hydroxylation, and reduction, lignin monomers are produced in cytoplasm and transported to the apoplast. Finally, lignin is generally polymerized with three main types of monolignols like p-coumaryl alcohol, coniferyl alcohol and sinapyl alcohol (Alejandro et al. 2012; Miao et al. 2010; Bonawitz et al. 2010; Liu et al. 2011). After transport, the lignin precursors are polymerized via free radical reaction. The formation of

radicals is catalyzed by oxidative enzymes, either H_2O_2-dependent peroxidases or O_2-dependent oxidases/laccases. These enzymes are secreted into the apoplast where they are either soluble or covalently or ionically bound to the cell wall (Blee et al. 2001).

The two amino acids L-Phenylalanine and L-Tyrosine which are widely present in plants are starting materials for the cinnamic acid pathway (Scheme Figure 2). Under the effects of various enzymes, the three monomers of lignin are finally synthesized after a set of chemical reactions, such as deamination, hydroxylation, methylation, reduction (Li et al. 2003; Geng et al. 2003), etc. Cinnamoyl CoA reductase (CCR) catalyzes the first step of the redox reaction of lignin biosynthesis, which may be the rate-limiting step, controlling lignin synthesis and the pathway from which carbon can go into lignin biosynthesis. Cinnamyl alcohol dehydrogenase (CAD) catalyzes the redox reaction of another step in the lignin synthesis process, which may control the reduction of coniferaldehyde. Sinapylalcohol dehydrogenase (SAD), ferulic acid 5-hydroxylase (F5H), and bispecific caffeic acid/5-hydroxyferulic acid O-methyltransferase (COMT) are immuno-localized in cells and tissues that have S lignin. CAD is located in tissues with precipitation of G lignin. It is speculated that the last step of redox reactions of different types of lignin may be passed through different synthetic pathways and catalyzed by different enzymes. C3H can catalyze coumaric acid to caffeic acid. Most research is inclined mainly to support the lignin biosynthesis and COMT can catalyze the methylation of caffeic acid, 5-hydroxyl coniferyl aldehyde, and 5-hydroxyl coniferyl alcohol into ferulic acid, sinapic acid, and sinapic alcohol, respectively (Lin et al. 2003).

4.1. Factors Influencing Lignin Synthesis

Different parts of plants would have different lignin content and composition. For example, the lignin content and structure are significantly different in the node and internode. The node lignin has a higher density than

the internode because of the high content of phenolic acids (p-coumaric acid and ferulic acid). In general, it has been observed that the overuse of nitrogen fertilizer will reduce the lignin content and hence stops the lignification of the plant. However, on the other hand, Phosphate fertilizer will greatly increase the lignin content in the cell wall of the plants.

4.2. Regulation of Lignin Biosynthesis

The lignin biosynthesis may be regulated by changing the activities of different enzymes in two main ways. The first way is to regulate the synthesis process of lignin monomers by simply reducing enzyme activities participating in the lignin synthesis, such as CCR, and CAD, and by reducing the lignin content. The second way is to regulate certain particular enzyme activity to influence the composition and chemical structure of lignin. It is generally believed that the degradation of GS lignin, which is composed of guaiacyl monomers and syringyl monomers, is easier than that for G lignin, which is simply composed of guaiacyl monomers.

In the gene regulation of lignin biosynthesis, the search for and separation of biological enzymes for lignin synthesis will be in first priority in the future. The amino acid sequence of zymoprotein is analyzed to obtain the sequence of its messenger RNA (mRNA), which is the coding sequence of the functional genes. Gene transfer can be done by using different methods like Agrobacterium-mediated indirect conversion and the gene gun technique. Antisense technology can be utilized for regulation of forest lignin. First, an oligonucleotide sequence is constructed that is antisense to the lignin synthase; then, the sequence is transferred into plants in direct or indirect ways, and it interacts with genes in plants to influence the translation and reduce the activity of zymoprotein. This is currently the most common and effective transgenic breeding technology in genetic engineering of lignin regulation. Finding and discovering a natural mutant in plants is also an equally effective and direct means.

5. POLYMERIZATION OF LIGNIN

Erdman (1930) studied the oxidative dimerization of various phenols in the biogenesis of natural products and reached the conclusion that lignin must be formed α,β-unsaturated C_6C_3 precursors of the coniferyl alcohol monomer through enzymatic dehydrogenation. Freudenberg and co-workers (1940-1970) had also verified the polymerization of precursors to lignin in nature follow the pathway as Erdman revealed and proposed (Figure 3). In their research, they confirmed that One-electron transfer from coniferyl alcohol by enzymatic dehydrogenation yield resonance-stabilized phenoxy radicals as mechanistically shown below:

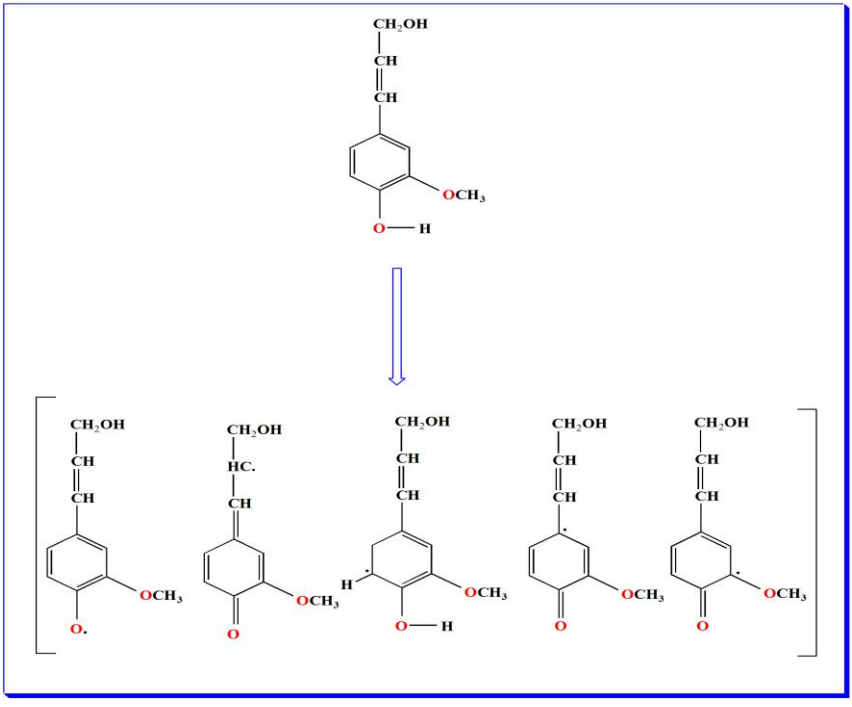

Figure 3. Formation of free radical monomers.

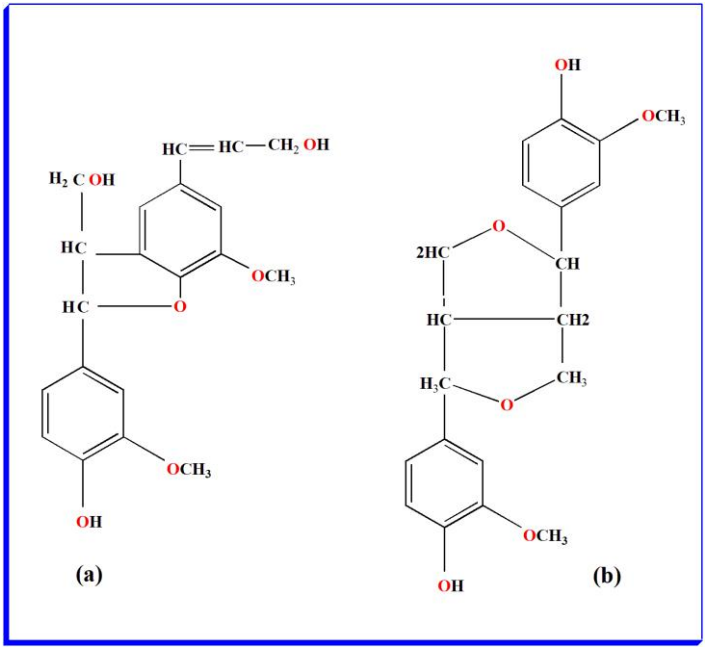

Figure 4. Polymerization of lignin monomer units.

Oligomeric products formed through coupling of coniferyl alcohol radicals as shown above. Endwise β-*O*-4 coupling of a coniferyl alcohol radical with a growing lignin group radical to an intermediate quinone methide (a) which is stabilized to a quaiacylglycerol-β-aryl ether (b) structure through addition of water (Figure 4). The scheme of oligomeric units polymerization is shown as under.

5.1. Types of Linkage and Dimeric Structure

It is clear and proved by the experiments that phenyl propane units are joined together both with C-O-C (ether) and C-C linkages. But however, the C-O-C linkages is dominant and is approximately 2/3 or more in the lignin structure. While the rest of the linkages are C-C type. Proportions of different type of linkages connecting the phenylpropane units in lignin are tabulated as below:

Table 1. Type of linkage and dimer structure

Linkage type	Dimer structure
β-O-4	Aryl glycerol-β-aryl ether
α-O-4	Noncyclic benzyl aryl ether
β-5	Phenylcoumaran
5-5	Biphenyl
4-O-5	Diaryl ether
β-1	1,2-Diaryl propane
β-β	Linkage through side chains

Table 2. Functional groups of lignin (per 100 C_6C_3 units)

Functional group	Softwood lignin	Hardwood lignin
Methoxyl	92 - 97	139 - 158
Phenolic hydroxyl	15 - 30	10 - 15
Benzyl alcohol	30 - 40	40 - 50
Carbonyl	10 - 15	-

5.2. Functional Groups in the Lignin Polymer

Lignin is a polymer contains characteristic Methoxyl groups, phenolic hydroxyl groups, and some terminal aldehyde groups in the side chain. However, only relatively few of the phenolic hydroxyls are free and most of them are occupied through linkages to the neighboring phenylpropane units. The syringyl units in hardwood lignin are extensively etherified. Alcoholic hydroxyl groups and carbonyl groups are introduced into the final lignin polymer during the dehydrogenative polymerization process. In some wood species, substantial amounts of the alcoholic hydroxyl groups are esterified with *p*-hydroxybenzoic acid or *p*-hydroxycinnamic acid. Ester of *p*-hydroxybenzoic acid is typical in aspen lignin. *p*-hydroxycinnamic acid is abundant in bamboo and grass lignin. The different functional groups and their distribution are tabulated as under:

6. APPLICATIONS

There are a number of applications of lignin in various fields which are discussed as under:

6.1. Antioxidant

Lignin acts as free radical scavengers. It's natural antioxidant properties provide a best use in cosmetic and topical formulations. Lignin sulfonate containing cosmetic compositions have been developed for decorative use on skin.

6.2. Paper

Lignin is used as a sizing agent. The polymerization of acrylamide and hydroxymethylated shown an enhance the tensile strength of paper. Packaging laminate comprising a barrier layer of lignin and oligo or polysaccharides, where the two are partly covalently bonded to each other.

6.3. Agriculture

The slow-release urea is composed of 90 - 99% urea and 1 - 10% lignin. That is why lignin is used either directly or after chemically modified as a binder dispersant agent for pesticides/herbicides, emulsifier and heavy metal sequestrate. The pulverized lignin, when blended with other chemicals, has been used as a soil water retention agent in acidic dry land or desert soil and also as a binder for fertilizer.

6.4. Dispersants

The Dye dispersant is prepared from sulfate or sulfite pulping liquors (lignin) which are cross-linked with formaldehyde products exhibit amazing properties like good dispersion, heat resistant stability, high-temperature dispersion property. Since the lignin sulfonates are biodegradable and non-toxic in nature and hence are used to prepare Jet printing ink. Chemically modified lignin has been used as a dispersing agent, complexing agent, flocculent, thickener or auxiliary agents for coatings, paints or adhesives. A mixture of polycarboxylic acid and lignin sulphonic acid has been used for cleaning aluminum plates.

6.5. Grease

When the calcium lignin sulphonate has been added to grease used to thickened the base grease in order to improve its lubricating quality. The grease which is mixed with lignin had improved not only corrosion protection properties but also provides anti-friction properties with longer lubrication life.

6.6. Heat

Since the artificial firelog using cellulosic matter, nonpetroleum based wax (lignin) and 1,3-propanediol derived from a renewable resource. However when an Indulin based lignin is added to wood pellets produces better quality pellets with high both fuel quality and value.

6.7. Fuel

The alkaline purified lignin, when mixed with diesel, are using as surfactants/emulsifiers. The lignin can be converted into the green gasoline

or diesel catalytically (metal precursor such as ruthenium or vanadium and a bidentate ligand) by the combination of different chemical methods pyrolysis, thermal cracking, hydrocracking or hydrocracking.

6.8. Battery

The lignin has great importance in batteries as it forms a thin layer on the graphite powder surface which prevents the battery from decreasing Hydrogen overvoltage and does not affect the condition of the graphite powder. It can also suppress generation of $4PbO.PbSO_4$ compound and hence enhances performance of energy storage devices.

6.9. Concrete

Low levels of lignin and its modified lignin can yield high-performance concrete strength aid. It can reduce damage to building external wall which can be caused by moisture and acid rain. Select lignins can improve the compressive strength of cement pastes and improves its binding property.

6.10. Plastics/Polymers

Lignin based rigid polyurethane resin which is comprised of an epoxy resin and a lignin-derived acid anhydride free lignin known as curing agent used for automotive brakes and epoxy resins for printed circuit boards. Polyphenylene oxide-based polymers and lignin esters are blended to exhibit modulus of elasticity, tensile strength, and elongation at break. Lignin can act as a water absorption inhibitor and as fluidization agents when mixed with polyamide. The use of alkali lignin poly(propylene carbonate) improves thermal stability and mechanical properties of the wonderful polymer.

6.11. Chemicals

One of the best use of lignin is the formations of phenols. Phenols are prepared by reacting lignin with hydrogen supplying solvent at elevated temperature or pressure. The reaction proceeds by the depolymerization of lignin in order to prepare phenolic compounds like:

- Cresols
- Catechols
- Resorcinol
- Quinones
- Vanillin
- Guaiacols

7. FUTURE RESEARCH

In the future, researchers are stressing to replace crude oil by lignin, as it is currently treated as industrial waste. The research route leading to this goal is being paved by new photo-catalysts. Unfortunately, despite many years of attempts by teams of chemists and other researchers from all over the world, still have not managed to develop efficiently. cheaper and successful methods of converting lignin. However, it seems a step closer to cheap solar biorefineries capable of processing lignin on an industrial scale using the new photo-catalysts. On the other hand, the efforts are also focused on how to make more efficient use of major raw materials streams of the paper and pulp industry of lignin. Since the lignin is the natural glue in plants and has a phenolic nature can be proved a new replacement for wood adhesives. An adhesive system for wood composites consisting mainly of lignin will be a new and great achievement in future.

CONCLUSION

The lignin is a wonderful complex natural product, secondary metabolite, and co-polymer. It is the second largest natural product after cellulose. It has a variety of applications in different fields as has been revealed and discussed in detail above. In past and present, a lot of work has been done on lignin. But however, the research on the lignin in future is open and will be a point of interest and consideration because of wood adhesive property of it.

ACKNOWLEDGMENTS

We highly acknowledge Dr. Masood Ayoub Kaloo Assistant professor (Chemistry) GDC Shopian for his discussion and support during various stages of preparation of this chapter. We are also highly thankful to Rukhsana Bilal, Sarhaan Bilal, Miss Gusia, Dr. Rafeeq Bhat and Saba Rafeeq for their valuable guidance and support with respect to the chapter.

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International Publications 07 International (edited) book along with ≥13 chapters with other publishers. She had supervised 08 PhD scholars and six more continuing.

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NSFC, Shaanxi Provincial Natural Science Foundation, Aerospace Science and Technology Innovation Fund. He was awarded the Second Class Prizes of The State Scientific and Technological Progress Award of China as the fourth executer, the Second Prize of Technological Invention Award in Shaanxi province and the First prize of Shaanxi National Defense Science and Technology Advancement Award as the third executer. He has published around 200 research papers and filed more than 50 patents, in which 23 of them were issued.

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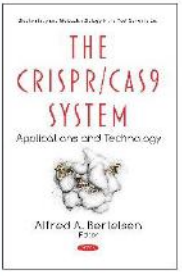

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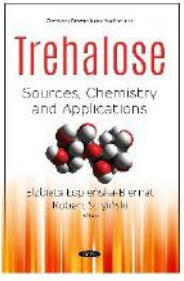

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OP-11

Role of communities and panchayats in conservation of Renewable Energy

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The Renewable Energy is the kind of energy that is collected or can be generated from the renewable sources such as biomass, sun, wind, tides, geothermal heat
The Renewable energy is very important as non renewable sources of energy such as petrol, diesel, LPG are non replenishable and will not last long, so renewable sources of energy will play a vital role in human life.
One such type of renewable energy resource is biomass such as wood, cow dung and agriculture waste which is available in large quantities in rural areas.
The Local communities and panchayats are encouraged to use biomass energy resources through mass awareness programs, and by local government agencies. There is emphasis for the biomass plantations which are grown on the marginal lands and under wasteland development programs. The grassland is also used to grow biomass and the agricultural residues are encouraged to be used as energy sources. The smokeless chullahs are promoted in the rural area to enhance the heath of community.
The present study is conducted in the rural and catchment areas of tribal belt in Udaipur and evaluation is made how the wise use of biomass energy is helping to meet the demand of the rural community.

Key words: Renewable energy, biomass, Community, Panchayat

OP-12

A new class of generalized polynomials

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Motivated by their importance and potential for applications in avariety of research fields,recently, various polynomials and their extensionshave been introduced and investigated. In this sequel, we modify the knowngenerating functions of polynomials, due to both Milne-Thomsonand Dere andSimsek, to introduce a new class of generalized polynomials and present someof their involved properties. As obvious special cases of the newly introducedpolynomials, we also introduce so-called power sum-Laguerre-Hermitepolynomials and generalized Laguerre and Euler polynomials and we presentsome of their involved identities and formulas. The results presented here,being very general, are pointed out to be specialized to yield a number ofknown and new identities involving relatively simple and familiar polynomials.

Key words: Laguerre- Hermite polynomials and generalized Laguerre

OP-13

Effect of nano–Al_2O_3 on the properties of Cementitious composites

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In this study, the effect of nano-Al_2O_3 on the setting time, workability, compressive strength, split tensile strength and flexural strength were investigated. The average diameter of nano-Al_2O_3 was used as 20 nm and it was used as a partial replacement of cement with three different contents 1.0%, 3.0% and 5.0% by weight. It was found that the setting time of the cement and workability of fresh concrete was decreased by increasing the content of nano-Al_2O_3. However, it was observed that the addition of nano-Al_2O_3 up to maximum replacement level of 5.0% improved the 28 days compressive strength, split tensile strength and flexural strength of concrete. Moreover, the ultimate strength of concrete was found at 3.0% of cement replacement.

Key words: Nano-Al_2O_3, Setting time, Workability, Compressive strength, Split tensile strength and Flexural strength

OP-14

Adsorption Property of Basic Dye by $NiFe_2O_4$/Polypyrrole Composite

Daud Hussain, Mohammad Fuzail Siddiqui and Tabrez Alam Khan
Department of Chemistry, Jamia Millia Islamia

$NiFe_2O_4$/polypyrrole magnetic composite was prepared by in situ chemical oxidative polymerization of pyrrole in the presence of $NiFe_2O_4$ particles, where the NiFe2O4 particles were synthesized by co-precipitation method. The composite was characterized using FT-IR, XRD spectra, EDX and SEM techniques. The adsorption characteristics of the NiFe2O4/ polypyrrole composite were assessed by using basic dye as an adsorbate. The adsorption process was investigated as the function of various parameters such as initial dye concentration, contact time, adsorbent dose and initial solution pH of basic dye. The equilibrium adsorption data fitted well to the Langmuir and Freundlich model and the maximum adsorption capacity was found to be 448.93 at 303 K. kinetics studies indicated that basic dye adsorption followed the pseudo-second order kinetic model.

Key Words: - $NiFe_2O_4$/polypyrrole, Adsorption, Langmuir

OP-15

Oxidative Coupling Reactions for Carbon-Carbon and Carbon-Heteroatom Bond Formations

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This review deals with the conceptual aspects of oxidative coupling transformations.A coupling reaction in organic chemistry is a general term for a variety of reactions where two hydrocarbon fragments are coupled with an aid of a metal catalyst. Several named reactions in this field such as Negishi reaction, Suzuki reaction, Stille reaction, Hiyama reaction and Buchwald–Hartwig reaction have been explored and widely applied in industry. By variation of the coupling partners, coupling reactions can be classified into three types: traditional coupling, oxidative coupling, and reductive coupling.

The mechanism for traditional coupling contains three main parts: (a) oxidative addition of C-heteroatom bond of electrophiles (b) transmetalation of nucleophiles and (c) reductive elimination. In traditional coupling, during oxidative addition, the electrophile itself acts as an oxidant to oxidize the low-valent metal catalyst. Its organic group ultimately becomes part of the cross-coupled product. While in oxidative coupling, the product contains two groups from two nucleophiles. The oxidant only acts as an electron acceptor to oxidize the metal species which in turn binds with the substrate nucleophiles to form a transition state without going into the cross-coupling product. Oxidative coupling activate two different C-H bonds or H-Heteroatom bonds. It couples them via a transition metal catalyst, and carries out the reaction in air/O_2 or with other oxidants.

Key words :- Coupling, Catalyst, Oxidative.

OP-16

Synthesis, Characterization and Antioxidant Studies of Heterocyclic Analogues as Potential Antibacterial Agents

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A series of heterocyclic derivatives was synthesized using various substituted amines with substituted aldehydes in acidic condition. Completion of the reaction was monitored by thin layer chromatography (TLC) in appropriate solvent system. Structural analysis of the synthesized heterocyclic derivatives was carried out by elemental analysis and various spectroscopic techniques like ^{1}H NMR, ^{13}C NMR, IR, UV-visible and mass spectrometry. The pharmacological treatment of heterocyclic derivatives was carried out by Molinspiration Cheminformatics for the calculation of important molecular properties (molecular weight, logP, number of hydrogen bond donors and number of hydrogen bond acceptors) and for the prediction of bioactivity score for the most important drug targets (GPCR ligands and kinase inhibitors). Results showed that heterocyclic derivatives have promising potential or bioactivity and none of the derivatives violates from Lipinski's rule. Antioxidant activity of all the heterocyclic derivatives was also carried out to evaluate the antioxidant nature against DPPH free radical and H_2O_2 assay.

Key words: Heterocyclic, DPPH, H_2O_2, antioxidant.

OP-17

In-situ Generation and Characterization of Gold Nanoparticles: A Nano-biomedical Approach

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Owing to the eminent beneficial properties because of the characteristic physicochemical properties of gold nanoparticles (AuNPs) their utilization in different fields has been tremendously increased. Generally physical methods for the formation of AuNPs involved more energy in the form of high temperature and pressure. Despite of this, hazardous chemicals which are quite toxic with their by-products are not environmentally benign. Alternatively, different advanced techniques are come into play such as laser ablation which is a rapid process for the reduction of AuNPs. However, as produced nanoparticles were observed to be aggregated and hence cannot be used in pharmaceutical and biomedical applications as well. Therefore, unlike laser ablation in this study we have successfully synthesized AuNPs in order to achieve well dispersed nanoparticles without agglomeration so as to use in biomedical field. The well dispersed AuNPs showed UV absorbance in the range of 500-550nm due to the surface plasmon resonsnce of electrons. Further characterization of spherical and triangular shaped AuNPs involved Dynamic Light Scattering (DLS), Fourier Transform infrared (FT-IR) Spectroscopy, Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Energy Dispersive Spectroscopy (EDS), X-Ray Diffraction (XRD), and Transmission Electron Microscopy (TEM). Additionally, we have go through the antibacterial activity against *E.coli*, *S. aureus* and P. aeroginosa as well as antioxidant activity of the AuNPs. Hence, we can conclude that the well dispersed AuNPs have potential to be used in biomedical sciences.

Keywords: AuNPs,biomedical sciences

OP-18

Optical Sensor for Real time Quality Analysis in Materials Engineering

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There has been an increase in use of optical devices for water treatment applications and in food manufacturing .This work proposes the use of a commercial optical sensor to achieve inline quick-time water content analysis. Samples of test fluids were used and optical measurements of attenuation of light intensity at four colours were made. These measurements were used to identify any relationship between these and the water quality parameters of turbidity and colour. Changes in light attenuation for turbidities up to 1800 NTU were settled by the instrument, with optical data for turbidities > 30NTU fitting well the Beer-Lambert model. The sensor was also able to clearly identify the effect of filtering out suspended solids with unfiltered samples exhibiting significantly higher attenuation coefficients than filtered samples .Furthermore, the studies will concentrate on whether the instrument can analyse samples with turbidities higher than 1800NTU, together with further investigating the variation in the attenuation seen with the colour of light and turbidity

Key words- RAMAN, EDFA, SOA, BER, quality factor, eye closure

OP-22

Study of Luminescent properties of CdS Nanocrystals

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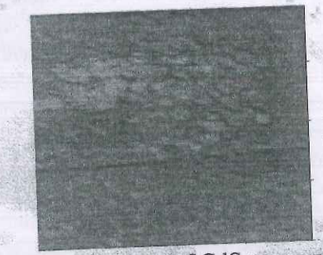
During the last few decades research has been performed on different types of semiconductor nanoparticles. Among the most studied are the III-V semiconductors (GaP, InP, GaN, etc) and II-VI semiconductors (CdSe, CdS, ZnS, ZnSe). There exist a many number of methods to obtain nano scale particles with different properties. CdS nanoparticles have been prepared using wet chemical route method and studied their luminescent properties. CdS nanocrystals are characterized by AFM and determined its crystalline size. The crystalline size measured by AFM of all the samples is found in nano-range. The size obtained from AFM photographs is between 20 nm-35 nm.



[Figure: AFM image of CdS nanocrystal

Key words: Preparation, characterization, CdS nanoparticles.

P-23

Copolymerization of Pyrrole and 5-Amino-2,3-dihydro-1,4-phthalazinedione: Effect on spectral, thermal and morphological and fluorescence characteristics

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The fabrication of conducting fluorescent copolymers to enhance their spectral, thermal and morphological properties has attracted so much attention. With the aim to bring systematic comparison of properties of homopolymers and copolymers of pyrrole and 5-Amino-2,3-dihydro-1,4-phthalazinedione, the present study reports the synthesis of homopolymers and copolymers of heterocyclic aromatic compound pyrrole and chemiluminescent material 5-Amino-2,3-dihydro-1,4-phthalazinedione by varying mol ratio by chemical polymerization. The formation of random copolymer was confirmed by reactivity ratio determination using Fourier transform infrared spectroscopy and by ultraviolet-visible spectroscopy. Ultraviolet-visible spectroscopy revealed changes in optical properties as well as monomer ratio varies. X-ray diffraction analysis showed the orientation of pyrrole moiety and how the higher feed of pyrrole distorts the structure by torsional strain and structure goes to non-planarity. TEM micrographs also revealed the highly ordered structure with long chains of copolymers for PPy/PLu-80/20 and confocal microscopy revealed intense red emission for the same copolymer in NIR region, hence could be used for bioimaging agents or advanced optoelectronic materials.

Key words: Conducting polymers, fluorescence, copolymerization

Keywords: Conducting polymers, fluorescence, copolymerization

OP-24

Impact of Electrochemical Biosensors for Food and Health Analysis

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In the last decade due to major developments in food industry it is necessary to check for the food items for various chemicals that can cause health risks like bacterial infections and other toxins. The techniques used earlier like chromatography, these techniques were able to analyze and detect the contaminations and their quantity, but they require larger labor, expensive equipment and delayed results. Therefore emerging technologies like electronic biosensors can help in doing this work at a very efficient manner. These can provide the result with high accuracy and ability to work in any condition temperature or pH whatsoever.

Keywords- RAMAN, EDFA, SOA, BER, quality factor, eye closure

OP-25

Green Chemistry Potential for Past, Current and Future

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Developments in Chemistry bring medical revolution till about the middle of twentieth century when the drugs and antibiotics were discovered. The global world's food supply also become just double due to the discovery of hybrid varieties, new methods of farming, good quality seeds, and increase use of insecticides, herbicides and fertilizers. The standard of living becomes better due to the discovery of dyes, plastics, cosmetics and other materials. Soon, the side effects of chemistry also became pronounced and results in pollution of land, water and atmosphere. . This is often caused chiefly because of the consequences of by-merchandise of chemical industries, that area unit being discharged into the air, rivers/ oceans and therefore the land. The use of toxic reactants and reagents also make the situation worse. The pollution reached its limiting value that different governments laws were made to minimize it. This marked the beginning of *Green Chemistry* by the middle of 29th century. Green Chemistry is defined as environmentally benign chemistry. As on nowadays, most pollution to the atmosphere is caused by varied chemical industries. Therefore, tries are created to style synthesis for producing processes in such the way that the waste merchandise area unit minimum, they need no impact on the atmosphere and their disposal is convenient. For concluding reactions it's necessary that the beginning materials, solvents and catalysts should be carefully chosen. For instance Benzene (C_6H_6) as a solvent must be avoided at any cost since it is carcinogenic in nature. If potential, it's best to hold out reactions within the liquid section. With this read in mind, synthesis strategies ought to be designed in such the way that the beginning materials area unit consumed to the most extent within the final product. Thereaction should also not generate any toxic by-products.

Keywords: Safer chemicals, Hazardous wastes, Chemical education, Environmental objectives, etc.

OP-26

Biodegradation Of Odor Causing Compounds By Bacterial Biofilter

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Gaseous streams and effluents from landfills and industrial processes carry many compounds, which are harmful for human health. A major part of this is odorous in nature which includes VOCs and inorganic compounds like ammonia (NH_3) and hydrogen sulphide (H_2S) etc. Some of compounds are in the list of ambient air pollutants as given by CPCB. A wide variety of odorous compounds can be treated by biological processes mainly biofilters. Biofilter has bed on which microorganisms are grown and the bed can be made of waste materials like wood, PVC pipes etc that may make it a part of sustainable development. Most biofilters used to remove contaminants from gas are carrying mixed cultures or bacteria. Bacteria grown biofilter are more advantageous then fungi grown biofilter as they have high rate of growth and high substrate utilization rate. This paper gives views about biodegradation possible by bacterial biofilters and optimum conditions for degradation. It also discusses about some comparisons between fungal and bacterial cultures used and their elimination capacities.

Keywords: Biodegradation, Bacterial biofilter, VOC, CPCB, Sustainable development

OP-2

Synthesis of Graphene Sheets by Green Synthesis Method and Their Anticancer

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Here in this work weapply total green synthetic method without using any additional chemical exfoliate the graphene sheets from commercially graphite with the aid of polymer nanoparti (PNP). In current work we apply different size of polymer nano-particle made up of Poly vi pyrrolidone (PVP) and got success in exfoliate the graphene sheets. Present work shows importance of different size of PVP-NP in the exfoliation of graphene sheets and suggest the s of graphene sheets is more stable and produce good yield. We also observe application of exfoliated graphene sheets as an anticancer agent and got remarkable results by MTT experimen

Keywords; Graphene, PVP-NP, Anticancer agent.Greensynthesis.MTT assay.

OP-28

Mechanical properties of open cell aluminum foams processed by pressurized infiltration casting technique

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Metal foams (MFs) have emerged as a new class of engineering material in past two decades. The physical and mechanical characteristics of MFs drastically differ from their bulk counterpart. Their structures offer potential for light-weight application in transport industry, for sound and vibrations energy absorption, and for thermal management. Among various MFs Aluminum (Al) foam combines properties such as relatively high strength, good workability, resistance to corrosion, good thermal and electrical conductivity, excellent joining characteristics, and good acceptance of applied coatings. Their porous nature allows relatively easy passage of air or fluids. These features of Al foams have miscellaneous and pertinent industrial applications such as materials in heat exchangers, compact aircraft fittings, camera lens mounts, couplings, marines fittings and hardware, electrical fittings and connectors, hardware, magneto parts, brake and hydraulic pistons, appliance fittings, bike frames etc. Technologically, different methods such as direct or indirect foaming method, infiltration technique, lost carbonate sintering method, electroplating technique using polymer foam etc., have been developed for fabricating Al MFs.

Here, Al MFs with wide range of relative densities have been synthesized by a low cost and convenient technique of pressurized infiltration casting with efficient control over pore size. NaCl particles of 1- 2 mm size were used as preforms. Infiltration processing offers a versatile and economical route for the production of open cell foams and is required to overcome the capillary force arising from non-wetting conditions between salt beads and molten Al. The molten Al was infiltrated into the preforms with an inert gas pressure of ~2 bar followed by cooling and leaching of salt in proper medium. The crystalline phase of the developed MFs was confirmed with X-ray diffraction (XRD). The morphology of the pores was studied using photographic image and scanning electron microscope (SEM). The distributions of pores were studied using X-ray tomography (CT-scan). The samples were cut into required dimensions following ASTM E9-09 standard and mechanical properties of the developed foams were analyzed with Universal testing machine under quasi static compressiveloading.

Key words: Metal foams, compressive loading, CT-scan, infiltration casting

OP-29

IoT Impact in Materials Processing Industry

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Internet of Things (IoT) is one vast network where almost any device is connected to the internet and other many devices using sensors and wireless networks. With the effective use of IoT, we can actually monitor and respond to various environmental conditions. Research by McKinsey Global Institutes revealed that many food processing industries will be benefited the most by the use of Internet of Things by 2025. IoT helps in operation management and predictive maintenance. In this research paper we have covered various areas in food processing where IoT has given a large impact like food safety, remotely monitoring , maintenance and logistics etc. Graphical measurements also shown which indicates the impact and growth by the use of IoT measures will change the food processing industry in 2025. Lastly we have shown the future aspects of IoT in food processing industry.

Key words: Internet of Things, sensors, food production, crop efficiency, smart farming.

OP-30

An Experimental Analysis on Strength Properties of Steel Fibre Reinforced Concrete

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Fibres are in general are used for crack resistance and reinforcement the concrete. The test was conducted on steel fibre reinforced concrete to study the influence of fibre in strength properties of concretei.e. compressive strength, tensile strength and flexural strength behaviour of composite concrete with different proportion of steel fibres mixed in it. Steel fibre of diameter 0.50 mm with aspect ratio 70 at various proportions as 0%, 0.5%, 1%, 1.5%, and 2% by the weight of concrete on M20 grade of mix proportion (1:1.56:2.84) with a low water-cement ratio 0.42 is used. Test results show that the concrete formed by using straight steel fibres had improved performance over the conventional concrete for an optimum dosage of 1.5% by weight of concrete. The compressive strength of SFRC increased up to 20 % as compared to plain concrete while the Split Tensile Strength and flexural Strength increased up to 35% and 40%respectively.

Key words: -Steel Fibre Reinforced Concrete, Compressive Strength, Split Tensile Strength, Flexural Strength.

OP-31

Design of Three-stage Y-junction based Wavelength Interleaver with Flattop Response

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A Y-junction three stage optical planar optical waveguide interleaver is analyzed. This interleaver is designed by using three identical Y-junctions Mach–Zehnder interferometer (MZI)-based wavelength interleaver. For spectral response at the output port a design equation has been derived and optimized the parameter. It has been theoretically demonstrated of 100 GHz channel spacing over a 50 nm wavelength window. The 0.5 dB pass -band at the two output ports were 45GHz and 50 GHz , respectively.

Key words: Dense wavelength division multiplexed networks, Y-junctions based Fiber couplers, Fiber slicer.

OP-32

A Review on Smart Nanogel for Targeted Delivery Drug

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Decades of massiveworks developed an array of different carriers that targeted to enhancethe transportation of drugs, to reducethe side effects and to achieve controllable action on the targeted curative sites of human body. The conventional challenges of drug delivery systems, its solubility, its substandard pharmacokinetics, in-vivo stability, toxicity and side effects, are being overcome by the advent of Nanotechnology. It originates the necessity for developing the nanogel system to transport the drug in controlled, continuous and targetable manner by adjusting its chemical network. Nanogels show faster responsiveness to change in light exposure, pH, ionic strength, temperature and magnetic field. These stimuli can be applied to develop an effective nanogel system for medical diagnostics. The different nanogel reviewed in this article depends onpH, temperature, magnetic field, temperature and pH, pH and magnetic field. In addition to this the temperature and pH responsive core-shell nanogels, functional group active nanogel, functional group active pH and temperature responsivenanogel and degradable nanogels system also reviewed.

Key words: Nanogels; pH; temperature; magnetic field; core-shell; degradable nanogel.

OP-33

Vortex nucleation: An Exact Diagonlaization study

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We have presented an exact diagonalization study on the rotating Bose-condensed gas of spinless particles interacting via finite-range Gaussian potential confined in a quasi-two-dimensional harmonic trap. For repulsove particle-particle interactions, the many-body ground states were obtained within subspaces of quantized total angular momenta in slowly rotating regime. A distinctive feature of this work is that in constructing the many-body variational ground-state wave function, we have included the higher Landau-level (LL) states with single-particle angular momentum quantum number m of either sign, in the slow rotating regime. In order to analyze the ground state properties of the rotating condensate, we have calculated the first order correlation as embodied in single-particle reduced density matrix. We have also determined degree of condensation and von Neumann entaglement entropy as the measure of many-body quantum correlation for stable as well as unstable vortex states corresponding to different quantized total angular momenta in the above mentioned regime. As a measure of internal structure of the many-body ground states, we have calculated the conditional probability distribution from the ground state of the rotating Bose gas.

Key words: Bose-Einstein condensation, Votex, Beyond lowest-Landau levels approximation, Quantum correlations, Finite range gaussian interaction

OP-34

Host matrix dependent improvement in electro-optical responses of polymer dispersed liquid crystal composites.

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Electro-optical properties of polymer dispersed liquid crystal films with poly(methyl methacrylate) (PMMA) and poly(methyl methacrylate-co- butyl acrylate) (PMMABA) as host polymer matrices have been studied on a low molecular weight nematic liquid crystal E44. For a wide range of polymer/liquid crystal compositions, the effects of voltage and frequency of the applied electric field on the light transmission and response time of the films were measured. A significant improvement in driving voltages, switching response and hysteresis effect were observed for the composites prepared with blend of polymers over the composites with individual polymers as host matrices. Scanning electron microscopy observations showed a significant variation in the morphology of phase separated E44 micro-droplets in different host matrices. A continuously embedded E44 phase in the polymer matrix resulted in a better response time of the order of sub milliseconds and the results could be easily controlled by varying the concentration of PMMA and PMMABA. The host matrices seem to be promising materials for the fast electro-optical switching devices.

Key words: Electro-optical, composites, PDLC, liquid crystal, display devices.

OP-35

Review On Use Of Geotextile To Enhance The Engineering Property Of Subgrade Soil

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Economic growth of a country is hugely dependent on its road transport infrastructure facilities available. The regular maintenance of road is restricted due to cost consideration which will affect the service and disturb the normal function of the road. To overcome these constraints, Geotextiles shall be used in pavements to increase the service life of the pavement structure which requires less repair and maintenance and also reduces the total thickness of the pavement system. In this paper, an attempt is made to review the use of geotextile to enhance the performance of Flexible pavement and Rigid pavement using woven geotextiles and non-woven geotextiles between the layers of subgrade and base course for subgrade stabilization. The use of geotextiles increases the California Bearing Ratio (CBR) value in un-soaked and soaked condition. The performance of Pavement is better when we use geotextiles because it has better puncture resistance when subjected to impact loading and also produce good drainage properties. And geotextile also increase the strength and stiffness of soil base having low bearing capacity, so we can use geotextile to enhance the subgrade properties.

Key words: Woven and Non-Woven Geotextile, Subgrade, California Bearing Ratio.

PP-07

Preparation and Characterization of Polyaniline and Molybdenum Disulphide Nanocomposites

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Nanocomposites of polyaniline (PANI) and molybdenum disulphide (MoS_2) were prepared by oxidative polymerization of aniline in present of MoS_2. The PANI-MoS_2 nanocomposites were characterized advance analytical techniques like FTIR, UV spectroscopy, SEM, TGA and XRD. Electrical conductivity studies were performed by four-in-line conductivity meter. Electrical conductivity Stability of nanocomposites in terms of d.c. electrical conductivity retention was studied in ambient atmosphere by isothermal and cyclic processes. These nanocomposites were found to be semiconducting in nature and followed the Arrhenius plot for semiconducting materials. The stability of DC electrical conductivity was found to improve with the increase in amount of MoS_2. The SEM and XRD data suggest the exfoliation of MoS_2 layers and presence of nanoparticles in the prepared nanocomposites.

Key words: Polyaniline, MoS_2, Electrical Conductivity, Stability

PP-08

Study of Erosion of Copper Electrode on Die Steel Material at Constant Current and Voltage by using EDM

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EDM is an electrical discharge machining, used in machining of those materials which are not machined by conventional machining process. This machining method is more advanced than conventional. In this experimental study cylindrical copper material is used as an electrode and die-steel is used as work piece material. In this empirical work results were found for erosion of copper electrode with respect to die steel work piece material at constant current and constant depth of machining by varying of time-on and time-off parameters. In this work input parameters are current, voltage, T-on and T-off and output parameters are erosion of electrode material in terms of weight (grams) and length (mm). The eroded metal on the surface of both work piece and the electrode is flushed away by the dielectric fluid. This study mainly concentrates on copper electrode and output parameters such as electrode wear rate and surface roughness. Electrode wear rate and surface roughness have increased with increase in pulse on time. Higher pulse on time will produce higher material removal rate. Surface roughness decreases with increasing pulse on time.

Key words: EDM, Electrode wear rate, Pulse, Current and Copper electrode.

PP-09

Adsorption of crystal violet dye onto the Polyaniline modified Luffa Aegyptica Peel

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In the present work, polyaniline modified Luffa aegyptica (PANI/LAP) has been employed as an effective adsorbent for the elimination of crystal violet (CV) dye from synthetic wastewater. Batch adsorption experiments have been conducted to optimize different factors affecting adsorption. The adsorption isotherm data were analyzed by Langmuir, Freundlich and Temkin models and the kinetics data were studied with pseudo-first-order, pseudo-second-order, Elovich, and intra-particle diffusion. The thermodynamic investigation indicates that the process of adsorption of CV by PANI/LAP is feasible, endothermic and associated with an increase of entropy. The results indicate that PANI/LAP is an efficient lowcost adsorbent for the removal of CV dye from wastewater.

Key words: Polyaniline modified Luffa aegyptica (PANI/LAP)

PP-10

Utilization of biosensors for present and future in food industry

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The purpose of this project is rediscovering the application of biosensors to detect the changes in food caused by the frying process. Changes in food and oil depends on the characteristics of the food, oil type, surface/volume ratio of the oil, rate of air incorporation of into the oil, temperature, heating process, length of immersion and the kind of material the frying container is made of. Additionally, the longer the oil is used, greater is the induction of adverse reactions. Extended exposure of oil to high temperatures and atmospheric air can generate highly oxidized, potentially toxic products. Biosensors are a device which uses a living organism or biological molecules, especially enzymes or antibodies, to detect the presence of chemicals. Biosensors act as analytical devices employing a biological material or biomimic as a recognition molecules integrated within a physicochemical transducer or transducing microsysytems. The outcome of this is a digital electronic signal proportional to the concentration of a specific analyte or analytes. Biosensors are used in various fields, with miniaturization and reduced cost has further increased the analytical capabilities of such device.

Key words: RAMAN, EDFA, SOA, BER, quality factor, eye closure

PP-11

Synthesis & characterization of PANI-Ag nanocomposite and its application as catalyst in organic synthesis

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Polymer nanocomposites are materials that blend or fuse the organic or inorganic filler of nanosized particle into the matrix of the polymer by physical blending or chemical polymerization technique. These nanocomposites have high performance than the simple polymers due to their nanometer size & exhibit unique design possibilities. There is a growing interest in developing nanoparticles for the catalysis of different type of reactions due to their high specific surface & catalytic performance which increases with decreasing size. Recently, PANI is been used as catalyst support because of its high conductivity, chemical & environmental stability, low operational voltage & unique redox properties associated with N-atom in it. Incorporation of Ag nanoparticle in PANI is of great interest. PANI-Ag nanocomposite is synthesized by in-situ polymerization of aniline & it is characterized by UV-Vis, XRD, FTIR, SEM& TGA. In future this catalyst will be used in organic and MOFs synthesis as a recyclable heterogenous catalytic system. The catalytic process is green & offers a number of advantages such as easy separation of catalyst from reaction mixture by filteration, reusable making nanotechnology based recyclable heterogenous catalytic reaction an advanced, green and environmentally sustainable.

Key words: PANI, UV-Vis, XRD, FTIR, SEM& TGA

PP-12

A facile Chemical Method to Produce Super-paramagnetic Graphene Oxide@Fe_3O_4-BC Nano-composite and its Multiple Applications in the Removal of Arsenic (III) and Methylene Blue Dye from Aqueous Solution.

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Nano-hybrid composite (GO@ Fe_3O_4-BC) was prepared by simple co-precipitation method and has been successfully utilized for the removal of As (III) and MB dye from the water. The amorphous phase of the GO@ Fe_3O_4-BC Nano-hybrid composite is determined by the XRD, the morphology and microstructure of the nano-composite are analysed by SEM-EDX and TEM, the magnetic property of the nano-composite is determined by the VSM analysis. The adsorption experiments results showed that the GO@ Fe_3O_4-BC was an excellent adsorbent because of its high uptake capacity. Batch adsorption experiments were conducted to study the effect of adsorbent dose, adsorption time and temperature. Isotherms, kinetics, thermodynamics were also studied, with a view to understand the adsorption efficiency, while the data of adsorption isotherm and kinetics were better fitted by Langmuir isotherm model and the pseudo second-order kinetic model for both ions, respectively. The free energy change ΔG° decreased with increase temperature and the positive ΔH° and ΔS° values indicated the endothermic nature of adsorption and increased randomness at the adsorbent- solution interface, respectively.

Key words: Nano-hybrid composite (GO@ Fe3O4-BC), SEM-EDX and TEM

PP-13

Investigation of Micro Hardness of the Welded Region of AL 5052 Using Friction Sir Welding

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Friction stir welding (FSW) has been used to join Al-5052 which is not possible by fusion welding process. The rotational speed of tool was varied from 1250 to 1600 rpm for joint process and achieve better surface finish. Two different profile of welding pin type was used to examine the effect of tool profile on mechanical properties of joint. The tool was designed and fabricated by varying the profile of the tool pin namely Tapered threaded, Tapered cylindrical and Cylindrical threaded. In present investigation FSW of Al-5052 have been study by various lab testing. The hardness of joint was also influenced by position of specimen. Maximum hardness of specimen at horizontal and vertical position was found as 138 HV and 144 HV respectively.

Key words: Aluminum; friction stir welding; hardness; tensile strength

PP-14

Treatment of dye contaminated water by Jackfruit Peel as an Adsorbent

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Present investigation comprises the preparation of a potential adsorbent from Jackfruit Peel (JP) waste and exploited for removal of methylene blue (MB) from aqueous solution. The unloaded and MB loaded adsorbent were characterized by scanning electron microscopy (SEM), energy dispersive X-ray analysis (EDAX), Thermo gravimetric analysis (TGA) and Fourier Transform Infrared (FTIR) spectroscopy. The batch parameters such as adsorbent-adsorbate contact time, initial concentration of MB, pH, JP dose, and temperature were optimized. The adsorption kinetics of MB onto the JP adsorbent obeyed the mechanism of pseudo-second order kinetics and its equilibrium data were fitted well with the Langmuir isotherm modelwith maximum adsorption capacity of 243.43 mg/g. Thermodynamic study revealed that the process of adsorption was endothermic and spontaneous in nature and accompanying with increase of entropy.On the basis of examination of the experimental data, it could be submitted that the present adsorbent has potential to decontaminate dye loaded wastewater.

Key words: EDAX, TGA, FTIR

PP-19

Effect of Information and Communication Technology on Students' Academic Achievement in Mathematics at Senior Secondary Level

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The present paper is an attempt to study the effect of information and communication technology on students' academic achievement in mathematics at senior secondary level. Eighty senior secondary students of 11th grade were selected through purposive sampling technique from an Inter College, Rudian, Badaun district, Uttar Pradesh. The two equated groups were formed on the basis of pre-treatment achievement scores and were randomly labeled as control group and experimental group. Results reveal that 1) information and communication technology positively affect students' academic achievement in mathematics at senior secondary level in comparison to traditional method of teaching mathematics; 2) information and communication technology positively affects academic achievement of school boys in mathematics at senior secondary level in comparison to traditional method of teaching mathematics; and 3) information and communication technology positively affects academic achievement of school girls in mathematics at senior secondary level in comparison to traditional method of teaching mathematics. Information and communication technology was found more compelling, effective and valuable in teaching mathematics when contrasted with traditional method of teaching mathematics. It is recommended that information and communication technology should be used in teaching mathematics for enhancing students' academic achievement at senior secondary level.

Keywords: Information and Communication Technology, Students' Academic Achievement, Mathematics and Senior Secondary Level.

PP-

A Review on Friction Stir Welding of Aluminium Alloys

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Friction Stir Welding is a new solid state welding technique for similar and dissimilar materi invented and developed by The Welding Institute in 1991.In producing efficient dissimilar joi Friction Stir Welding technique has brought a revolution. It is the process of welding the b material, well below it's melting temperature. Already huge research has been done parameters like effect of welding speed on microstructures, hardness distribution and ten properties of the welded joints were investigated. In this paper a review is done how FSW is for aluminium alloys.FSW is becoming an emerging technology with numerous applications.

Keywords:FSW, aluminium alloys

PP-21

Cyber-Security Behavior: A Study of Higher Education Students

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This paper describes the cyber-security behavior of higher education students with respect to gender, locale and department. Descriptive survey method was used. A sample of 71 higher education students comprised of 42 female and 29 male, was selected through convenience sampling technique for the present research. A 50 item Cyber-Security Behaviour Instrument designed by the LalithaMuniandy, BalakrishnanMuniandy and ZarinaSamsudinwas used to collect the responses of the higher education students. Results reveals that there exists no significant difference in cyber-security behaviour of higher education students with respect to gender and locale; Psychology department students have better cyber-security behaviour as compared to students of computer science as well as education department; and Cyber-security behaviour of psychology and geography department students; computer science and geography department students; computer science and education; and geography and education department students is found to be similar.

Key words: Cyber-Security, Phishing, Hacking and Higher Education Students

PP-22

Performance analysis of Biosensors with Challenges in Sustainable Food Engineering

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In the last decade due to major developments in food industry due to increase in population it is necessary to check for the food items for various chemicals that can cause health risks like bacterial infections and other toxins and at the same time ensuring safety of the environment. There's a huge demand in biosensor technologies for food sustainability. The demand of point of care (POC) technologies focus on rapid, simple, accurate, portable, and low-cost analytical instruments. These can provide the result with high accuracy and ability to work in any condition temperature or pH whatsoever, providing food production, food safety, food processing, supply chain, food waste management and quality assurance.

Key words- RAMAN, EDFA, SOA, BER, quality factor, eye closure

PP-27

Removal Of Methylene Blue from Wastewater Using Nanocomposites

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Methylene blue dye is a common constituent in wastewater effluent from textile mills. Nanocomposites are very promising for commercial applications in water treatment as they have shown excellent abilities for adsorption of contaminants. In this study, literature survey on the recent studies on the uptake of methylene blue via applications of various nanocomposite sorbents was made. Adsorption performance of reported nanocomposites is compared with respect to their mode of synthesis, and cost. Challenges and future prospects of nanocomposites in the removal of methylene blue are also presented.

Key words:Methylene blue; adsorption; water treatment; dye

PP-28

Review on Biodegradable Plastics

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Bioplastics are plastic derived from renewable sources such as vegetable fats and oils, starch and cellulose. Synthetic plastics are nonrenewable, threaten to the environment, declining impacts on marine life and increases environmental pollution. The development of bioplastics helps to solve many of these sustainability problems, offering the potential of renewability, biodegradation, and a path away from harmful additives and moreover a healthy earth. Therefore, there is a tendency to replace the existing plastic with Biodegradable plastic which are made up of starch, cellulose, and protein derivatives. These biodegradable plastics will be helpful in reducing the soil and water pollution.

Key words: Biodegradable plastic, starch based plastic, cellulose based plastic, Renewable-sustainability

PP-29

A Review On Application Of Bio-Degradable Polymers As Bio- Materials In Bio-Medical

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Application of polymers as Bio-Material has great role in enhancementof modern medicine. In this review article, we will emphasize oncharacteristics of Bio-Degradable polymers which make them perfectly cceptable for orthopedic uses where a permanent implant is not required.Especially, these polymeric Bio-Materials which are Bio-degradable give thenotable benefits of being able to be broken down and detached after they hadperformed their function. The market of these Eco-friendly materials is intremendous increase of 20-25% per year. Uses are of wide range withdegradable polymers being used medically as surgical seam and implants. Tofulfill functional needs, materials with desired physical, chemical, biologicaland degradation characteristics must be chosen. This review recapitulates therecent enhancement in this area, especially highlighting new interestingfindings in tissue engineering and drug delivery utilization.

Keywords: Bio-Degradable, Bio-Materials, Degradation,Eco-Friendly, Orthopedic

PP-30

Guar Gum Based Gel Polymer Electrolyte for Electrochemical Devices

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Lithium ion conducting solid polymer electrolyte based on Guar Gum complexed with glycerol as plasticizer were prepared by using solution cast technique. Ionic conductivity was measured using ac impedance analyzer and observed as $3.7x10^{-3}$ S/cm at room temperature. Structural characterization was performed by using X-ray diffraction (XRD) and Fourier Transform infrared (FTIR) spectroscope technique. XRD results shows the amorphous nature of the electrolyte film. Fourier transform infrared (FTIR) spectroscopic analysis confirmed the complexation of the salt and plasticizer with the polymer matrix. Differential scanning calorimetry (DSC) was used to determine the glass transition and melting temperatures of pure Gum and Gum based polymer electrolyte film.

Keywords – Guar Gum, Lithium salt, Ionic conductivity, Biopolymer, Solid Polymer Electrolyte

PP-35

Superabsorbent Polysaccharide Hydrogels as Nutrient Carriers

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In this work, we have developed polysaccharide based superabsorbent hydrogels (SAH) for nutrient carrier applications. The hydrogels were synthesized by chemical crosslinking method. A mechanism for hydrogel formation was proposed and the structure of the product was established using Fourier transform infrared spectroscopic (FT-IR) and scanning electron microscopy (SEM).The swelling behavior of these superabsorbent hydrogels was investigated in various salt solutions.

Key words: Fourier transform infrared spectroscopic (FT-IR) and scanning electron microscopy (SEM)

PP-36

The Bactericidal Effect of Silver Nano Particles

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Nanotechnology is expected to open new avenues to fight and prevent disease using atomic sc
tailoring of materials. Among the most promising nanomaterials with antibacterial properties
metallic nanoparticles, which exhibit increased chemical activity due to their large surface to volu
ratios and crystallographic surface structure. The study of bactericidal nanomaterials is particul
timely considering the recent increase of new resistant strains of bacteria to the most potent antibiot
This has promoted research in the well known activity of silver ions and silver-based compou
including silver nanoparticles. The present work studies the effect of silver nanoparticles in the ra
of 1–100 nm on Gram-negative bacteria using high angle annular dark field (HAADF) scann
transmission electron microscopy (STEM). Our results indicate that the bactericidal properties of
nanoparticles are size dependent, since the only nanoparticles that present a direct interaction with
bacteria preferentially have a diameter of ~1–10 nm.

Key words: Nanoparticles, Nanomaterials, Bactericidal, Diseases, Bacteria.

PP-37

Flax Shape's ZnO NPs by Chemical Synthesis method and Optical Properties

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Synthesis of zinc oxide nanoparticles (ZnO-NPs) at room temperature using chemical synthesis method in the presence of zinc acetate as a metal salt precursor. The creation of ZnO-NPs was examined by UV-visible spectroscopy. The shape as well as size of the synthesized ZnO-NPs was visualized by transmission electron microscopy (TEM) and scanning electron microscopy (SEM) observations. These results were recognized by X-ray powder diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR) analyses. The effect of the flax shape ZnO-NPs on the organic transformation rate as well as the efficiency of ZnO-NPs as a promising candidate for the catalysis of organic pollutant through the electron transfer process.

Key words: Zinc nanoparticles, Pollutant degradation, FTIR, XRD, FESEM and HRTEM

PP-38

Modified Lead Acid batteries (LABs)

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Out of all the metals lead is one of recyclable metals. In the lead acid batteries, lead is the main component but it is very hazardous too because of its toxicity, it affects environment as well as human health. About 70% of lead is used worldwide for the production of lead acid batteries. Lead acid batteries were invented in 1859 by Gaston Planté and first demonstrated to the French Academy of Sciences in 1860. They remain the technology of choice for automotive SLI (Starting, Lighting and Ignition) applications because they are robust, tolerant to abuse, tried and tested and because of their low cost. For higher power applications with intermittent loads however, Lead acid batteries are generally too big and heavy and they suffer from a shorter cycle life and typical usable power down to only 50% Depth of Discharge (DOD). Despite these shortcomings Lead acid batteries are still being specified for Power Net applications (36 Volts 2 kWh capacity) because of the cost. Lead-acid batteries are composed of a Lead-dioxide cathode, a sponge metallic Lead anode and a Sulphuric acid solution electrolyte. During discharge, the lead dioxide (positive plate) and lead (negative plate) react with the electrolyte of sulfuric acid to create lead sulfate, water and energy. During charging, the cycle is reversed: the lead sulfate and water are electro-chemically converted to lead, lead oxide and sulfuric acid by an external electrical charging source.
In present context the lead-acid battery faces the problem of low life cycle majorly caused by the corrosion of both positive and negative electrodes. Hence it becomes necessary to convert it into modified LAB, either by replacing the electrolyte or the electrode with light weight and better electrically conductive materials. Attempts were made to develop and study the behaviour of lead electrode by alloying with different materials including carbon in various forms.
The proposed project is aimed to obtain the lead-carbon electrode with improved electrochemical activity, by un-altering the existing manufacturing setup in any battery Industry. The proposed project is aimed to achieve better performance by targeting improved charging storage and inhibiting corrosion leading to improvement of lead-acid battery, through replacement of Antimony by Carbon in different forms obtained using different processing techniques from waste dry cells, electrodeposition technique and ball milling approach.

Key words: Lead-dioxide cathode, Sulphuric acid solution electrolyte

PP-39

Online Book Store with additional functionalities using Apache Tomcat 7.0

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Nowadays the network plays an import rule in people's life. In the process of the improvement of the people's living standard people's demands of the life's quality and efficiency is higher, the traditional bookstore's inconvenience gradually emerges, and the online bookstore has gradually been used in public. The objective of the current work is to create an online book store that allows users to search, select and classify the books utilizing several parameters. The system has been implemented using programming languages (such as JAVA, JavaScript, and HTML) with relational databases (such as MySQL, Access) and software *viz.* Eclipse, JDK/ JRE, Apache Tomcat 7.0. The salient features of the developed system include the administrative control and advanced functionalities, compared to the common user. In addition, the author can write and edit their own books and upload it. The database is connected to the system and is used in validating users' requests. Customers will make a variety of desired choices from a wide range of books to choose from and the system will provide a reliable online payment system, leading to localized deliver of the books. Overall, the online bookstore system is designed with a pre-requisite of providing convenience and service to the people.

Key words: Bookstore, Eclipse, Apache Tomcat.

PP-40

Parameters influencing SHI induced mixing

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Energetic ion beams with energy ranging from few MeV to GeV of different elements are used for the manipulation of material properties, surface modification, characterization and synthesis of novel materials. These energetic ions having velocity comparable to the velocity of orbital electrons are known as swift heavy ions (SHI). Ion beam effect on the materials depends upon parameters such as ion energy, fluence, heat of mixing of the elements, ion velocity. We report on the interface mixing in metal/semiconductor systems (Si/Ge/Bi/C, Si/Ge/Zr/C, Si/Ge/Nb/C, and Si/V/Ge/C) and metal/metal system Si/Ti/Bi/C under Swift Heavy Ions (SHI) irradiation at the fluence of 1×10^{13}, 5×10^{13} and 1×10^{14} ions/cm^2.Ion and energy used for the irradiation are 120 MeV Au ions, 80 MeV Au ions and 100 MeV Ag ions. Mixing effect is explained in the framework of thermal spike model. The SHI-induced interface mixing was studied by characterizing the samples before and after irradiation using Rutherford Backscattering Spectroscopy (RBS), Atomic Force Microscopy (AFM) and Grazing incidence X-ray diffraction (GIXRD) patterns to check for interface mixing, surface roughness and crystalline phase formation during irradiation. The diffusivity values suggested a transient melt phase at the interfaces following the thermal spike model. It is observed that interface mixing increases with the fluence and heat of mixing. Also the lower velocity of ion beam results in higher mixing which is due to higher energy deposition in thermal spike

Key words: Swift heavy ions, RBS, AFM, GIXRD

PP-41

Analysis of SRS Induced Crosstalk With Variety of Fibers in SCM-WDM Transmission System

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SCM is used to carry RF signals to transmit through optical fiber using single wavelength. The advantage of using SCM technique in optical communications is that one can put different optical carriers closely without much power fluctuation from one channel to another. SCM-WDM is equivalent to packing more WDM channels in a given optical bandwidth and it further reduces minimum channel spacing imposed by current optical device technology.
SCM–WDM systems however, suffer from nonlinear effects in fiber. When multiple wavelengths carrying SCM signals propagate in a single fiber, fiber nonlinearities can lead to crosstalk between subcarriers on different wavelengths. In a dispersive fiber, the dominant fiber nonlinearity that causes crosstalk is stimulated Raman scattering (SRS).If the peak power of incident wave is more than threshold level, the SRS transfers energy from pump wave to generate Stoke's wave. The Stoke's wave co-propagates along with the pump signal in the same direction. The pump and Stoke's waves interact with each other through Raman gain as a result power of the pump wave depletes and interaction between two waves results in generation of crosstalk. This crosstalk is detrimental for optical communication. Fiber nonlinear effect such as SRS may generate significant amounts of nonlinear crosstalk between adjacent SCM channels because they are very closely spaced.
In this paper, the SRS- induced cross talk has been evaluated. The modulation frequency varies from 0 to 2GHz as SRS–induced crosstalk for Standard single mode fiber (SSMF) varies from (-45 to -68)dB, further for true wave –reduced slope fiber (TWRS) the SRS induced crosstalk varies from (-42 to -42) dB, for large effective area fiber (LEAF) the SRS induced crosstalk varies from (-45 to - 44) dB, for true wave fiber (TW) the SRS induced crosstalk varies from (-39 to -40) dB, for Dispersion Compensation Fiber (DCF) the SRS induced crosstalk varies from (-29 to -54) dB. It has been observed that SSMF has the least crosstalk at 2GHz. That is why SSMF is used for long haul communication system.

Key words- Sub-Carrier Multiplexing(SCM), Stimulated Raman Scattering(SRS), Wavelength Division Multiplexing(WDM), Radio Frequency (RF).

PP-42

Effect of temperature and period of post-annealing on the optical properties of ZnO nanoparticles

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In the research work the effect of temperature (300-700°C) on the optical properties of ZnO nanoparticles. The absorption coefficient, transmittance, reflection and optical band gap energy for different types of conditions have been calculated. The transmittance properties of ZnO nanoparticle up to 600°C approximately are constant, but at higher temperatures (800°C) a reduction of the transmittance and reflectance results showed increase. The band gap of nanoparticles did not vary with temperature as well as period of heating. Higher temperature as well as longer period of post annealing produces larger growth size and better crystal quality. The XRD results have been supported by SEM and TEM studies.

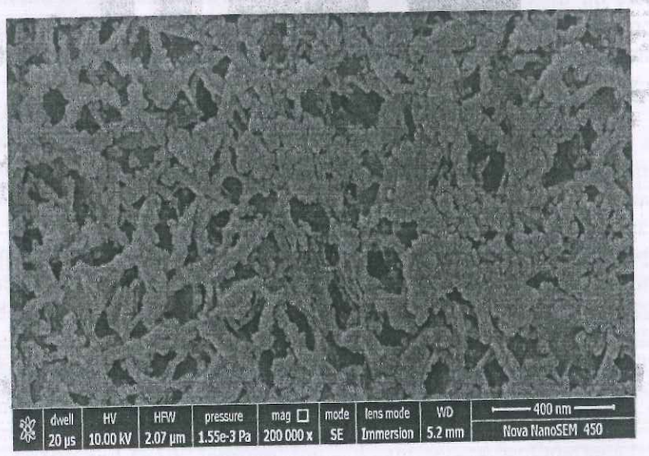

Figure: SEM patterns of Synthesized ZnO nanoparticles

Key words: ZnO nanoparticles, Band gap energy, Annealing, Optical properties, XRD, SEM, TEM and FTIR.

PP-43

Stimulus Responsive Nanogels As A Drug Delivery Vehicle

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Nanogels are innovative drug delivery system that can play an integral part in pointing out many issues related to old and modern courses of treatment such as nonspecific effects and poor stability. These are highly cross-linked nano sized hydrogels ranges from 20-200 nm. They have a high degree of drug loading capacity which shows better permeation capabilities due to smaller size, release the drug by pH responsive, thermosensitive, volume transition, photochemical internalization and photo isomerization mechanism. These are classified by stimuli responsive or non-responsive behaviour and type of linkages present in the network chains of gel structure. They can be synthesized by photo lithographic, modified pullulan, emulsion polymerization, reverse microemulsion polymerization, inverse mini-emulsion and free radical cross-linking polymerization technique. They are used for the treatment of cancer, diabetes, inflammation and bone regeneration etc. Nanogels are the novel drug delivery system for both hydrophilic and hydrophobic drugs.

Key words- Nano-gels, , hydrogels, drug delivery, thermosensitive

PP-44

Synthesis of Silver Nanoparticles using Acacia Concinna plant extract and Optical Properties

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Green synthesis of AgNPs by plant extract of Acacia concinna with silver salt. Synthesis of Ag Nps has been planned as a valuable and eco-friendly approach. This research work is eco-friendly as well as cost effective i.e, reduction method used for green process of AgNPs formation. In this work plant extract similar as a both reducing and capping agent. The essential ingredients liable variables are triterpenes, flavonoids and eugenol present in the fruit extract, which are responsible for the formation of AgNPs. After the reduction process silver (Ag^{+}) ions was monitored, it showed the formation of Ag NPs using UV-visible spectrophotometry which show absorption peak around at 420 nm. The morphology as well as size of nanoparticles was calculated by scanning electronic microscopy (SEM) and transmission electron microscopy (TEM). For the exchange of Ag+ to AgNPs at room temperature, this recently developed process for AgNPs synthesis could show a better substitute without the role of any hazardous chemical methods currently used.

Key words: Green Synthesis, Eco friendly, TEM, UV-visible, XRD, FTIR, Diffusion Method etc.

PP-45

Green Synthesis of Silver Nanoparticles Using Aloe Vera Plant Extract and Optical Properties

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Abstract: Green synthesis of silver nanoparticles (AgNP) performed at room temperature using Aloe vera extract with silver nitrate solution. The presence of broad variability of bio molecules in plants can act as capping and reducing agents and thus increases the rate of reduction and stabilization of nanoparticles. The synthesized AgNPs was characterized by FTIR and UV-visible spectroscopy at different time intervals. The formation and stability of the reduced silver nanoparticles in the colloidal solution were monitored by Uv-vis spectrophotometer analysis. The size and shape of the synthesized AgNPs were characterized by scanning electron microscopy (SEM) and transmission electron microscopy (TEM), X-ray powder diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR) analyses. FTIR spectroscopy confirmed the presence of protein as the stabilizing agent surrounding the Ag NPs. The resulting silver nanoparticles are characterized by UV-Vis spectroscopy. The maximum intensities of silver nanoparticle showed a sharp peak at 420 nm. The green synthesized AgNPs are investigated for their catalytic properties. As-synthesized Ag NPs were tested for their catalytic reduction activity towards the conversion of P-nitro phenol to P-amino phenol in excess of $NaBH_4$.

Key words: Aloe vera gel, Silver nanoparticles, Green synthesis, Catalytic reduction.

PP-46

Design, synthesis and biological evaluation of some novelsubstituted-2-oxo-1,2 -dihydro-quinolin-4-yl as potent acetylcholinesterase inhibitors.

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A novel series of substituted N-(substituted phenyl)-2-[4-(6-substituted-2-oxo-1,2 -dihydro-quinolin-4-yl)piperazin-1-yl]acetamide compounds were synthesized from Malonic acid and corresponding Aniline. The novel synthesized compounds were depurated, and the structure was confirmed by IR, ^{1}H NMR, ^{13}C NMR, Mass Analysis and X-ray crystallography. Acetylcholinesterase(AChE) proteins are believed to be the cause of Alzheimer's disease(AD). Molecular docking(Auto Dock) studies of all compounds show binding energy values ranging from −11.00 to −8.50 kcal/mol.Binding mode between the compounds and the receptors were determined which shows strong interaction of molecules with the amino acid residues.Binding energy values of the compoundsare studied by molecular docking which suggested thaton mode of inhibitionthese compounds could bind appreciably to the amino acids present at the active site of recombinant human acetylcholinesterase (rhAChE) and could decrease the activity of Acetylcholinesterase(AChE)

Key words: Alzheimer's disease; Acetylcholinesterase; Biochemical; Docking

PP-47

Molecular Interaction of Esterase with the 3rdGeneration Antibiotic, Cefotaxime

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Antibiotics are either bacteriostatic or bactericidal, depends on the target of interaction and mechanism employed. The bacteria has developed some resistant strategies to overcome the toxic effect of antibiotics,andamong them, the enzymatic mechanisms are mostly seen. The esterase is one of the enzymeswhoprovidesresistance to bacteria through its hydrolytic action on antibiotics. Antibiotics now a day fails to recover the biological body (human, animal or birds) from bacterial infection, sonew antibiotics development programs are always in progress. Hence, the Insilico interaction of esterase with the 3rd generation Cefotaxime was checked, where the interaction was observed as positive, and the possibility of resistance was predicted. The molecular structure of Cefotaxime is drawn by chem draw software and validate with Ramachandran plot, as good quality. The enzyme was extracted from NCBI (Accession number WP_015622920),and the active amino acid (CASTp server, online) of the protein found to be in interaction with antibiotic was Arginine at 88th position with the bond length of 3.177. The Insilico study may indicate the involvement of esterase enzyme with the antibiotic resistance against Cefotaxime.

Key words: Bacteriostatic, Cefotaxime

Nano based Medicine In Clinical Research

PP-48

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Nano medicine based drug delivery systems for systemic (i.e., intravenous) applications have significant advantages over their nonformulated and free drug counterparts. Nano particle systems are capable of delivering therapeutics and treating areas of the body that other delivery systems cannot reach. As such, nanoparticle drug delivery and imaging systems are one of the most investigated systems in preclinical and clinical settings. Here, we will highlight the diversity of nanoparticle types, the key advantages these systems have over their free drug counterparts, and discuss their overall potential in influencing clinical care. In particular, we will focus on current clinical trials for nanoparticle formulations that have yet to be clinically approved. Additional emphasis will be on clinically approved nanoparticle systems, equally for their currently approved indications and their use in active clinical trials. Finally, we will discuss many of the often overlooked biological, technological, and study design challenges that impact the clinical success of nanoparticle delivery systems.

Key words: Nano medicine, Clinical Research, Noval drug delivery system.

PP-49

Synthesis, structural analysis and *in vitro* antiplasmodial activity of chemically stable *1*-propylsulfonylpiperidine dispiro-1,2,4,5-tetraoxanes

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Artemisinin and its semi synthetic analogs are considered as very effective antimalarial drugs.[1] Continued and property enhancement in antimalarial drugs through focused analysis and development are essential to treat and control malaria.[2,3] Amplifiedexertions in discovery of antimalarial drug are needed indeed. Here, our objective is toprovide safe as well as affordable new drugs to counter the spread of malaria parasites that areresistant to existing agents. Drug efficacy, pharmacology and toxicity are the important factors in the selection of compounds for development.[4]
A rapid two step synthesis of newer dispiro-1,2,4,5-tetraoxane analogues, efficiently catalysed by using methyltrioxorhenium(VII) (MTO) is reported herein.Using this methodology, various tetraoxanes have been synthesized with different ketones (cyclic, acyclic or acetophenone derivatives). The yields of the desired products vary from 44% to 65%. Yield of tetraoxane analogues depends upon the substituent on dispiro-1,2,4,5-tetraoxanes. All the synthesized tetraoxanes were characterized by various techniques such as ^{1}H NMR, ^{13}C NMR and HRMS. The structures of tetraoxanes were confirmed by single crystal XRD. Most of the analogues display potent *in vitro* antiplasmodial activity,falling in single digit nanomolar values against 3D7 (chloroquine sensitive) and Dd2 (multi-resistant) strains of *P. falciparum*.

Key words: Methyltrioxorhenium, tetraoxanes, falciparum

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PP-50

Performance Evaluation of OFDM technique for Dense Optical Communication System

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The technology is continuously moving forward in the field of Communication System due to the increase in demand for Faster, Robust, Flexible and Cost Efficient transmission. The application of multi-carrier techniques such as (OFDM) Orthogonal Frequency Division Multiplexing and DMT (Discrete Multitone) can fulfil this approach. OFDM is a powerful technology to increase data rate transmission over optical communication systems. However OFDM technology is already been applied and used in the field of wired and wireless communication systems. The drawback of OFDM is its high peak to average power ratio and its sensitivity to phase noise and frequency offset. OFDM can be adapted in various ways in single mode and multi-mode fibers to achieve a good performance.

Key words - OFDM, WDM, SOA, EDFA, SDM, FFT

PP-51

Proton Conducting Bio- Polymer Electrolyte for Electrochemical Devices

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Proton conducting solid polymer electrolyte based on Xanthan Gum were prepared by using solution cast technique. Ionic conductivity was measured using ac impedance analyzer and observed as $7.5x10^{-5}$ S/cm at room temperature. Structural characterization was performed by using X-ray diffraction (XRD) and Fourier Transform infrared (FTIR) spectroscope technique. XRD results shows the amorphous nature of the electrolyte film. Fourier transform infrared (FTIR) spectroscopic analysis confirmed the complexation of the salt and plasticizer with the polymer matrix. Differential scanning calorimetry (DSC) was used to determine the glass transition and melting temperatures of pure Xanthan Gum and Xanthan Gum based polymer electrolyte film.
Keywords – Carboxymethyl cellulose, Lithium salt, Ionic conductivity, Biopolymer, Solid Polymer Electrolyte

Key word: Transform infrared (FTIR) spectroscope, Differential scanning calorimetry (DSC)

PP-52

Synthesis and Characterization of Polysaccharide based Bioplastic

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Petroleum derived plastics dominate the food packaging industry even today. These materials have brought a lot of convenience and attraction to agro, food and packaging industry. These materials also have brought along with them problems relating to the safe-disposal and renewability of these materials. Due to the growing concern over environmental problems of these materials, interest has shifted towards the development and promoting the use of "bio-plastics". Bio-plastic is a term used for sustainable packaging materials derived from renewable resources i.e. produced from agro/food sources, materials such as starch, cellulose, etc. and which are considered safe to be used in food applications. This has encouraged the interest to the development of new renewable and biodegradable matrices.
In this study, films with different polysaccharides in combination with some other co-polymers are synthesized and their properties are analyzed. In general, the films are homogeneous, smooth, with no pores and with better extensibility, plasticity, and low tensile strength.

Key words- Bioplastic, Biodegradable, Natural, Polysacchrides

PP-53

Insight into the interaction of chalconetriazoleanalog with Human Serum Albumin: Spectroscopy and molecular docking approaches

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The mechanistic insight into the interaction of triazole linked chalcone (CT) with Human Serum Albumin (HSA) was explored using various spectroscopic techniques (UV-Visible absorption, Fluorescence, Circular Dichroism) and molecular docking. Fluorescence quenching experiment performed at three different temperatures revealed the static mode of quenching and value of binding constant (K_b ~10^9) obtained indicated strong affinity of the CT for HSA. Further, significant changes in the secondary structure of HSA in presence of CT was also confirmed by far UV-CD spectroscopy. The thermodynamic properties such as enthalpy change (ΔH^0), Gibbs free energy change (ΔG^0) and entropy change (ΔS^0) revealed binding process was spontaneous and exothermic. Theoretical studies viz. molecular docking corroborated the experimental results as its binding with HSA was through hydrogen bonding and hydrophobic interactions. The present study provides useful information regarding interaction mechanism of the triazole linked chalcone with HSA, which could provide a new avenue to design more potent chalconetriazoleanalogs for use in biomedical field.

Key words : HSA, Fluorescence, Circular Dichroism, Molecular docking.

PP-54

Some Integrals Associated With Multiindex Mittag-Leffler Functions

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The object of the present paper is to establish two interesting unified integral formulas involving multiple (multiindex) Mittag-Leffler functions, which is expressed in terms of Wright hyper geometric function. Some deductions from these results are also considered.

Key words: Unified , Multiindex, Mittag-Leffler and hypergeometric

PP-55

Effect of Polymers for removal of low concentration heavy metals from wastewater

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Innovative processes for treating industrial waste water containing heavy metals often involve technologies for reduction of toxicity in order to meet technology-based treatment standards. This manuscript reviews the recent developments and technical applicability of various treatments for the removal of heavy metals from industrial waste water. A particular focus is given to reduce low concentration heavy metals from waste water by the use of polymers. Their advantages and limitations in application are evaluated in this study. It is evident from survey that synthetic polymers are widely applied for the treatment of metal-contaminated waste water. It is important to note that the overall treatment cost of metal-contaminated water varies, depending on the process employed and the local conditions. But this process is economical and efficient. Synthetic polymers are more effective in removal of Zinc, cadmium and nickel.

Key words: waste water, polymers, heavy metals, Zinc, cadmium and nickel.

PP-56

Extended Beta, Hypergeometric and confluent Hypergeometric functions

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We aim to introduce a new extension of beta function and to study its important properties. Using this definition, we introduce and investigate new extended hypergeometricand confluent hypergeometric functions. Further, some hybrid representations of thisextended beta function are derived which include some well known special functionsand polynomials.

Key words: Hypergeometric and confluent hypergeometric functions.

PP-57

Natural Products as an Anticancer Agent

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Natural product is a chemical compound or substance produced by a living organism, which is found in nature. Natural products have therapeutic benefits as traditional medicine for treating diseases, yield knowledge to derive active components as lead compounds for drug discovery. The dietary source of natural products have anticancer benefits includes fruits, vegetables and spices yield biological active compounds such as curcumin, isoflavone, saponin, phytosterol, lycopene and many others. Cancer is well organized global health problem responsible for 7.6 million deaths worldwide which is expected to rise to 13.1 million by 2030. The plant based drug discovery resulted mainly in the development of anticancer agents including plants, marine organism and microorganisms. There are 39 natural compounds from marine species, mostly invertebrates and 10 from microorganisms, mostly from bacteria of the *Streptomyces* genus, as potential new anti-cancer agents. The present clinically used anticancer agents of natural origin as well as those compounds of this type now in advanced clinical trial are known to exhibit structural diversity. There are some examples of anticancer plants such as *Allium sativum, Andrographis paniculata, Apis mellifera, Cannabis sativa* and *Gossypium hirsutum*. Thus nature is an attractive source of new therapeutic compounds as a tremendous chemical diversity is found in million of species of plants, animals, marine organisms & microorganisms as potential anticancer agents.

Key words: Anticancer, Cannabis sativa, Curcumin Natural Products, Streptomyces

PP-58

Preparation, Characterization and Study of CdS: (Cu, Ni)Nanoparticles

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Semiconductor nanoparticles having unique chemical and physical properties due to their high surface area to volume ratio. The optical properties, reactivity, toughness and other properties are also dependent on their size and shape. Due to unique properties of nanoparticles, they are suitable for various commercial and domestic applications. CdS: (Cu, Ni) nanoparticles has been prepared by using chemical method. CdS: (Cu, Ni) nanocrystals are characterized by XRD and determined its size. The particle size measured by XRD is found in nano-ange. The size obtained from AFM photographs is between 04 nm-06 nm.

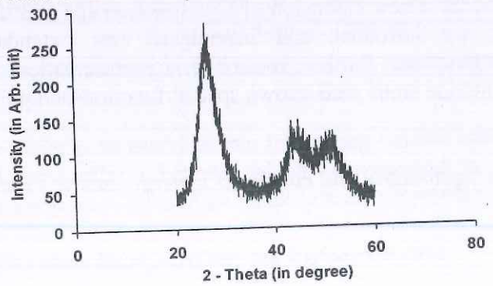

Figure: XED of CdS nanoparticle

Key words: CdS(Cu,Ni) nanoparticles, XRD.

PP-59

Preparation, Characterization and Study of ZnS: (Cu, Ni) Nanoparticles

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Semiconductor nanoparticles having unique chemical and physical properties due to their high surface area to volume ratio. The optical properties, reactivity, toughness and other properties are also dependent on their size and shape. Due to unique properties of nanoparticles, they are suitable for various commercial and domestic applications. ZnS:(Cu, Ni) nanoparticles has been prepared by using chemical method. ZnS:(Cu, Ni) particles are characterized by TEM and determined its size. The particle size measured by TEMis found in nano-ange. The size obtained from TEM photographs is between 14 nm-20 nm.

Figure: TEM image of ZnS nanoparticle

Key words: ZdS(Cu,Ni) nanoparticles, TEM.

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Synthesis, Characterization and application of modified textiles nanomaterials

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The development of textiles nanomaterial has been one of the most active and important research areas in recent years. Design and synthesis of nanomaterials with a novel combination of textiles material is expected to expand the demanding scope in the future. This chapter will focus on the chemical nature of textiles nanomaterials as well as the methods used to characterize them with regard to different applications.

Key words: Nanomaterials, Synthesis, Textile.