VPM's B N Bandodkar College of Science, (Autonomous)

Thane -400601

3.4.4. Number of books and chapters in edited volumes / books published per teacher during the year:

Index

Fundamentals Of Natural Resource Management

by

Dr. Ghanshyam Vatsa

Dr. Vinda Manjramkar

Dr. Shweta Rani

&

Dr. Alok Kumar Saran

AG PH Books

2022

Fundamentals Of Natural Resource Management

Dr. Ghanshyam Vatsa, Dr. Vinda Manjramkar,
Dr. Shweta Rani and Dr. Alok Kumar Saran

ISBN – 978-93-95936-21-7

Published by:

AGPH Books (Academic Guru Publishing House)

Bhopal, M.P. India

Contact: +91-7089366889

About Authors

Dr Ghanshyam Vatsa, MD (Ayurveda) Associate Professor, Department of Swasthavritta & Yog, GS Ayurveda Medical College & Hospital, Pilkhuwa, Hapur, Uttar Pradesh is an Ayurvedic Physician & Teacher of Ayurveda having working experience of 23+ years. He is author & co author of several books having diverse domains like Ayurveda, Yoga, Wellness, Psychology, Research, Environment, Education & Management etc. Dr Ghanshyam Vatsa is Member of Syllabus Drafting Committee, NCISM, Ministry of Ayush, Govt of India. He is a well known Speaker & Resource Person in workshops, Seminars & Conferences In search of knowledge Dr Ghanshyam Vatsa have travelled across the globe & India to attend National & International Seminars, Conferences, Symposium etc to interact with Scholars & to present his research work. He is also editor & co editor in Research Journals Being a clinician his focus remains, practical application of knowledge for the betterment of society. He is associated with multiple NGO's like Jignasa, Idam Rashtraay, Arogya Sutra, Edumed, Healing Tree etc. to serve the purpose.

Dr. Vinda Manjramkar, M.Sc. Zoology, (Endocrinology), Ph.D. (Zoology) M. A. (clinical sociology), M.B.A (GENERAL BUSINESS ADMINISTRATION) , M.Phil. (Rural Development), Excommissioned NCC officer. She is

Professor in Zoology with 26 years of experience. In teaching and research B.N. Bandodkar College of Science (Autonomous), Thane, Maharashtra she is Member of Zoology syllabus committee board university of Mumbai for UG and Chairman BoS Human Science and Clinical psychology. Member BoS syllabus committee MRS (Masters in Rural studies) Shivaji university. Faculty Advisor CASI MAHA Model united nations WHO. Resource person for UGC refresher courses at different Universities, workshops, Conferences (national and international),6 Indian patents, 5 international patents, and Interdisciplinary research, and publications. Edited 4 books and author of chapters in many zoology books available online. She has presented many research paper in National and international conferences , seminars workshops also she invited to deliver plenary lectures in conferences.

She is Recipient of Samaj Bhushan Puraskar from Thane Pattrakar Sangh, BEQET (team member) Special Citation Award, Maharashtra govt Merit scholarship for Ph.D. 1991 to 1993, International woman's diamond jubilee scholarship, All India 4th Rank holder in NCC pre-commission course.

Dr. Shweta Rani is currently working as Assistant Professor (Senior Grade) in the Department of Geography at Dyal Singh College, University of Delhi. She holds 'Masters in Geography', 'M.Phil. and PhD' (Geography) from Department of Geography, Delhi School of Economics,

University of Delhi. She has a rich and varied teaching experience of almost 12 years at University of Delhi and her keen research interests includes, Urbanization and Development, Advanced Statistical Methods in Spatial Analysis, Research Methodology, Geoinformatics, Hydrology and Water Resource Management and Sustainable and Regional Develop-ment. She possesses an exceptionally high and commend-able academic excellence and achievements. She is a merit rank holder securing first position at the higher secondary level and topped the stream in graduation from Patna University receiving ***"Shanti Lata Memorial Award"*** in 2002 and ***"Mother Theodosia A.C. Memorial Award"*** in 2005. She is also the recipient of ***"Smt. Draupadi Ishwari Prasad Bhargava Memorial Gold Medal"*** from University of Delhi (2008) and awarded fellowship for meritorious students in Science by UGC (2012). She grabbed the prestigious award for National level ***"Geographer's Youth Conclave"*** for two consecutive years in 2019 and 2020. Recently, she has been conferred with the prestigious "NAARI SHAKTI Best Women Academician Award", Awards for Women-2022 followed by "GC Memorial Best Research Author Award" on September 5, 2022. Dr. Rani has been immensely recognized and appreciated for her research work with more than 35 research papers to her credit in Reputed Journals in India and abroad including her contributions as chapters in edited books by well-known scholars and 5 books. Dr. Rani has also carried out major project (from ICSSR) in capacity of Co-PI and supervising M. Phil and

Ph. D students. She has presented over 60 Research Papers in several Conferences/ Seminar/ Workshops in India and Abroad and received numerous awards for Best Research Paper Presentations both at the international and national level. She has delivered more than 30 invited talks at different institutions of higher learning in India. Dr. Rani has filed and published 11 Indian patents to her credit. She is also a member of several academic committees, geographical bodies, and editorial boards.

Dr. Alok Kumar Saran began his passion of helping peoples in all aspects of life by adopting a teaching career as Assistant Professor from Chaudhary Devi Lal University, Sirsa, Haryana. Where he thought Environmental Awareness, Natural Resource, Environmental Impact Assessment, Energy Conservation and Management. Being dual post graduated in Environmental Sciences (i.e, Master of Science and Master of Technology) from Chaudhary Devi Lal University, Sirsa and Guru Jambeshwar University of Science and Technology, Hisar respectively. He is a distinguished personality having knowledge of environment in theoretical and technological aspect. While in doctorate program he worked over different simulation software using different approaches for advancement of society. He has been influencial in thinking and have direct and indirect influence over the contents. He had also filed a patent and published a book too.

Preface

The writers of the book "The Fundamental of Natural Resources" have included all of the material and knowledge that is pertinent to this book and is required for this book to have. The readers will benefit from the substantial amount of information included in this book, which will assist them in expanding their existing understanding of the topic. It is very important for us to preserve our environment and all of the resources so that our planet can provide us with more and also assist us in making the planet more sustainable. As we are aware, the environment is the single most important resource that humans possess, and it is the environment that supplies the essential resources that have become a part of our day-to-day lives.

The reader will have the opportunity to learn a great deal from this book, and they will also be made aware of a variety of topics that are connected to the environment and other environmental concerns. This book is packed with knowledge that can be put to good use and is presented in a manner that makes it accessible to readers of all reading levels. If you read this book chapter by chapter, you will have a much better comprehension of the ideas that are presented in this book since each chapter makes a significant contribution

Table of Content

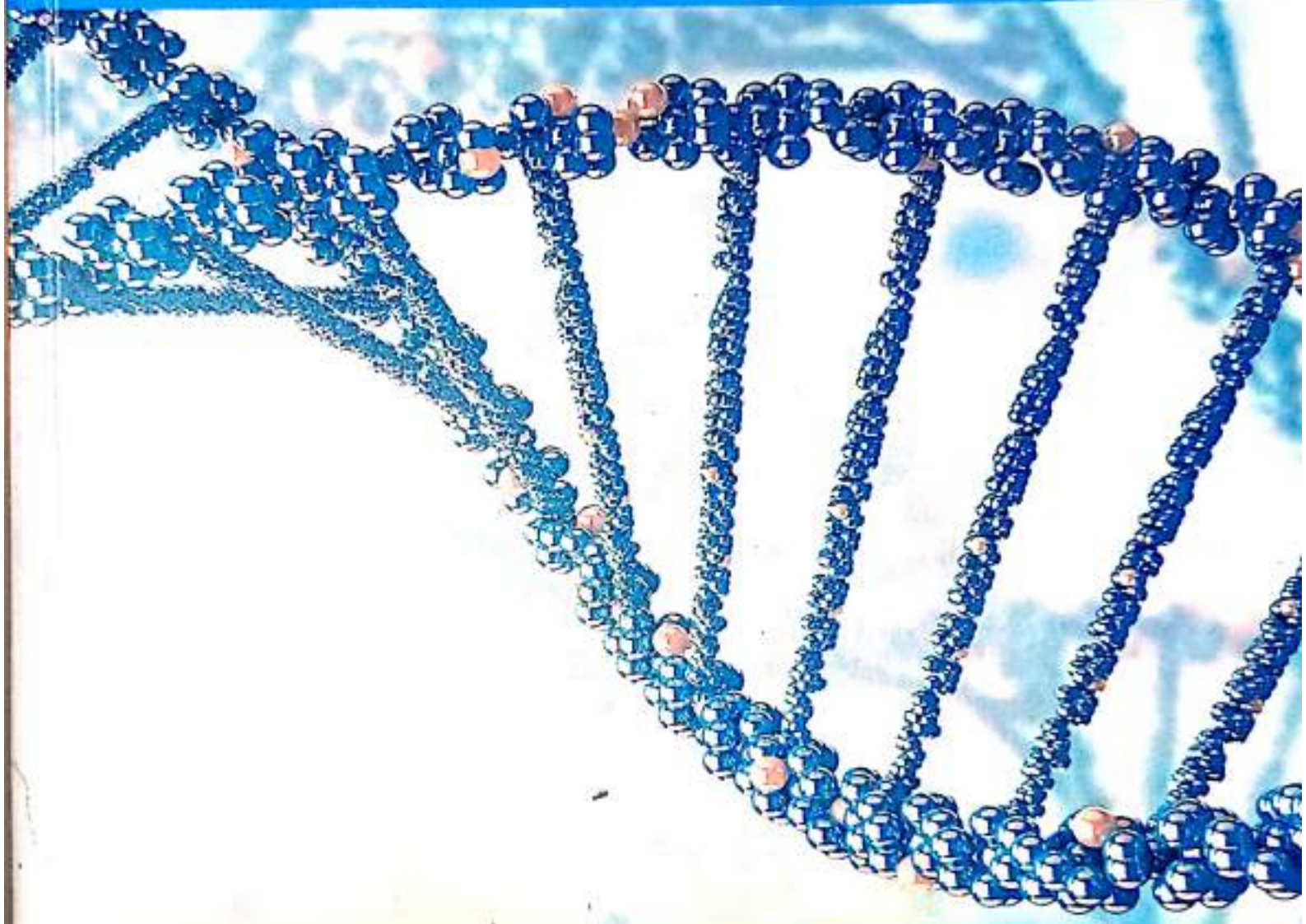
Chapter 1

Introduction to Natural Resources Bases

1.1. Concept of Resource

The term "resource" is used to describe all the things in our environment that can be used to meet our needs and goals, whether they are technologically accessible, economically practical, or culturally sustainable. When categorised according to their longevity, resources may be broken down into two categories: renewable and non-renewable. Their degree of development and application may also categorise them as either real or prospective, their source as either biotic or abiotic, and their dispersion as either pervasive or localised (private, community-owned, national and international resources). Time and improved technology transform a thing into a useful resource. Increased income, efficient system operation, and improved quality of life are only few of the possible outcomes of efficient resource management. A natural resource is any item culled from the wild and put to use meeting human need. If we take a more macrobiologic or

BIOINFORMATICS



Dr. M. A. MHATRE
Prof. VINDA MANJRAMKAR

AIP

BIOINFORMATICS

FIRST EDITION

Authors

Dr. M. A. MHATRE

Prof. VINDA MANJRAMKAR

αIP

Title of the Book: BIOINFORMATICS

Edition: First - 2023

Disclaimer

The authors are solely responsible for the contents published in this text book. The publishers or editors do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the editors or publishers to avoid discrepancies in future.

ISBN: 978-93-5762-086-4

MRP: Rs. 600/-

PUBLISHER & PRINTER: Alpha International Publication (AIP),

3/725/2, Kammangudi, Adichapuram,

Thiruvarur District, Tamilnadu- 614717, INDIA

Email: editoraippublications@gmail.com

Website: www.alphainternationalpublication.com

PREFACE

Bioinformatics includes biological studies that use computer programming as part of their methodology, as well as specific analysis "pipelines" that are repeatedly used, particularly in the field of genomics. There has been a tremendous advance in speed and cost reduction since the completion of the Over the past few decades, rapid developments in genomic and other molecular research technologies and developments in information technologies have combined to produce a tremendous amount of information related to molecular biology. Bioinformatics is the name given to these mathematical and computing approaches used to glean understanding of biological processes.

Common activities in bioinformatics include mapping and analyzing DNA and protein sequences, aligning DNA and protein sequences to compare them, and creating and viewing 3-D models of protein structures. Boinformatics is a science field that is similar to but distinct from biological computation, while it is often considered synonymous to computational biology. The field of bioinformatics experienced explosive growth starting in the mid-1990s, driven largely by the Human Genome Project and by rapid advances in DNA sequencing technology.

Before sequences can be analyzed they have to be obtained from the data storage bank example Genbank. DNA sequencing is still a non-trivial problem as the raw data may be noisy or affected by weak signals. . For a genome as large as the human genome, it may take many days of CPU time on large-memory, multiprocessor computers to assemble the fragments, and the resulting assembly usually contains numerous gaps that must be filled in later.

In the context of genomics, annotation is the process of marking the genes and other biological features in a DNA sequence. This process needs to be automated because most genomes are too large to annotate by hand, not to mention the desire to annotate as many genomes as possible, as the rate of sequencing has ceased to pose a bottleneck.Annotation is made possible by the fact that genes have recognisable start and stop regions, although the exact sequence found in these regions can vary between genes. Genome annotation can be classified into three levels: the nucleotide, protein, and process levels. For example, gene expression can be regulated by nearby elements in the genome. Promoter analysis involves the identification and study of sequence motifs in the DNA surrounding the coding region of a gene. These motifs influence the extent to which that region is transcribed into mRNA. Enhancer elements far away from the promoter can also regulate gene expression, through three-dimensional looping interactions. These interactions can be determined by bioinformatic analysis of chromosome conformation capture experiments.

TABLE OF CONTENTS

UNIT: I INTRODUCTION

UNIT :II SEQUENCE ALIGNMENT

UNIT: III PHYLOGENETIC METHODS

UNIT: IV PROTEIN STRUCTURE ANALYSIS

UNIT :V PERL PROGRAMMING

UNIT: I

INTRODUCTION

1.1 Introduction of Operating System Difficulty

❖ An operating system acts as an intermediary between the user of a computer and computer hardware. The purpose of an operating system is to provide an environment in which a user can execute programs conveniently and efficiently.

❖ An operating system is a software that manages computer hardware. The hardware must provide appropriate mechanisms to ensure the correct operation of the computer system and to prevent user programs from interfering with the proper operation of the system.

Operating System

Definition:

An operating system is a program that controls the execution of application programs and acts as an interface between the user of a computer and the computer hardware.

• A more common definition is that the operating system is the one program running at all times on the computer (usually called the kernel), with all else being application programs.

• An operating system is concerned with the allocation of resources and services, such as memory, processors, devices, and information. The operating system correspondingly includes programs to manage these resources, such as a traffic controller, a scheduler, a memory management module, I/O programs, and a file system.

Features of Operating system – Operating system has the following features:

Convenience: An OS makes a computer more convenient to use.

1. Efficiency: An OS allows the computer system resources to be used efficiently.

SOIL CONSERVATION AND LAND MANAGEMENT

FIRST EDITION

Ramya Ranjan Behera
Dr. K Narasimhulu
Dr. Vinda Manjramkar
Dr. Saurav

AGPH BOOKS
ACADEMIC GURU PUBLISHING HOUSE

SOIL CONSERVATION AND LAND MANAGEMENT

By

Ramya Ranjan Behera,

Dr. K Narasimhulu,

Dr. Vinda Manjramkar

&

Dr. Saurav

AG PH Books

2022

SOIL CONSERVATION AND LAND MANAGEMENT

Ramya Ranjan Behera, Dr. K Narasimhulu,

Dr. Vinda Manjramkar and Dr. Saurav

ISBN – 978-93-95468-97-8

Published by:

AGPH Books (Academic Guru Publishing House)

Bhopal, M.P. India

Contact: +91-7089366889

PREFACE

In India, soil degradation is widespread, resulting in a decrease in agricultural output, a weakening of plant cover, a worsening of water quality and quantity, and increased air pollution. The expanding population of the nation in recent decades has made it even worse, making it necessary to farm ever-more-arid land in order to keep up with rising food demand. As people's access to food, fodder, and fiber decreases due to poverty and the depletion of natural resources, they are forced to look for new places to farm.

Human-caused degradation includes deforestation, overgrazing, turning forests to farms, and farming steep slopes. On-site trash burning, synthetic fertilizers, and lack of organic manure diminish soil organic carbon. To feed its rising population and preserve economic and ecological stability, India must boost its production. Understanding soils, water, climate, and biodiversity helps optimize land usage.

Environmental issues include erosion. It removes the most productive soil first, diminishing production at hardly perceptible transport rates. Soil erosion has been researched for decades, yet it still creates worldwide concerns. This book covers the entire topic related to soil conservation and land degradation for students and readers.

ABOUT AUTHOR'S

Ramya Ranjan Behera is a researcher at the Rekhi Centre of Excellence for the Science of Happiness, Indian Institute of Technology Kharagpur. A gold medalist, both at the bachelor's and master's level from Ravenshaw University Cuttack, Mr. Behera was awarded the Rajiv Gandhi Chatra Pratibha Puruskar, Odisha for his outstanding performance in academics as well as in students' politics in the year 2014. He has represented Odisha and India at many international political forums.

Dr. K. Narasimhulu, Professor and HOD, Department of Civil Engineering, Sree Vidyanikethan Engineering College, Tirupati, Andhra Pradesh. I did my B.Tech Civil Engineering from Osmania University, Hyderabad, M.Tech in Structural Engineering from JNTU Hyderabad and Ph.D in Structural Engineering from IIT Madras. I have 7 years of industry experience and 12 years of teaching experience. My research interests are self compacting concrete, 3D printing concrete and advanced construction materials. Presently I am guiding seven Ph.D scholars. I have 12 publications in reputed journals.

Dr. Vinda Manjramkar M.Sc. Zoology, (Endocrinology). Ph.D. (Zoology) M.A. (clinical sociology), M.B.A (GENERAL BUSINESS ADMINISTRATION), M.Phil. (Rural Development), Ex- commissioned NCC officer.

She is Professor in Zoology with 26 years of experience. In teaching and research B.N. Bandodkar College of Science (Autonomous), Thane, Maharashtra she is Member of Zoology syllabus committee board university of Mumbai for UG and Chairman BoS Human Science and Clinical psychology. Member BoS syllabus committee MRS (Masters in Rural studies) Shivaji university. Faculty Advisor CASI MAHA Model united nations WHO.

Resource person for UGC refresher courses at different Universities, workshops, Conferences (national and international), 6 Indian patents, 5 international patents, and Interdisciplinary research, and publications. Edited 4 books and author of chapters in many zoology books available online. She has presented many research paper in National and international conferences , seminars workshops also she invited to deliver plenary lectures in conferences. She is Recipient of Samaj Bhushan Puraskar from Thane Pattrakar Sangh, BEQET (team member) Special Citation Award, Maharashtra govt Merit scholarship for Ph.D. 1991 to 1993, International woman's diamond jubilee scholarship, All India 4th Rank holder in NCC pre-commission course.

Dr. Saurav is currently working as Assistant Professor in the Department of Civil Engineering at Jaypee University of Information Technology (JUIT) Waknaghat, Solan, Himachal Pradesh-India. He has more than 10 years of teaching experience at UG and PG levels. He had obtained his B.Tech in Civil Engineering from BIT Sindri, Dhanbad

(Govt. of Jharkhand) in 2009 and M.Tech from IIT BHU, Varanasi in 2012. He obtained his Ph.D from JUIT, Waknaghat in 2018. He has published many research papers in SCI and Scopus indexed journals and also published papers in National and International conferences. He is also currently reviewing research papers of reputed peer review journals. He has guided many M.Tech and B.Tech project Students. He has been called by many reputed engineering institutes across India for delivery expert lectures. He is working in various consultancy works related to soil structure interaction, environmental sustainability and concrete materials.

Contents

RECENT ADVANCEMENTS IN ANALYTICAL CHEMISTRY

DR N PADMAJA
DR VISHNU KIRAN MANAM

SCIENG PUBLICATIONS

RECENT ADVANCEMENTS IN ANALYTICAL CHEMISTRY

Edited by
DR N PADMAJA
Associate Professor of Chemistry,
Lal Bahadur College, Post Graduate center
Warangal, Telangana, India.
Email: padmajamg@gmail.com

DR VISHNU KIRAN MANAM
Scientist – R&D/Technical
BMR Group
Chennai, Tamilnadu, India.

SCIENG PUBLICATIONS

SCIENGPUBLICATIONS
Tamilnadu-604303 (INDIA)
(ISO 9001:2015 Certified Company)

Title: **RECENT ADVANCEMENTS IN ANALYTICAL CHEMISTRY**

Editors: **DR N PADMAJA & DR VISHNU KIRAN MANAM**

First Published, 2022

ISBN: 978-93-94766-13-6

Published by:
SCIENG PUBLICATIONS
(ISO 9001:2015 Certified Company)
Janani Illam, Maniyakar Street
Anumandai, Marakkanam Taluk
Villupuram District, Tamilnadu 604303
Website: http://sciengpublications.com
Email: sciengpublications@gmail.com
editor@sciengpublications.com

Printed in India, by: Sagar Color Scan, New Delhi.

Disclaimer: The views expressed in the book are of the authors and not necessarily of the publisher and editors. Authors themselves are responsible for any kind of plagiarism found in their chapters and any related issues found with the book.

PREFACE

Analytical chemistry has a vital role in every stage of life. It is the science of obtaining, processing, and communicating information about the composition and structure of matter. In other words, it is the art and science of determining what matter consists of and measuring the same. By applying analytical chemistry, we have gained insight into the origin and evolution of the universe and life on our planet. Through these insights, we can improve the material characteristics of natural resources and industrial materials to benefit humankind. Today we cannot think of even a single product of commercial use which has not been tested using analytical techniques before clearance from consumption.

There are two essential aims of analytical chemistry – the first is to attain analytical information of the highest quality with the lowest possible uncertainty, and the second is to solve analytical problems derived from biochemical details of different areas. This way, analytical chemistry plays an enormous role in various fields such as drug manufacturing, process control, medical diagnostics, environmental monitoring, food production, and forensic surveys. In our modern world, without analytical chemistry, we would not be able to make any important decisions such as soil remediation, limiting values for environmental pollution, choosing the correct dosage of medicines and food for patients, etc.

Analytical chemistry is also focused on improvements in experimental design, chemometrics, and the creation of new measurement tools. It has broad applications in medicine, science, and engineering. It is poised to make more significant contributions to improving life and understanding new materials. It will lead the way to developing new materials with desired features and detection at levels that could not be imagined before. Analytical chemistry has evolved dramatically over the past few decades from the traditional notion held for centuries to that of a modern, active discipline of chemistry. It produces quality (bio) chemical information of global and partial type from natural and artificial objects and systems to solve analytical problems derived from information needs. Analytical chemistry is an information discipline and is highly essential to modern society.

CONTENTS

Chapter
10

CHROMATOGRAPHY: A VERSATILE TECHNIQUE FOR SEPARATION

DR. ANITA S. GOSWAMI-GIRI[1] & DR. GEETALI S. INGAWALE[2]

[1]Associate Professor and Head, Department of chemistry, VPMs B N Bandodkar College of Science (autonomous) Thane-1 MS India.
[2]Assistant Professor, Department of Humanities and Applied Sciences, VPMs B N Bandodkar College of Science Thane-1 MS India
* Corresponding authors: Dr. Anita S. Goswami-Giri & Dr. Geetha S. Ingawale,
Email: anitagoswami@yahoo.com, gsingawale@vpmthane.org

INTRODUCTION

Chemical analysis is the concern with the identification and estimation of a component in a given substance to evaluate the scientific problem. To identify unknown compounds/ elements, proportions/amount is the major concern with using new, easy, and quick analytical methods and improving existing works. Ancient time quantitative approach in chemical research and normal experimental is the key role in the development of science. All branches of chemistry including biological, environmental, pharmaceutical, medicinal, petroleum chemistry depend on analytical techniques such as chromatographic and spectroscopic techniques. Hence, in present chapter discussed separation techniques- different types of chromatography procedures, advantages, and their application.

Chromatography is the biophysical technique based on a principle where molecules in a mixture applied onto a solid surface or liquid phase are separated from each other by running with the mobile phase. Chromatography is regarded as a method of separation in which the separation of solute occurs between stationary and mobile phases. This separation of solute occurs between the stationary and mobile phases. This separation technique becomes universal and has been extended in chemistry, biology, medicine, and pharmaceutical industry in the manufacturing of pure chemicals and bioscience for the separation of biomolecules. The name chromatography means color, writing. In chromatography method, it involves the following steps.

1. Adsorption of substance on the stationary phase.
2. Separation of the absorbed substance by the mobile phase.
3. The recovery of the separated substances is called elution.

4. Quantitative and quantitative analysis of the eluted substance.

Types of Chromatography and its Stationary and Mobile Phase

Sr. No.	Chromatography	Stationary Phase	Mobile Phase
1.	Column Chromatography	Solid	-liquid
2.	Partition chromatography	liquid	liquid
	e.g. Paper chromatography	liquid	liquid
3.	Adsorption chromatography		
	e.g. Thin layer Chromatography (TLC)	Solid	liquid
	High-Pressure Thin layer Chromatography (HPTLC)	Solid	liquid
	High-Pressure Liquid Chromatography (HPLC)	non-polar	moderately polar
4.	Gas-liquid chromatography	liquid	Gas
	Gas solid Chromatography	Solid	Gas
5.	Iron Exchange Chromatography	Solid	Gas
	Iron Exchange Chromatography	Solid	liquid
6.	Gel-permeation (molecular sieve) chromatography	A stagnant liquid in porous bead	liquid
7.	Affinity chromatography	Solid	Lysate/ liquid

The chapter deals with Column chromatography, Partition chromatography Paper chromatography, Adsorption Chromatography- a)Thin-layer chromatography (TLC),b) High-pressure Thin-layer chromatography (HPTLC) and c) High Pressure Liquid chromatography, Gas Chromatography, and Ion Exchange Chromatography.

COLUMN CHROMATOGRAPHY

The technique in which the stationary phase is alumina or silica gel and the mobile phase is either gas or liquid is known as adsorption chromatography. These techniques are used for Identification of the non-identified two substances, in determining the concentration of products, contaminants in commercial products, in separation and Purification of technical products, etc.

The principle of chromatography is based on differential adsorption of substances by the adsorbent.

Factors Affecting Column Efficiency: Following are some of the important factors after column efficiency.

1. Dimension of the column

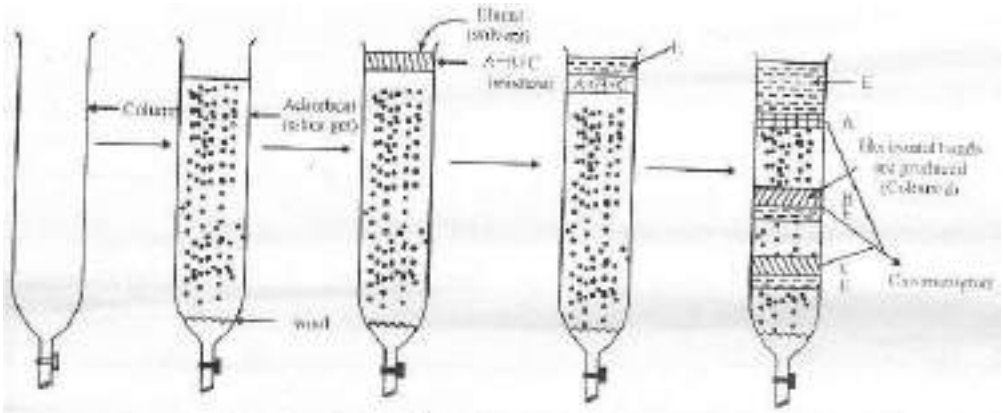
Column efficiency has been improved by increasing the length/width ratio of the column for column preparative separations sample/column packing ratios from 1:20 to 1: 100 in adsorption and from 1:50 to 1:500 in partition chromatography. Recently length/ width ratios of 10: 1 to 100: 1 are more satisfactory.

2. Particle size of column packing

Particle size plays an important part in chromatography is improved by decreasing the particle size of the adsorbent. This is probably due to the rapid decrease in flow rates. The recommended particle size used for both adsorption and partition is 100-200 mesh range.

3. Pore diameter of column packing:

Polar adsorbents have been found to have a pore diameter of 20 A^0 according to keen a decrease in average pore diameter from 70-20 A^0.



Elution is a chemical process that involves removing a material's ions by ion exchange with another material. Eluent is a solvent/mobile phase that passes through the column. In liquid chromatography, the eluent is liquid while in Gas chromatography eluent is a gas carrier.

PARTITION CHROMATOGRAPHY

Paper Chromatography

In partition chromatography, the substances are distributed between the stationary liquid/stationary phase and the moving liquid/mobile phase. The component of the mixture to be separate traveled at different rates and appeared as spots at different points on method. Originally paper chromatography was used to separate a mixture of organic substances such as dye and amino acids, steroids, vitamins, Pesticides, Pigments but now this method has been used to separate cation and anion of inorganic substances as well.

Procedure

1. A drop of the test solution is applied to the bottom of a filter paper. After drying the spot, filter paper is placed in a suitable solvent in such a way that the edge of filter paper is deep into a solvent called *developing solvent*.
2. As soon as the filter paper gets the liquid through its capillary axis and reaches to spot of the test solution, the various substances are moved system at various speeds. When

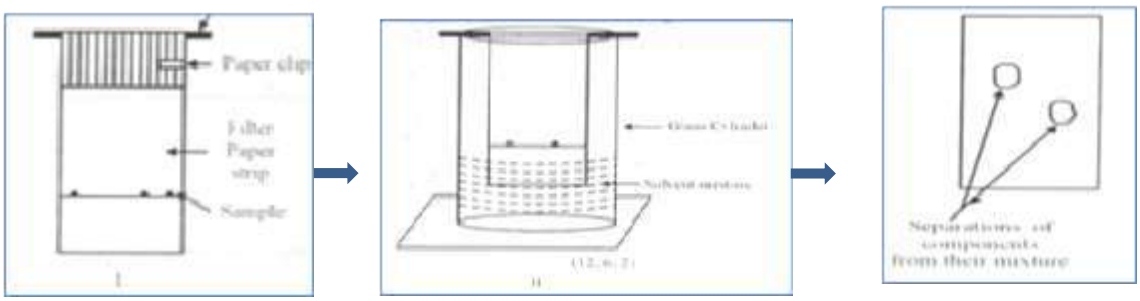
the solvent has moved to a suitable height the paper is dried and various spots are visualized by the suitable reagent called *visualizing reagent*. The movement of the substance relative to a solvent is expressed in terms of Retention Factor/ Retardation Factor (RF values).

$$\text{R.F.} = \frac{distance\ traveled\ by\ solute\ from\ original\ line}{distance\ traveled\ by\ solvent\ from\ the\ original\ line}$$

Types of paper chromatography: There are 5 types of paper chromatography

1. **Descending, b) Ascending, c) Ascending-descending, d) Circular and e) Two-dimensional**

When the development of the paper is done by allowing the solvent to travel up the paper. It is known as *Ascending technique while as* the solvent travels down the paper it is known as **the** '*Descending technique'*. Both ascending and descending techniques have been employed for the separation of organic and inorganic substances. The advantage of the descending technique is that the development can be continued even though the solvent runs off at the other end of the paper.



1. **Ascending-descending** - This is the hybrid of both of the above techniques. The upper part of ascending chromatography can be folded over a rod to allow the paper to become descending after crossing the rod.
2. **Circular chromatography** –The sample is applied at the center of circular paper after marking with a pencil. After drying, kept it in a Petri dish by wick of the paper dipped in the solvent. As solvent rises through the wick, components get separated into concentric rings.
3. **Two-dimensional**- on square or rectangular filter paper the sample is applied to one of the corners and development is performed at a right angle to the direction of the first run.

Limitation of paper chromatography

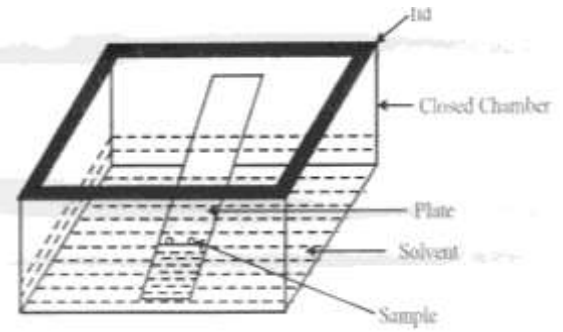
1. A large quantity of sample and Corrosive material cannot be applied on paper chromatography

2. Complex mixtures cannot be separated

ADSORPTION CHROMATOGRAPHY

Thin Layer Chromatography: TLC was first introduced in 1938. It is used for the isolation of non-volatile mixtures. It's also called as TLC is also made by other names such as-

1. Surface chromatography
2. Column chromatography



ADVANTAGE OF TLC OVER OTHER CHROMATOGRAPHY TECHNIQUES

TLC is superior to column and paper chromatography. The main advantage is given below-

1. TLC required simple equipment and methodology.
2. It required less analysis time for development for drying and Ultra-choice of stationary phase.
3. It requires low solvents can be analyzed numbers of samples.
4. Complex mixtures easily separated based on polarity
5. Required very small quantity of samples
6. **Easy recovery:** It is possible to remove the powder coating of plates by scraping a knife.
7. **Easy equalization of the paper** component. Detection of a component under U.V. light is easier than paper chromate.
8. **Chemically inert stationary phase** the greatest advantage of this technique is very strong corrosive reagents such as concentrated $H_2\ SO_4$ can also be used.

APPLICATION OF TLC

Due to its simplicity, sharpness, high sensitivity in separation, and easy recovery, TLC has found increasing application in all branches of chemistry and its allied branches. The application of TLC in organic chemistry is as follows.

1. It is used for checking the purity of organic, inorganic, and biological samples

2. To observe the purified product and also measurement cycles in the purification process
3. Estimation of reactions/progress in reactions/purification method and for the identity of separated organic compounds such as amino acids, proteins, alkaloids, phospholipids antibiotics, acids, alcohols, ethers, amine, etc.

LIMITATIONS OF TLC

1. It is used only for small preparative work but researchers have obtained high resolution by using TLC while using film techniques.
2. Humidity and temperature can affect the result
3. Compounds run streak rather than spot
4. A limited amount of material can be isolated

PROCEDURE FOR TLC

1. TLC plate is be prepared by using silica as a stationary phase with fine and uniform.
2. Mark the line by pencil to the bottom of the plate and upload the sample to be separated
3. A suitable solvent or solvent mixture which is pure and particulate-free can be used as a mobile phase. Sample loaded TLC plate is placed into TLC chamber in such a way that the loaded sample should be well above the solvent system/mobile phase and Cover the chamber with lid
4. After the development of the spot remove the plate and observed the spot under the UV chamber
5. Mark the spot and calculate RF values of spots.

HIGH-PERFORMANCE THIN LAYER CHROMATOGRAPHY (HPTLC)

The advanced version of TLC is HPTLC, working on the adsorption-based principle for separation. HPTLC can be used as an alternative technique for high-performance liquid chromatography (HPLC) and gas chromatography (GC). HPTLC is also called flat-bed chromatography or planar chromatography.

APPLICATION OF HPTLC

1. It is cost-effective, easy to maintain and Multiple analyses can be done simultaneously
2. No risk of contamination and have a wide range of stationary phases
3. The method is sensitive, rapid, reproducible, precise Required less solvent for separation

DISADVANTAGE

1. Limited samples can be tested on a plate

2. Short separation of bed
3. Silica also detected in the test

PROCEDURE

1. *Sample preparation-* For HPTLC 0.1µl concentration of sample used for transferring the sample solutions to the thin layer qualitative work.

2. *Preparation of chromatographic layers***-** Layers can be performed on a sheet of glass, plastics, and or aluminum foil which is coated with a thin layer of adsorbent materials/stationary phase. Generally, silica gel, alumina oxide, calcium phosphate are used as a coating material for better plating some binders like gypsum, calcium sulphate, starch are added to absorbent gypsum is most used.

1. The various methods of preparing layers such as Pouring, dipping, spraying, and spreading. After preparing slurry in water or solvent, the plate dipped into slurry, remove and dry it well. The slurry is spread uniformly on the glass surface. After setting the layer of adsorbent activate the plate by keeping it in an oven at 100 ^{o}C for 1 hr.

2. *Washing and conditioning-* Methanol and also in combination with ethyl acetate wash the plate. Plates should be handled only at the upper age to avoid contamination. For quantitative analysis and reproducible results plated need to equilibrate.

3. *Sample application-* For a sampling of the standard sample, a capillary tube or micropipette can be used for spotting. The spot can be placed 2cm above the base of the plate. The plate should be kept into the

4. *Selection of mobile phase-* It depends on the stationary phase used in the system and chemical properties of solvents such as Diethyl ether, methylene chloride, and chloroform combined individually or together with hexane. The Choice of solvent is an important decision. In practice generally benzene, chloroform, acetone, benzene-methanol, chloroform-Methanol

5. *Chromatographic development*: Assembling of chromatography T.L.C. plate is placed in the development chamber with angle 45^{0} it is imp that development chamber is perfectly saturated with solvent paper.

6. *Detection of spots:* The lower edge of the plate is deep into the closed developing chamber. Due to capillary action, the samples run up to desired distance .depending upon the vapor pressure in the chamber and composition of components, the stationary phase absorbs molecules from the gas phase, and migration of components of the mobile phase is separated. Chamber saturation is more important for the detection of spots

7. *Documentation:* the developed plate may be digitally documented under UV and white light

HIGH-PRESSURE LIQUID CHROMATOGRAPHY (HPLC)

HPLC is a non-destructive method used for the simultaneous analysis method. The separation of sample ingredients/ analytes between the mobile phase and stationary phase. The distribution of analytes depends on chemical structure, intermolecular interaction between molecules, and packing material in the column. Different common packing materials are for normal phase, reversed phase, size exclusion, ion exchange, affinity chiral, or hydrophilic interaction for the separation in HPLC. Change in composition of mobile phase in HPLC the system is known as gradient elusion system.

HPLC is mainly divided into two types.

1. Normal phase HPLC and

2. Reversed-phase HPLC.

PRINCIPLE

Resolving power of chromatography column increases with increase in column length. There is development in adsorption partition, exchange affinity chromatography resulted in faster resolution hence HPLC is the most popular, powerful, and versatile form of chromatography.

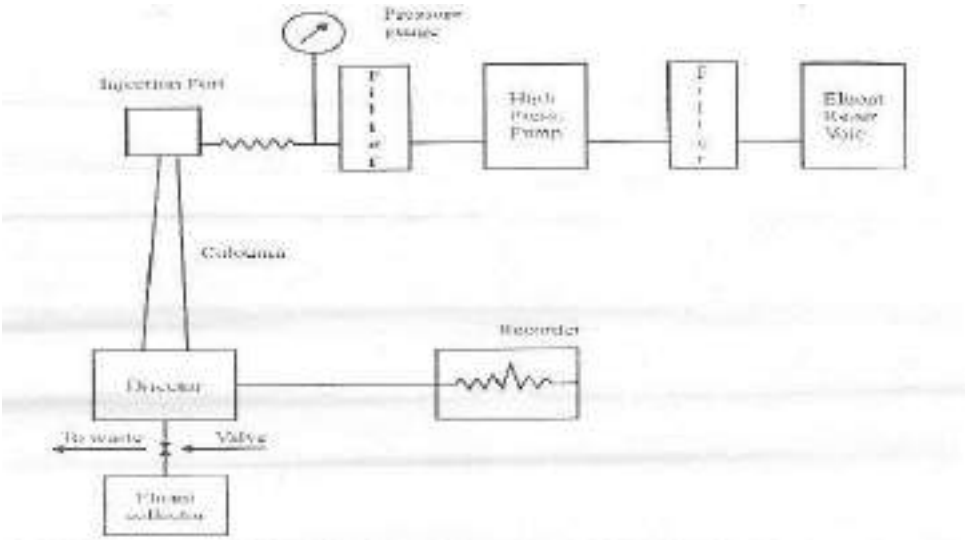
EQUIPMENT

Fluent reservoir, de-gasing solvents, Gradient controller and mixing unit, filter, Hinge press. Pump, filter, pressure gauge injection port (Column), director, recorder, eluent collector.

This is a schematic representation of high performance eluent-

1. From the solvent reservoir achieves a constant flow of solvent at 100 psi.
2. The flow gets smooth with the dumper.
3. It is possible to measure the inlet press of column with manometer after leaving the column the sample studs high pressure. The sample is injected through a spectrum in an injection hole either directly or to the column or on a small plug, employing an appropriate valve. The fluent form a channel section through the injection pole. Degassing is used to prevent gas bubbles in the pump detector. The solvent must be passed through the column at high pressure while as stationary phase particles are smaller (5-10μ) resistant to the flow of solvent hence high pressure is recommended. A flow rate of 0.1to 10 ml/min is recommended. The outlet which leads directly onto the column is highly impure solvents, Urine, whole blood which has preferably been detected by high resolving power. The separated analytes are recorded by the system in the form of peaks. Total all peaks are known as a chromatogram. All peaks given the information about the analytes such as shape, the intensity of the peaks, time required to

appear for peaks. The area of peaks that depend on the concentration of analytes is known as Gaussian bell-shaped curve. Delay time, retention time, peak width, and Trailing factor /peak symmetry



ADVANTAGES

1. It is simple, rapid, reproducible, Repeatable, and sensitive methods
2. It exhibits accuracy, precision and its stationary phase is chemically inert.
3. Less amount of mobile phase is required in developing chamber.
4. Techniques are important for the validation of the product, quality control studies.
5. It is used for both analytical and preparative purposes.
6. HPLC is used in easy to fractionate and purify

APPLICATIONS OF HPLC

1. It is used to detect, identify, quantify and purify all chemical and biological molecules.
2. HPLC is widely used for the separation of Polar components such as vitamins. Steroids, polyphenols, Peptides. The separation of some highly polar compounds such as amino acids can be separated economically by this method.

GAS CHROMATOGRAPHY

It is quite similar to column chromatography except that gas is used as a mobile phase instead of a liquid. Gas solid chromatography (GSC) and Gas liquid chromate (GCL) is encountered. The main advantage of gas chromatography are as follows-

1. A complex mixture can be resolved easily.

2. It gives good precision and accuracy.
3. The analysis is completed in a short time.
4. The cost of the instrument is relatively low.
5. Its life is generally long for the operation of gas chromatography. It doesn't require. A highly skilled person for calculation.

PRINCIPLES OF GAS CHROMATOGRAPHY

When the gas of vapors comes in contact with the adsorbent certain amount of it gets adsorbed on solid. In the system Helium, argon, or nitrogen are used as carrier gas. The component separated inside the column and detector measure the number of components. The separation techniques are capable of separating complex mixtures based on physical constant, polarity, and vapor pressure.

PROCEDURE

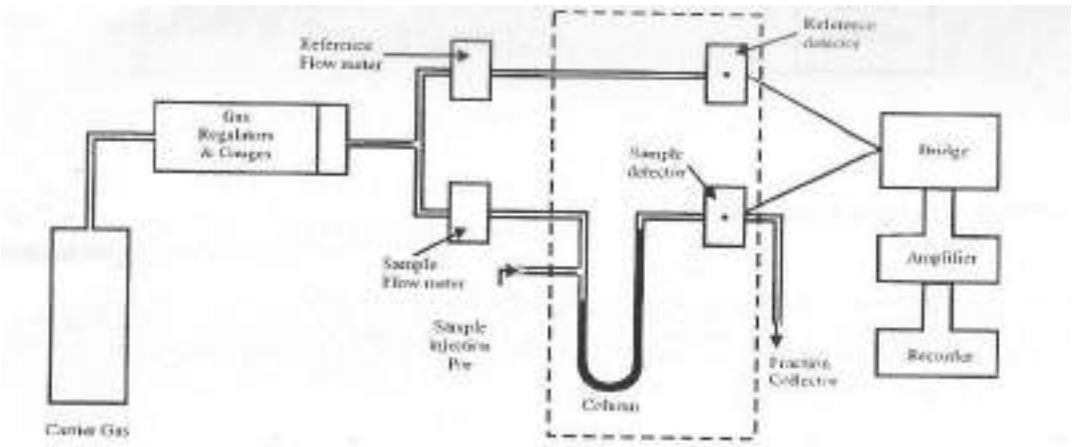
Its operation is similar principle of column chromatography where samples are dissolved in the mobile phase and passed through the stationary phase.

There are 4 steps in the analysis

1. *Sample collection*- sample is introduced into the stream of gas. A gas sample is collected and then it is introduced into an inert gas stream called a carrier gas
2. *Sample injection*- here it's in hot conditions which allows the solvents and compounds to evaporate (liquid sample need to be evaporated before injecting into the carrier)
3. *Sample separation*- samples moved through the packed column, with the stationary nonvolatile phase. Samples interacted with the stationary phase very less
4. *Sample detection*- Samples quantified collected through the detector.

APPLICATIONS

1. The detection of steroid drugs used by international sports competitions.
2. Hazards pollutants such as CO2, formaldehyde, benzene can be monitored by G.C.
3. An analysis of food products like milk, sugar, butane, and added colors and salts G.C.cab be easily identified.
4. It is also used in drug analysis, identification of plastic, paints, and synthetic polymers, and various environmental studies

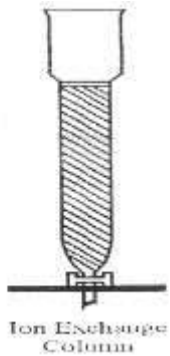


ION EXCHANGE CHROMATOGRAPHY

PRINCIPLE

The principle feature underlying this form of chromatography is the attraction between oppositely charged particles. Ion exchange separations are mainly carried out in a columns pack with an Ion exchanger. There are two types of ion exchangers, namely caution and anion exchanges. Cation exchanges possess negatively changed groups which will attract negatively charged molecules.

The quality of an ion exchange resin is determined by its capacity which in turn depends upon the total number of ion active groups per unit weight of the material. Greater the number of ions the greater the capacity of the resin for the exchange process. The efficiency of the resin has been found to depend upon the degree of cross-linking and the higher the efficiency of the resin.



Univalent anions, the capacity has been found to decrease	$1^{-}>NO_3^{-}1^{-}>Br^{-}>CN^{-}>C1^{-}>OH^{-}>F^{-}$
Univalent cation the capacity has been found to decrease	$H^{-}>cs^{+}1^{-}>Rb^{+}>NH_4^{+}>Na^{+}>Li^{+}$

A glass column fitted with glass wool or ordinary burette with resin provides a large surface area for contact between the solution and the resin.

APPLICATIONS OF ION EXCHANGERS

Ion exchange is used mostly in inorganic chemistry.

1. Separation of amino acids and sugars from food, actinides
2. Purification of organic compounds
3. Separation of contaminations from water and for analysis of pollutions

REFERENCES

1. Joseph Sherma , Gunter Zweig Paper Chromatography 1971, chapter 3 - Techniques of Paper Chromatography Pages 30-89
2. Joseph Sherma , Bernard Fried 2003 the Handbook of Thin-Layer Chromatography, Third Edition Routledge publication
3. Shrivastava, M.M. 2011, An Overview of HPTLC: A Modern Analytical Technique with Excellent Potential for Automation, Optimization, Hyphenation, and Multidimensional Applications. In: Shrivastava, M.M. HPTLC. New York: Springer, pp. 3- 24.
4. Patel, R.B. and Patel, M.R. and Patel, B.G.2011, Experimental Aspects and Implementation of HPTLC. In: Shrivastava, M.M. HPTLC. New York: Springer, pp. 41- 54.
5. McNair H M, Miller J M, Snow N H. Basic gas chromatography. John Wiley & Sons, 2019.
6. Scott R P W. Introduction to Analytical Gas Chromatography, Revised and Expanded. CRC Press, 20

ISBN: 978-93-91768-38-6

Current Research of Nanotechnology in Science and Engineering

Volume II

Editor:

Dr. Bassa Satyannarayana

Bhumi Publishing

First Edition: 2022

CURRENT RESEARCH OF NANOTECHNOLOGY IN SCIENCE AND ENGINEERING

Volume II

It's a Present & Future Technology

(ISBN: 978-93-91768-38-6)

Editor

Dr. BASSA SATYANNARAYANA

Assistant Professor,

Department of Chemistry,

Govt. M.G.M P.G College, Itarsi, MP 461 111

Email: satyanarayana.bassa@gmail.com

Bhumi Publishing

2022

First Edition: 2022

ISBN: 978-93-91768-38-6

Published by:

Bhumi Publishing,

Nigave Khalasa, Kolhapur 416207, Maharashtra, India

Website: www.bhumipublishing.com

E-mail: bhumipublishing@gmail.com

Book Available online at:

https://www.bhumipublishing.com/books/

CONTENT

Chapter
2

ROLE OF NANOTECHNOLOGY IN *LANTANA CAMARA* RESEARCH

ANITA S. GOSWAMI-GIRI*[1], RITESH OZA[1] AND GEETALI INGAWALE[2]

[1]B. N. Bandodkar College of Science (Autonomous), Thane
[2]Humanities and Applied Science, I/C Library and Information Center,
VPM's Polytechnique, Thane, M.S.
Corresponding Author: Anita S. Goswami, Email: anitagoswami@yahoo.com

ABSTRACT

Lantana camara contains several bioactive molecules having antimicrobial, fungicidal and insecticidal properties and acts as alternatives in some therapeutic markets. Due to demand supply gap it is essential to extract the bioactive substances from natural sources. It is biomass source from nature that occurs in tropical and subtropical region of world. It shows significant pharmacological and therapeutic properties dueto richness in content of important secondary metabolites that have different biological activities. However, considering trace level of few of these bioactive molecules, it is advisable to implement nanotechnology approach in research and development of these compounds. Nanoparticles are unique subset of the broad field of nanotechnology. Being sparingly soluble and labile biological active substance, it has great potential in the promising drug delivery system. Due to biocompatible and biodegradable properties, it interacts with target cell and improves the function of cell. A well-known versatile drug Lantadene / penta cyclic triterpenoids isolated from Lantana camara. Hence, special attention was given to importance of Nanotechnological workflows with different perspectives into research of this biochemically significant plant species.

KEYWORDS: Anti-microbial, Therapeutic properties, Lantana camara, Nanotechnology.

INTRODUCTION

The source of various novel bioorganic compounds is waste lands. A waste land weed ; Lantana camara play vital role as anti-motility, anti-ulcerogenic anti-microbial activity, allelopathic activity, anthelmintic, anticancer, antifungal, cytotoxicity, nematocidal, insecticidal, analgesic, anti-inflammatory, antimalarial, haemorrhoidal activity, antipyretic, larvicidal, anti-tumour activity etc. The plant Lantana camara derived pharmaceutical active compounds namely pentacyclic tripene have complex structure making chemical synthesis, an economically competitive option. Yet, the derived compound and its potential need to get investigated for its additional potential.

Lantana camara is rich source of natural product. The natural products contains active and bioactive molecules that are heterocyclic in nature. The *Lantana camara* exhibits various organic compounds extracted with organic and aqua solvents. The diversified processes for extraction of organic molecule depend on the physical properties such as its solubility and polar or non-polar bonds.

Reflecting on the last decade of biosensor development, one can apparently perceive the impact of nanotechnology in this research area. Antiquity, Ag-based antiseptics [Ratyakshiand Chauhan; 2009] Ag salts showed antibacterial [Khan etal; 2011]. Due to its pharmaceutical, stabilizing and reducing and

catalytic activity, the plant used for the fabrications of nanoparticles to advances significance in the filed of chemistry. Goswami-Giri and Ingawale; 2012 exhibited AgNP catalyses the chemical reactions of natural product including Pentacyclic triterpenoids having antitumor activity. Reduction of metal into the particle deviates the appearance of particles. Therefore, the potential for chemical reactivity of reaction extensively used by researcher for drug delivery (Narayanan and Pal; 2008, Hodges; 2011, ShuangToh, etal; 2013, Solomon etal; 2007). Considering above benefits, there is needed to develop bioactive silver nanoparticle having application as a bacterial inhibitor for the potential confirmation in chemical reactivity for urinary tract infection. Nano-technological approaches in the *Lantana camara* evaluation had pronounced attention as an alternative medicine.

SYNTHESIS OF SILVER NANO PARTICLES (AGNP)

METHODS

IDENTIFICATION OF LANTANA CAMARA PLANT

Lantana camara was identified and collected from VPM's B.N Bandodkar College, (Autonomous) Thane (MS)-India campus. Segregated all part were air dried, powdered and store until used.

EXTRACTION OF BIOACTIVE COMPOUND FROM LANTANA CAMARA L.

Hundred gram of powder of Lantana leaf, stem powder, flowers and ripened black fruits were treated separately with 500 ml organic solvent/methanol and refluxed it for 3 hours to observed respective extract. The extract was concentrated under vacuum at 13-14 mm/Hg at 58^{o}C.The obtained residue suspended in water, after filtration the residue was treated with methanol-water (1:7) followed by ethyl acetate (2 X 25cm3) and washed with n-butanol ((2 X 25cm3). The residue of lantana plants part loaded over silica gel column (60–120 mesh) using chloroform-methanol (9:1) as eluting solvent. The extract was re-chromatographed using n-Hexane and acetone. The concentred extract was suspended in water and then consequently extracted with ethyl acetate and n- butanol. The ethyl acetate fraction is loaded on a silica gel column using a mixture of CHCl3-Methanol with increasing solvent polarity as effluent for the segregation of layers. Neutral layer examines with n-Hexane and acetone to yield active compound.

The similar process was carried out using aqueous reflexion under vacuum at 14 mm/Hg at 84^{o}C to become concentrated residue. The residues obtained with methanol and aqueous media of all plants part were qualitatively analysed by TLC, HPLC UV, IR analysis, TEM.

PREPARATION OF SILVER NANO PARTICLE (AGNP) OF BIOACTIVE MOLECULE

The above characterized pentacyclic compound was used for the preparation of nanoparticles. Analytical pure grade Silver nitrate and tri-sodium citrate were used as starting materials without further purification. The silver nanoparticles of lantana camara were prepared by using chemical reduction method. 100M $AgNO_3$ (90cm3) was heated to 80-90^{o}C with 10 cm3 of 1 % trisodium citrate by gentle stirring on magnetic stirrer. In this reaction solution, 10cm3 (100µl) bioactive Pentacyclic triterpenoids isolated from *Lantana camara* (leaves) was added dropwise under vigorously, stirring. The obtained Silver nano particles were analysed by UV-Visible spectrophotometry and evaluated its role as an antibacterial and antifungal using amala fruit fungus.

The fungus isolated from Amala fruit were utilised in the method. Silver nanoparticles of bioactive molecule (10 mgs) were used to urge concentration ranging from 25 to100 ppm by mixing methanol and distilled water. The experiment was carried out using hot malt agar broth under sterilised condition. The agar poured into Petri plate which was solidified into transparent solid. The disc test method was used to check antifungal and antibacterial activity. Three an inoculated plate was used for the evaluation by

using various drug disc along with the nanoparticles by streak plate method. The disc plates dried at 35-37 ^{0}C incubated for 48 hours. One-disc plate was kept as controlled (containing malt agar). This control plate was kept as control without Silver nano particles. A fungus mycelium taken from the 48 hours old fungus culture were placed in disc containing silver nano particles and incubated at 35^{0}C. Observe the anti-fungal effect and % of inhibition of silver nano particles on the radial growth of fungus after three days. The Aggregate of lantadene nanoparticle was kept for room temperature for its atmospheric nature study. Serially up to four month sits nature was observed.

SILVER NANOPARTICLE OF PENTACYCLIC COMPOUND LANTADENE

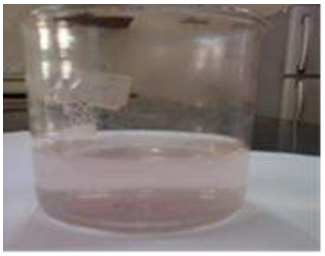
The silver colloid particles were formed immediately after addition of reacting materials. Vigorously shaking with magnetic stirrer along with cooling the colourless solution changed to white, indicates the formation of AgNp of lantadene whereas without Lantadene it showed pink to violet (figure 1).The particle having reaction mechanism of reaction is as follows –

$4Ag+ + C_6H_5O_7Na_3 + 2H_2O \rightarrow 4Ag + C_6H_5O_7H_3 + 3Na+ + H+ + O_2\uparrow$

Also, Lantadene + Silver nanoparticles = Aggregation (figure2)

FOR THE SILVER NANOPARTICLES OF LANTADENE SAMPLE

UV spectrum was carried out of isolated pentacyclic compound and its nanoparticles at Shimadzu-1800 spectrophotometer. Silver nano particles of pentacyclic compound/Lantadene is hydrophobic in nature due to these particles were dissolved in methanol and water. Purity and quality of solvents were strictly maintained. Correction line of methanol solvent was determined, after the standardization of the system. Sample solution of silver nano particles was subjected for the determination of UV-Visible spectra along with the determination of UV maxima. Colloidal particles have a +ve or –ve electrostatic charge. Due to presence of electrical fields particle dispersion is more and the particles travel in oppositely charged directions. Hence its migration due to scattering light measured by Doppler shift method totally depends on electrophoresis mobility. Silver particle in suspension exhibited zeta potential because all solid, liquid & gases states and colloidal states have great impact on Van der Waals attractive (VA) and electrical double layer repulsive (VR) forces that exist between particles and colloidal system become stable due to energy barrier. The extract acts as reducing and stabilizing agent hence can be used in particles. Zeta potential is a very excellent index of the magnitude of the interface between colloidal particles and dimensions of zeta potential are normally used to evaluate the firmness of colloidal systems. It depends on pH and naturally occurring material aqua material. This information may be useful in the field of pharmaceuticals, agrochemicals, pigments, dyestuffs, foods and explosives. Conformation of same molecule in different solvents showed different stability and consequently its bioavailability gave knowledge to the chemotherapy of life. Crystals from acetone were treated with boiling methanol and then cooled at 4^{o}C.



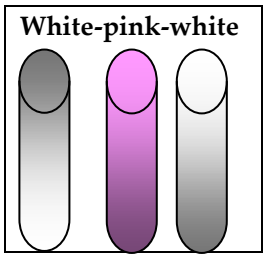


Fig. 1: Changes in color of nano particle a. Colorless b. Pink c. White

Fig. 2: AgNp-lantadene aggregated compound (10mgs)

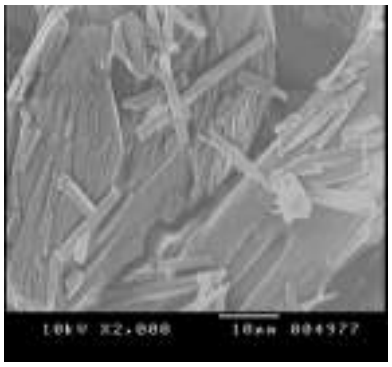


Fig. 3:(a)SEM of pure Lantadene

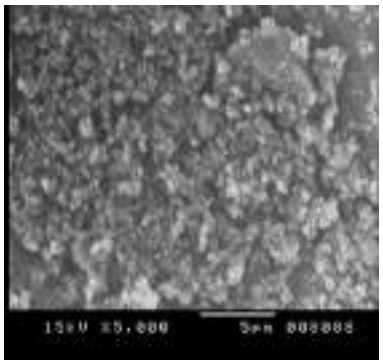


Fig. 3:(b) SEM of Nanoparticles (5 μM)

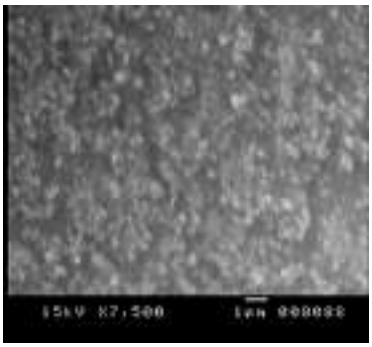


Fig. 3:(c) SEM of Ag Nanoparticle (1 μM)

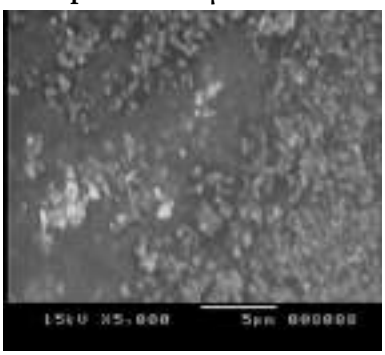


Fig. 3:(d) SEM of Ag Nanoparticles (5 μM)

Fig. 3: SEM of silver nano particles

Silver nano particles with 100 ppm cause reduced the colonies number. Pentacyclic compound/ Lantadene AgNp by exhibiting excellent antifungal activity. The effect of AgNp treatment was evaluated by measuring the number of fungi colonies. Black, brown, green and yellow colored fungi detected on the plates. By varying (25ppm, 50ppm and 100ppm) concentration of Silver nano particles of Lantadene there was not considerable reduction of fungal growth observed. The incubation period by comparing number of different colored fungus growth showed the actual inhibition of growth of fungus. As in all three concentrations there was much growth of fungus observed towards the periphery as compared to the center of the plate. The efficiency of silver nano particles treatment was evaluated by measuring the fungi colonies diameter.

RESULT AND DISCUSSION

The literature review on *Lantana camara* has been dealing with the various aspects of bioactive molecules and its approach towards nano-techniques. The biophysical, biochemical methods are used for the characterization with the search for new microorganisms providing higher control rates. The purity of bioactive compounds and its nanoparticles effective of fungus inhibition. The structural elucidation of the bioactive molecules and its potential inhibition explore in the field of medical application which verifies the pivotal role of Nano technological processes.

Organic molecule in plant material is depending on solubility, polarity, extractions of a specific bioactive compound in the nature and extraction medium. The extract was carried out by conventional, novel

methods and the yield of triterpenoid/tripene was compared in rotation with time. Assortment of effective organic solvent for natural product is very much important for the maximum recovery of product. Antibacterial screening with the help *Lantana Camara* pentacyclic compound and its fabricated silver nanoparticles. The extracts *Lantana camara* parts exhibits UV range from 270 nm to 330nm. UV spectrum of Lantana Camara Ag-Np's were exhibited between 270-350nm. Various colour on TLC was monitored having Rf values are 0.82, 0.86, 0.46 for Lantana leaf, stem powder, flowers and ripened black fruits respectively.

The FTIR spectra of leaves crude bioactive compound belongs to O-H and C-H with stretching modes by exhibiting at 3465 cm^{-1}, 2700-3100 cm^{-1}1457 $cm^{-1}$and at 1302 -1396 cm^{-}1. The involvement of function group of Lantana Camara leaf extract in the reduction and capping process of nanoparticles was well displayed in FTIR. Lantana camara leaves having anti-filarial activity as well as metabolites isolated from leaves possess antitumor, anti-thrombin, anti-nociceptive and antipyretic activity. The bioactive molecules observed in lantana various atoms with 270 normal modes of vibration.

Antimicrobial activity of *lantana* and its Silver nanoparticles also possessing antifungal activity. Antibacterial effect was evaluated with B. Subtilis, S. aureus, S. typhi and E.coli. TEM analysis of extract disclosed spherical and crystalline shaped nanoparticles along with antifungal activity. The consequence of nanoparticles X-ray diffraction pointed peak at 38 representing the crystalline nature.

Contribution of phenol, amino groups in Lantana may have important role in toxicity. During processing, ethyl acetate does not sort out entire extract of tripene in methanol–water mixture. Hence, Ethyl acetate, methanol used in reaction along with hexane to observe maximum yield. Quantifications of it were completed with qualitative test-Salkowski Test, Liebermann Burchard test, and colorimetric method. By surface morphology was evaluated to characterize coating surface with high resolution and by recording of X-ray spectra. Figures 3 indicate that there are no significant changes in the surface morphology. Nevertheless, it exhibited fluffy and rod-shaped uniform crystals which also confirmed with X- ray diffraction.

Silver nanoparticals were synthesized from fruit extract using spectroscopy. Secondary metabolites, various acids indicate the interaction between silver nanoparticles is present in fruit extract of Lantana Camara Linn. Oleanolic acid was isolated from root.P. Rama Devi 2015 also evaluated antimicrobial active Silver nanoparticle synthesis from Lantana Camara seed extract. The process used in biosynthesis process of antibacterial silver nanoparticles using Lantana camara seed extract are conjugated with organic bioactive molecules .The particles and its physical properties depend on the various dyeing material and its surface area ratio.

Lantana nanoparticles have articulated substantial improvements owed to wide range of applications in the field of biomedical, sensors, antimicrobials, bio-insecticides, catalysts, electronics, optical fibers, agricultural, bio labelling, Bioremediation, their role in health care system, diagnosis in drug delivery. In the modulation of the size and shape of the nanoparticles product is nontoxic and to protect the environment. It also opens up the application in wood chemistry, industrial waste absorbent and harmful chemicals to useful with traditional medicinal properties. The nanoparticles are economy source and driver for its application in the field of medicine.

REFERENCES

[1] Emily Ann Hodges (2011). Anti-microbial self-assembling -click monolayer's utilizing silver nanoparticles for indwelling medical devices, MSc Thesis, Louisiana State University.

[2] Goswami-Giri Anita and Ingawale Geetali. (2012). *Lantana camara* (LINN): Green informatics Approach Bio nanofrontier *ECO REVOLUTION*-2012 COLOMBO SRILANKA, 291-294.

[3] Ewes M., Gad, A. (2011). Control of Beta Vulgaris Pathogens, using *Lantana camara* Linn essential oil in vitro. *International Journal of Botany* ISSN. 1811-9700, 289-294.

[4] Her ShuangToh, Christopher Batchelor-McAuley, Kristina Tschulik and Richard G.Compton. (2013). Electrochemical detection of chloride levels in sweatusing silver nanoparticles: a basisfor the preliminary screening for cystic fibrosis, *Analyst*, DOI: 10.1039/C3AN00843F

[5] Khan Z., Hussain J., Kumar S., Hashmi A.and Malik M. (2011). Silver Nanoparticles: Green Route, Stability and Effect of Additives," *Journal of Biomaterials and Nanobiotechnology*, Vol. 2 (4) 390-399.

[6] Narayanan S.S, Pal S.K. (2008). Structural and Functional Charactreisation of luminescent Silver protein *Nano Bioconjugates J.Phys.Chem.C*, 112; 4874-4879

[7] Ratyakshi and Chauhan R.P. (2009). Colloidal Synthesisof Silver Nano Particles, *Asian Journal of Chemistry* Vol. 21, No. 10, 113-116.

[8] Solomon S. D, Baha dory M, Jeyarajasingam A.V, Rutkowski S.A., Boritz C., and Mulfinger L. (2007). Synthesis and Study of Silver Nanoparticles, *Journal of Chemical Education*, 84,2007; 322-325

[9] Efunt O. (2004).Fungi associated with herbal drugs plant during storage, *mycopathologia*, 136:115-118.

[10] C.Manoharachary, K.Sridhar, Reena Singh. (2005). Fungal biodiversity distribution, conservation and prospecting of fungi from India, *Current science*, Vol 89, 1-12.

[11] Goswami-Giri Anita S.and Neha A. Sawant. (2011). Cytotoxic Activity of *Lantana* Extract Against Wood Destroying Agencies, *Biosciences Biotechnology Research Asia*, Vol. 8(2), p 821-824.

[12] S. P. Chavan *et al.* (2011). A survey of some medicinal plants for fungal diseases from Osmanabad district of Maharashtra state, *recent research in science and technology*, Vol 3(5): 15-16.

[13] Vertical Rai and Shanta. (2005). Toxic contaminants in herbal drugs, Enviro, News 11.

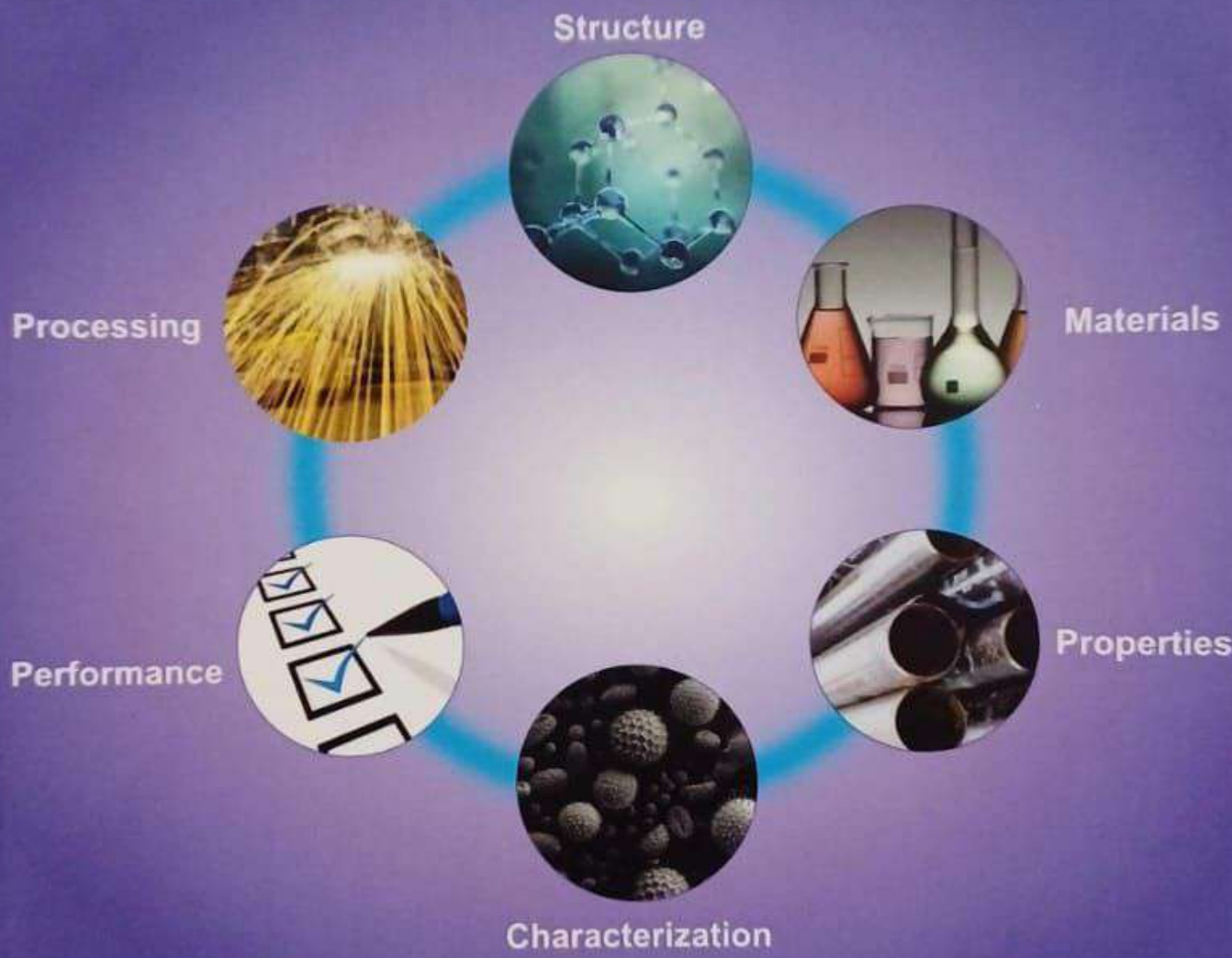
[14] Ajitha B, Ashok Kumar Reddy Y, Sreedhara Reddy P. (2015). Green Synthesis and Characterization of Silver Nanoparticles Using *Lantana Camara* Leaf Extract. Mater Sci Eng C Mater Biol Appl. 49:373-381. doi: 10.1016/j.msec.2015.01.035

[15] Nilesh Meghani, Heena Mankani and Saraswathy Nagendran. (2013). Synthesis of Silver Nanoparticles of Aqueous Extract of Plant *Lantana Camara*and Evaluation of Its Antimicrobial Activity. *World journal of pharmaceutical research* Vol. 3(1), 1339-1351.

[16] P. Rama Devi, G. Lakshmananand R.D.Thilaga (2015). Antimicrobial Active Silver Nano Particle Synthesis from *Lantana Camara* Seed Extract. JPRD, Vol 7(05) 39 - 43.

Advances in Material Science

Characterization and Application



Dr. Ramesh B. Bhise
Dr. Mahendra S. Shinde
Dr. Vishal H. Goswami

SEAMBooks

A Book entitled

ADVANCES IN MATERIAL SCIENCE

Characterization and Application

First Edition-August 2022

EDITORS:

Dr. Ramesh Baburao Bhise, Ph. D. [Physics] Assistant Professor
Balasaheb Jadhav Arts, Commerce and Science College, Ale, Tal: Junnar, Dist: Pune, State: Maharashtra, Pin:4124114. Contact: +91-9822425883 Email: bhiseramesh@gmail.com

Dr. Mahendra Shantaram Shinde Ph. D. [Physics] Assistant Professor
Mahant Jamanadas Maharaj Arts, Commerce and Science College Karanjali (Peth) Dist. Nashik-
State: Maharashtra, Pin:422208 Contact: +91-9423550299
Email: mahen3569@rediffmail.com , msshinde123321@gmail.com

Dr. Vishal Hareshgiri Goswami, Ph. D. [Physics] Assistant Professor
Chikitsak Samuha's S.S & L.S Patkar College Of Arts & Science And V.P. Varde College of Commerce & Economics.
Piramal Nagar, S. V. Rd, Goregaon West, Mumbai, Maharashtra, Pin: 400061 Mumbai (India)
Contact: +91 9892633216 Email: vishalgiri.h.goswami@gmail.com

ISBN Number: **978-81-957290-1-2**

ISBN 978-8-19-572901-2

9 788195 729012 >

Published by **Kritinjal Academic Solutions Private Limited, SPTBI. Office No 14, Bhavans Campus, Munshi Nagar Andheri (west) Mumbai- 400058**

Website : www.seambooks.com
Email id : support@seambooks.com

Books Available online at: https://play.google.com/store/apps/details?id=com.primeussystems.seam

Year of Publication: August 2022

 ISBN: 978-81-957290-1-2

Chapter: 23

Dielectric Behaviour of 2-Ethane Diol, Allyl Amine And Their Mixtures.

S.S. Meshram, Assistant Professor, mitra1610@gmail.com 9870457822

U. B. Tumberphale, Researcher umakant.tumberphale@gmail.com 9422873117

P.G. Gawali, Professor, pggawali_123@rediffmail.com 9421387622

Abstract: *Dielectric analysis of mixtures at microwave frequency and room temperature reveals details about the system's molecular interaction, complex formation and monomer and multimer formation [1–3]. The intermolecular and intramolecular hydrogen bond formation will strongly influence the mixture chemistry of diols, the most common organic compounds, due to the existence of two –OH groups in the molecule. Diols are important in organic chemistry and biochemistry because they affect the state of physical system of molecules. Ethane diol (ED) is an organic compound that is generally utilized as antifreeze in automobiles and as a polymer precursor. It's a minor ingredient in a liquid use to polish and other inks and dyes. The analysis of dielectric behaviours of Ethane diol (ED), Allyl amine, and its mixtures is expected to yield useful information about molecular structure.*

The values of dielectric constant (ε') and dielectric loss (ε") obtained experimentally using Surber's technique at 9.85 GHz microwave frequency, used in calculating molar polarization (P_{12}) and excess permittivity ($\Delta\varepsilon'$, $\Delta\varepsilon''$). The excess parameters for viscosity ($\Delta\eta$), square of refractive index (n_D^2) and activation energy (ΔE_η) also determinate for viscous flow. Computed variables help to describe the molecular interaction and complex formation in the mixtures.

Keywords: Ethane diol (ED), Molecular interactions, dielectric constant, dielectric loss

Materials and Method:

Ethane diol (ED) and Allyl amine of A.R. grade is acquired from Spectrochem Ltd., Mumbai used with no further purification. To ensure good thermal equilibrium, the mixtures were mixed in proportion to their volume and held in well-stopper bottles for six hours. Pycknometer and Oswald's viscometer were used to calculate the density (ρ) and viscosity (η) of the liquids and its binary mixtures respectively. Abbe's refractometer was used to determine the refractive indices of sodium D-line. Surber's approach was applied to find the dielectric constant (ε") and loss factor (ε").

There are two basic techniques for studying dielectric properties of solids and liquids: 1) Time domain technique and 2) Frequency domain technique.

Dielectric parameters such as dielectric permittivity and dielectric loss can be studied using the frequency domain technique. Microwave bench experiments are commonly used to test dielectric effects such as dielectric permittivity, dielectric loss, and tan with a frequency range of 8.2 to 12.4 GHz.

Surber's methodology of estimating reflection coefficient from the air dielectric boundary of the liquid was used to figure out the dielectric constant (ε') and dielectric loss (ε''). This method allows for simple VSWR calculation.

Centered on standing wave parameter measurements, Roberts and Von Hippel [4, 5] devised a method for measuring permittivity. Microwaves are reflected at normal incidence in TE mode from a dielectric sample positioned against a perfectly reflecting surface in this process. As a consequence of reflection, standing waves form in the space in front of the sample. The separation from the first minimum and the sample's face is determined by the wavelength of electromagnetic waves in the sample as well as the sample's dimensions, and hence the dielectric constant. The wavelength change would also cause a move in the minima and, as a result, a shift in the half power width of the standing wave pattern. Furthermore, losses in the dielectric must reduce VSWR, and tan is linked to this reduction in VSWR.

The relation of relative amplitudes of reflected and incident signals might possibly be valuable to calculate VSWR. The reflectometer [6] is a unique device that allows for fast VSWR measurement. A simple reflectometer device is depicted in fig.

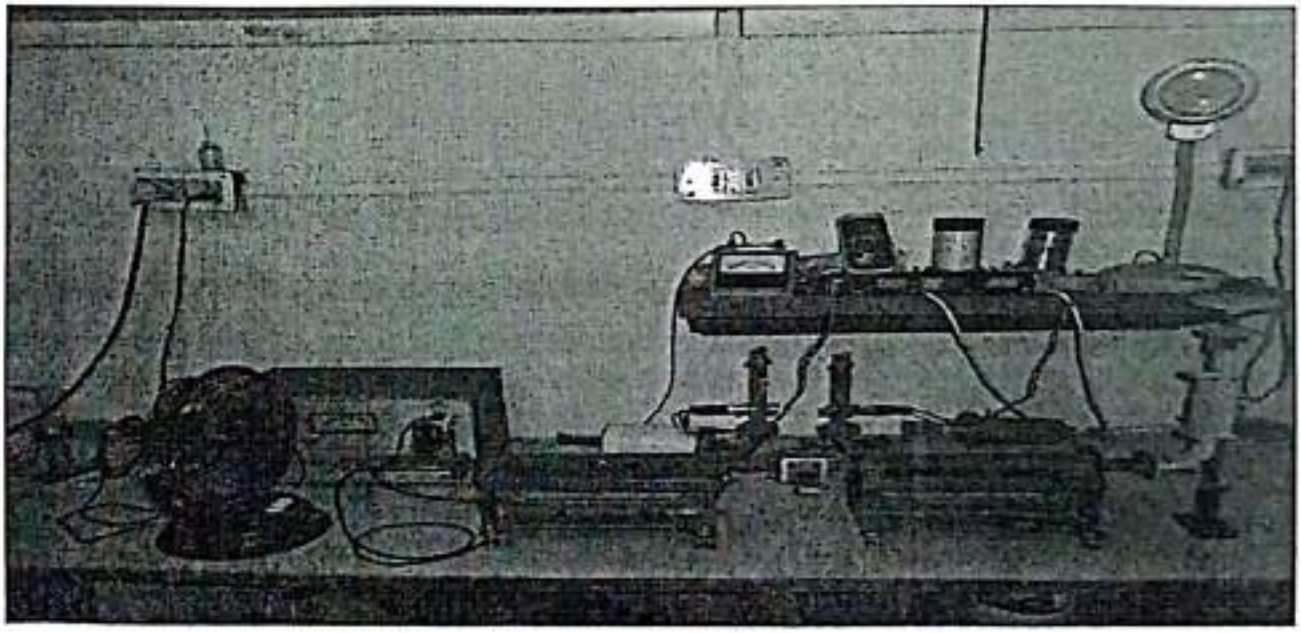


Figure (1): Arrangement for measurement of a material dielectric constant with reflectometer principle.

Dielectric Parameters:

The dielectric constant (ε') and dielectric loss (ε'') have been obtained from the following equations.

$$\varepsilon' = \left(\frac{\lambda_o}{\lambda_c}\right)^2 + \left(\frac{\lambda_o}{\lambda_d}\right)^2 \quad (1)$$

$$\varepsilon'' = \frac{2}{\pi}\left(\frac{\lambda_o}{\lambda_c}\right)^2 \left(\frac{\lambda_g}{\lambda_d}\right)\frac{d\rho}{dn} \quad (2)$$

Where, λ_o is free space wavelength, λ_c is cut off wavelength for the wave guide and λ_d is the wavelength in the wave guide consisting of the solution. ρ is the inverse of the voltage standing wave ratio (VSWR) and $\frac{d\rho}{dn}$ is the slope of ρ versus n where, n = (1, 2, 3 .....) as a result $\frac{n\lambda_d}{2}$ signifies the length of the dielectric filled with waveguide.

The free energy of activation E_a of the viscous flow for the pure liquids and their binary mixtures is obtained by from the following equation [7]

$$\eta = \left(\frac{hN}{V}\right)\exp\left[\frac{E_a}{RT}\right] \quad (3)$$

Where, η is the viscosity of the liquid and V is molar volume and other symbols have their usual meaning.

The values of molar polarization of the mixtures were calculated by using the formula [8]. P. J. Singh et al (1996)

$$P_{12} = \left(\frac{\varepsilon'-1}{\varepsilon'+2}\right)\left[\frac{M1X1+M2X2}{d}\right] \quad (4)$$

Where, M_1 and M_2 are the molecular weight, X_1 and X_2 are the mole fraction of the constituents of the mixture. As suggested by Earp and Glasstone [9] the values of P_1 and P_2 are calculated.

$$P_{12} = X_1P_1 + X_2P_2 \quad (5)$$

Where, P_1 is the polarization of another portion of the solution in the pure liquid state, P_2 is the apparent polarization of each liquid in the mixture.

1.5 Excess Dielectric Parameters:

The excess dielectric properties give Qualitative information obtained by the following relations

$$\Delta Y = Y_m - (X_1Y_1 + X_2Y_2) \quad (6)$$

Where ΔY is any excess parameter and Y specifies to the mentioned quantities. The subscripts m, 1, and 2 used in the above equation are respectively for the mixture, component (1) and component (2). X_1 and X_2 are the mole fractions of the two components in the liquid mixtures.

(1) $\Delta\varepsilon'=0$: This means no interaction between the solute and the solvent.

(2) $\Delta\varepsilon'<0$: The total effective dipoles are reduced. Multimers of system may form, with less efficient dipoles. In binary mixtures, negative excess permittivity designates the formation of multimers.

(3) $\Delta\varepsilon'>0$: The effective dipoles increase; multimers are removed from either the solute or the solvent.

The excess loss factor ($\Delta\varepsilon''$) given by

$$\Delta\varepsilon'' = \varepsilon'' - (X_1\varepsilon''_1 + X_2\varepsilon''_2) \qquad (7)$$

Results and Discussion:

Fig (2) shows the Density (ρ) curve is non-linear, possibly due to weakening of solute-solvent interactions and an increase in system volume. The maximum deviation from linearity is at the mole fraction $X_A = 0.4$ of Allyl amine.

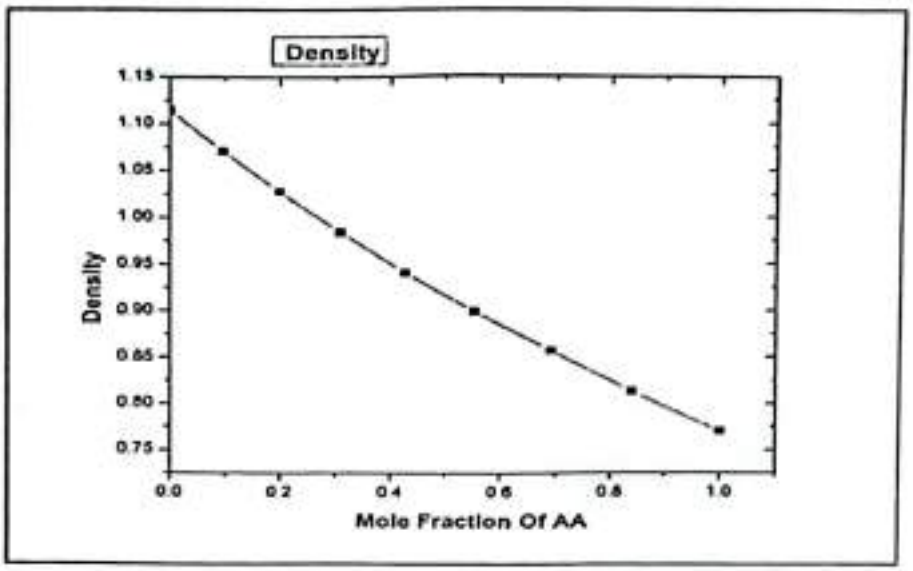


Figure (2): Plot of Density with Mole Fraction of AA.

Fig (3) shows viscosity curve is non-linear. At the mole fraction $X_A = 0.4$ of Allyl amine, the highest deviation from linearity occurs. This curve's behaviour is consistent with the findings of Rahul Singh et al. [10].

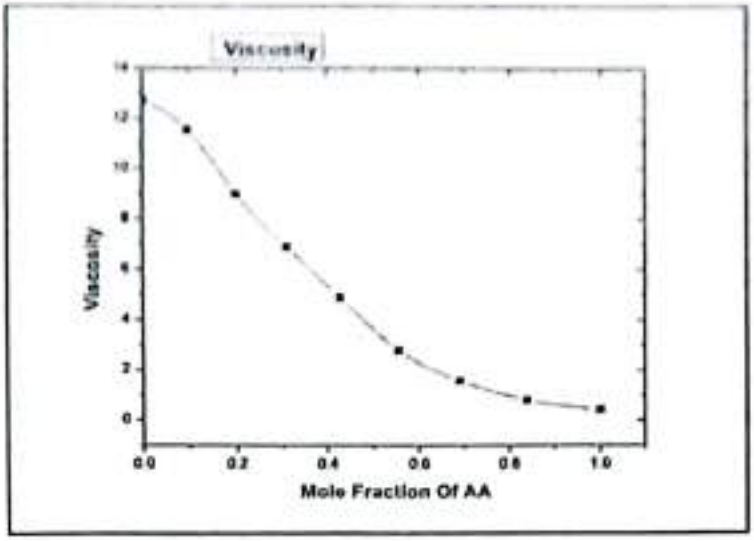


Figure (3): Plot of Viscosity with Mole Fraction of AA.

The non-linear behaviour of dielectric constant (ε′) versus mole fraction (X_A) of Allyl amine is depicted in fig.4. A curve has two maxima and single minima at X_A=0.4275 shows that the mixture is forming complexes and the system is undergoing intermolecular interaction.

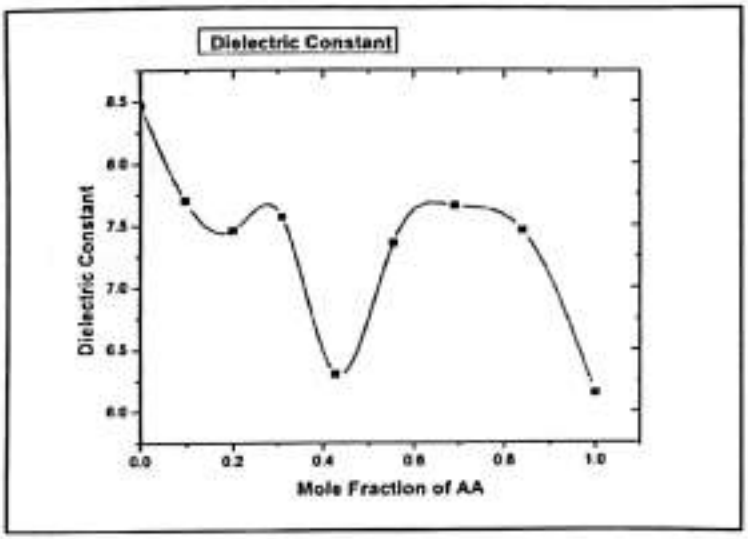


Figure (4): Plot of Dielectric Constant with Mole Fraction of AA.

The wobbling nature of loss tangent ($\tan\delta$) curve **Fig. (5).** with two maxima and a minima is reported in the system (ED + Allyl amine). This observation is in consistent with the Nemmaniwar's B. G. et al [11] results and the minima is occurred at the X_A = 0.4275 mole fraction of Allyl amine, supports earlier findings.

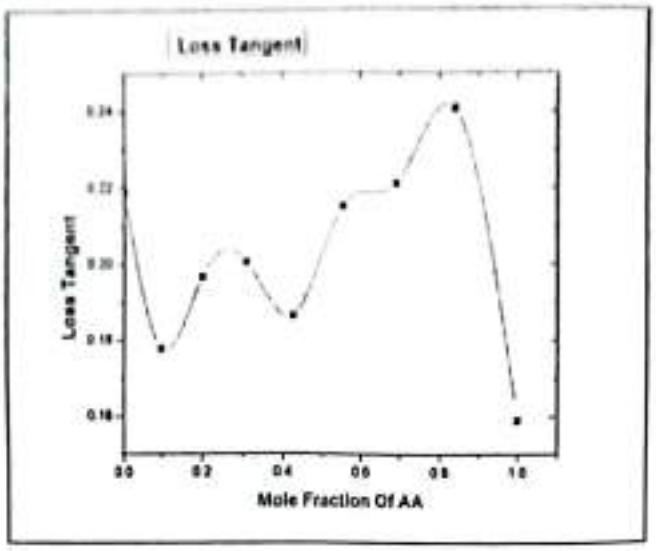


Figure (5): Plot of Loss Tangent with Mole Fraction of AA.

The **fig. (6)** Shows variation of molar polarization (P_{12}) with mole fraction of Allyl amine

The amount of complex present in our binary mixture investigation is responsible for the polarisation curve's wobbling existence.

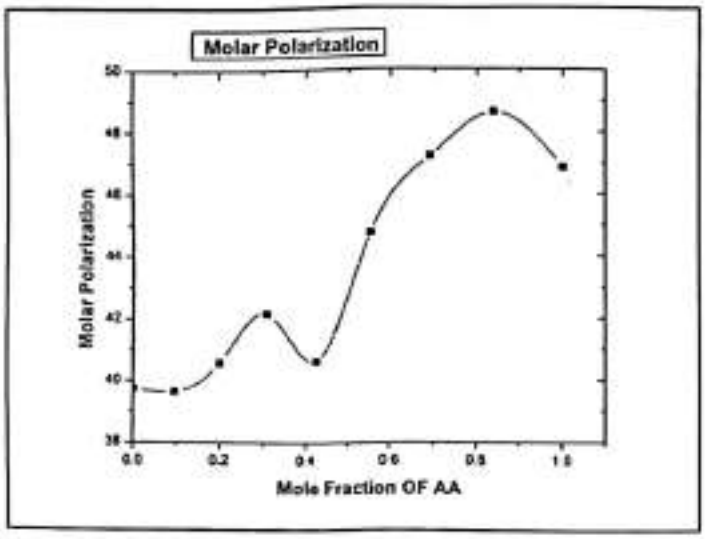


Figure (6): Plot of Molar Polarization with Mole Fraction of AA.

The variation of square of R.I. (n^2_D) with the molar concentration (X_A) of Allyl amine in the binary liquid is shown in **fig. (7)** The square of R.I. (n^2_D) variance of refractive index as a function of Allyl amine's mole fraction indicates that the H-bonded interaction between –Ethane diol and Allyl amine influences the electronic polarization of the molecules in the mixed state. Sizeable the atom or molecule and the moderate the velocity or higher the refractive index, the greater the electrical polarization. At $X_A = 0.4275$, the size of the constituent atoms or molecules in a mixture reaches its limit.

 ISBN: 978-81-957290-1-2

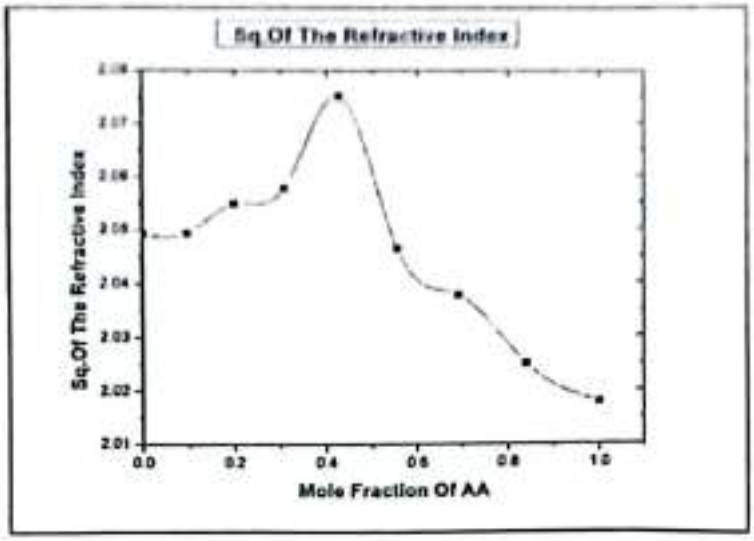


Figure (7): Plot of Sq. of the Refractive Index with Mole Fraction of AA.

Excess parameters in a liquid mixture deviate from ideal behaviour and have been shown to be extremely sensitive to molecular interactions in the liquid mixture.

Negative excess dielectric constant ($\Delta\varepsilon'$) indicates that molecules in the mixtures can form multimer structures by hydrogen bonding, lowering the effective dipole. The polar connection forms with the lower dipole since certain neighbouring dipoles are oriented in the opposite direction.

Positive ($\Delta\varepsilon'$) stipulates that the mixtures' molecules can form monomers or dimers structures, increasing the number of effective dipoles. The solution chemistry of these compounds can be highly affected by the formation of intermolecular and intramolecular hydrogen bonds, as A. Ghanadzadeh Gilani et al [12] pointed out, it due to the presence of two – OH groups in the molecule and some molecular flexibility (H-bond).

The hetero interaction between the unlike molecules in the mixture is lowest at 0.4275 and highest at 0.8394 mole fraction of AA.

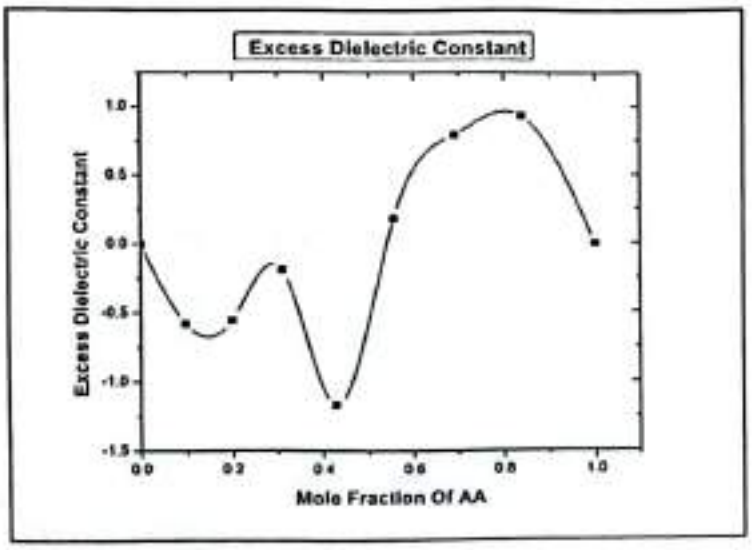


Figure (8): Plot of Excess Dielectric Constant with Mole Fraction of AA.

In figure **(9)** ($\Delta\varepsilon''$), excess loss is caused by **molecular motions** and are controlled by the molecular interaction's **dynamic forces**.

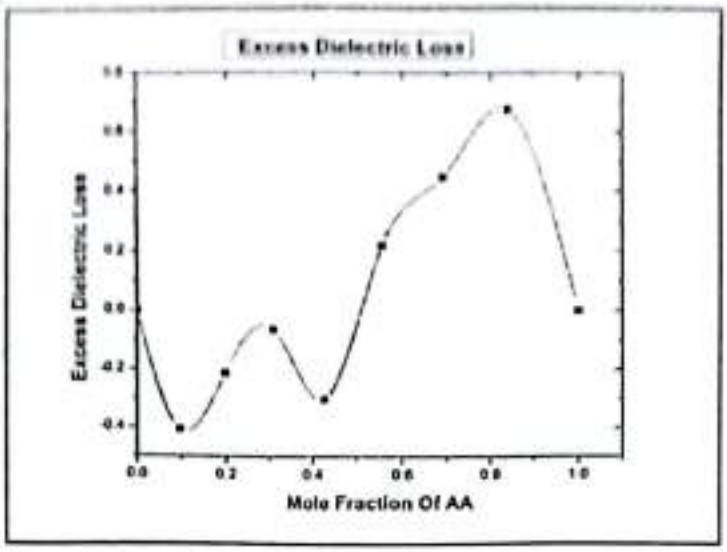


Figure (9): Plot of Excess Dielectric Loss with Mole Fraction of AA.

Figure (10) depict parallel alignment of molecular dipoles is the dominant factor in the AA associated rich region, where long-range electrostatic interaction is crucial for polarization A wave-shaped structure is compatible with the fact that alpha-multimers are predominant in the dilute solutions

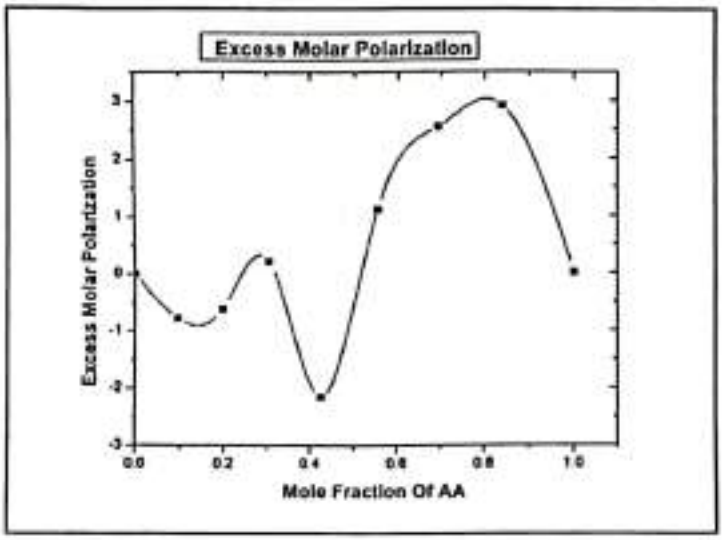


Figure (10): Plot of Excess Molar Polarization with Mole Fraction of AA

Figure (11), Positive values greater than zero suggesting a strong association that results in the formation of complexes via intermolecular hydrogen bonding interactions between unlike and similar molecules.

 ISBN: 978-81-957290-1-2

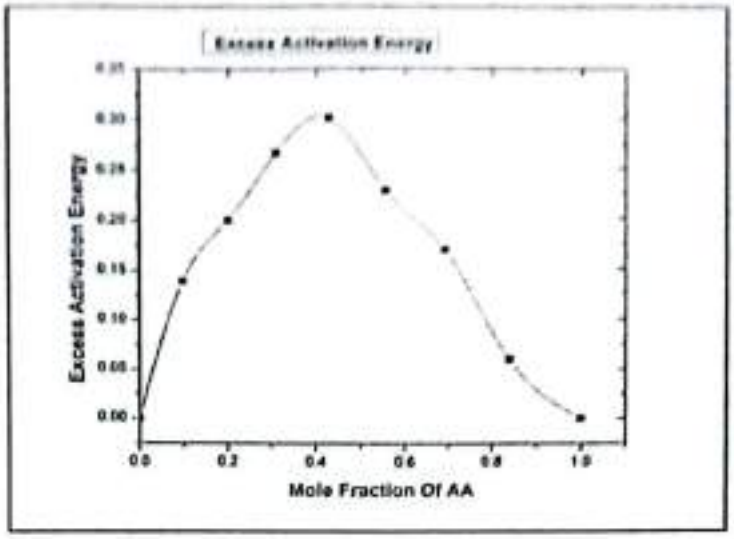


Figure (11): Plot of Excess Activation Energy with Mole Fraction of AA.

Negative deviations, as shown in Fig. (12), the OH- -OH interaction firmly self- associate's alkanol molecules shows impact on the thermo-physical properties.

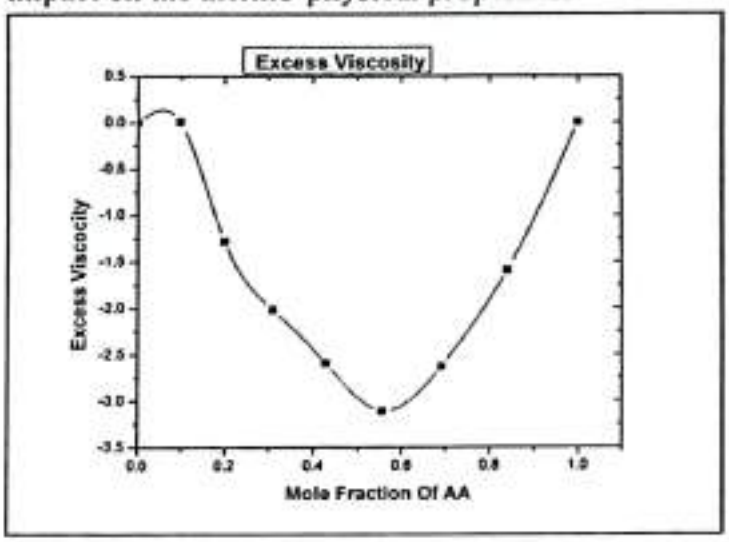


Figure (12): Plot of Excess Viscosity with Mole Fraction of AA.

As revealed in figure, Positive Δn^2_D values for binary mixtures of Allyl amine and Ethane Diol indicate good intermolecular interactions, indicating intermolecular activity linked to a decrease in molar volume [13].

 ISBN: 978-81-957290-1-2

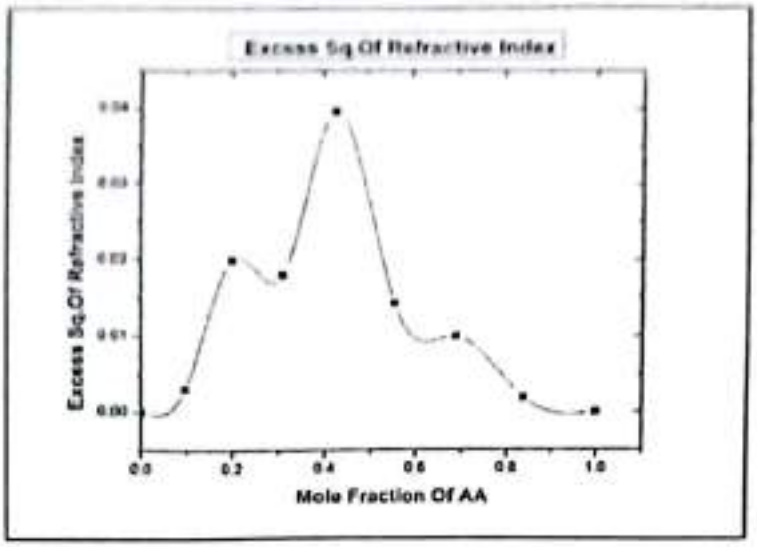


Figure (13): Plot of Excess Sq. of Refractive Index with Mole Fraction of AA.

Conclusions:

1. The non-linear behavior of dielectric constant (ε'), loss tangent (tan δ), molar polarisation (P_{12}), and square of the refractive index confirms the intermolecular interaction and complex formation in the ED + AA binary mixture.
2. The Δε is Negative in the Ethane Diol-rich region, indicating the formation of multimers, while the Positive in the Allylamine-rich region, indicating the formation of monomers and dimmers structures.
3. Positive Excess refractive indices for the whole spectrum of AA mixtures indicate good intermolecular interactions.

References:

1. Patil A. V., Shinde G. N., and Pawar V. P. J. Mol. Liq., 168, 42 (2012).
2. Patil A. V. and Pawar V. P., J. Mol. Liq. 188, 1 (2013).
3. Patil A. V., Achole B. D., Shinde G. N. and Pawar V. P., Archives of Applied Science Research 4(4), 1665 (2012).
4. Roberts and Von Hippet A., J. Appl. Phys. 17, 610(1946).
5. Von Hipple A., Dielectric Materials & Applications, John Wiely & Sons Inc, New York (1953) (1965).
6. Sisodia M. L. & Raghuvanshi G.S., Basic Microwave Techniques & Lab Manual, Wiely Eastern Ltd., New Delhi (1990).
7. Narwade B, S., Gawali P.G., Pande R., Kalmase G. M., Journal of chemical sciences. Vol. 117 (6), 673-676(2005).

8. Singh P.J. and Sharma K.S. Pramana J. Phys., 46 (4), 259-270(1996).
9. Earp D.P. and Glasstone S., J. Chem. Soci., Part-II, 1709(1935).
10. Singh Rahul, Kumar Sudir, Sagar Sangeeta and Gupta Manisha J Thermodyn Catal 7(2),1-7 (2016).
11. Nemmaniwar B.G., Kalyankar N. V. and Kadam P. L., Orbital: The Electronic Journal of Chemistry 5(1), (2013).
12. Gilani A. Ghanadzadeh, Gilani H. Ghanadzadeh, Ansari M. J. Chem. Thermodynamics 55, 203–212(2012).
13. Susmita K, Satyaban J and Bipin B S, J Chem Thermodyn, 37, 820-825(2005).

 ISBN: 978-81-957290-1-2

Indexing and Abstracting in Following Databases

1. Bowker: A ProQuest Affiliate

2. Crossref

ISBN 9789355701879

9 789355 701879

₹ 735 US$ 16

Published by
AkiNik Publications,
#169, C-11, Sector - 3, Rohini,
Delhi-110085, India
Toll Free (India): 18001234070

Peer Reviewed & Refereed

Current Trends in ICT and Education

Chief Editor
Dr. P. Pachaiyappan

Volume - 1

AkiNik Publications
New Delhi

Current Trends in ICT and Education

Volume - 1

Chief Editor

Dr. P. Pachaiyappan
Professor, Department of Education, GRT College of Education, Tiruttani, Tamil Nadu, India

AkiNik Publications
New Delhi

Published By: AkiNik Publications

AkiNik Publications
169, C-11, Sector - 3,
Rohini, Delhi-110085, India
Toll Free (India) – 18001234070
Phone No. – 9711224068, 9911215212
Email – akinikbooks@gmail.com

Chief Editor: Dr. P. Pachaiyappan

Publication Year: 2022

Pages: 108

ISBN: 978-93-5570-187-9

Book DOI: https://doi.org/10.22271/ed.book.1826

Price: ₹ 735/-

Contents

Chapter - 1
ICT: A Promising Platform for the Indian Higher Education

Author

Sandeep S. Kahandal
Assistant Professor, Department of Chemistry, V.P. M's
B.N. Bandodkar College of Science, (Autonomous)
Thane, Maharashtra, India

Chapter - 1

ICT: A Promising Platform for the Indian Higher Education

Sandeep S. Kahandal

Abstract

Information and communications technologies (ICT) have conquered various facets of life on earth. The contribution of the digital platforms in Indian higher education to make teaching-learning effective is not uniform. The advances in ICT introduced the process of teaching-learning through electronic communication, easy access to information, formalized teaching by means of electronic resources. The ICT significantly increases the role of teachers in the development of the pedagogical atmosphere and its improved implementation. Today, training programs in India rather than in the world, ICT becomes the most useful and appealing tool. This study aims to explore the contribution of ICT in the Indian higher education system to engage the students with the teaching-learning processes in the present Covid-19 situation.

Keywords: ICT, Teaching-learning, Higher education, Online courses, MOOC, SWAYAM.

1. Introduction

The ICT term was coined in 1992 illustrates the “computer and associated operations” [1]. ICT is a discipline and management process for science, technology and engineering to manage information, its utilization, and engagement with socio-economic and cultural matters [2]. In the current scenario ICT tools are quite overlooked in most cases [3]. In the industrialized world and present contemporary science, the conventional educational system was not adequate to stimulate the attention of the learner. The current approaches also struggle to fulfill the learning needs of the students. Conventional processes of teaching-learning which delivered knowledge as bits [4], it includes memorizing theories, justifications, facts and principles that do not accomplish teaching objectives. For effective teaching, new and innovative methodologies must be tailored to enhance interest among the students.

The internet is a worldwide computer network that allows individuals to

navigate through information and transmit data. It creates room for communication in an effective and user-friendly approach. This approach also reduces space and time-related barriers and learners can interact anywhere and anytime [5]. Students have access to information and expertise through television, online media, and the internet. In specific, examples of LinkedIn, Academia, Researchgate, Live webinars using some common platforms like Zoom, Gotowebinar, Google Meet, and Microsoft Teams are some networking applications useful for the exchange of information. In the 21st century, ICT plays a significant role in the teacher education system. A teacher without proper knowledge about the classroom is not possible to effectively use all ICT resources [1]. Higher education is an important part of a country's progress because it is apparent as a valuable tool for creating a knowledge-based community.

2. Why do we need to introduce ICT in Science education?

Universities in India face problems in terms of access, equity and quality in higher education. During the eleventh five-year plan, the Indian government acquired a number of steps to improve access to higher education, by the implementation of state-specific policies, curriculum changes, and increasing vocational education. However, India continues to lag behind the global average and developing economies such as Brazil and China in terms of the Gross Enrollment Ratio (GER). In the present discussion, we would like to consider two perspectives, on the coalition among present higher education and the ICT tools available in Indian higher education.

ICT may be used to create and disseminate online course materials and to share content with students who are located in different parts of India. In the present covid-19 situation, we tried to investigate the promising ways of ICT tools to provide study materials via digital platforms. To understand the impact of digital tools and evaluate problems and applications in research and development in developing countries.

Education is now restructured based on the need of modern society and the industrialized world. ICT has one of the methods that develop and bring in abrupt communication. Students and teachers must include ICT in the teaching-learning process [6]. The most challenging factor faced by Indian higher education is insufficient infrastructure to meet the growing demand of enrolled students. It was revealed that the Higher Education Gross Enrollment Ratio (GER) has wide inequalities across states, urban vs. rural areas, ethnicity and communities, all of which must be addressed. Moreover, faculty scarcity, weak physical infrastructure, ill-equipped libraries and curriculum not as per the demand of the society and market make the challenging situation. The involvement of ICT will definitely attempt to address the question faced by in

Indian higher educational system.

3. ICT and MOOC

The term MOOCs stands for Massive Open Online Courses. Canadian professor David Cormier proposed the word "MOOC", when George Siemens and Stephen Downes delivered the initial MOOC in 2008 at the University of Manitoba, Canada. Attention in MOOCs has risen so quickly that “The Year of the MOOC” has announced by the New York Times, newspaper in 2012 [7]. MOOC is known by different titles, such as web classes, video tutorials, educational learning and free educational tools [8]. In addition to conventional course resources, MOOCs have collaborative user communities that assist learners and mentors. In India, the Government of India initiated SWAYAM (Study Networks of Active-Learning for Young Ambitious Minds) as a MOOC program to accomplish access, equity, and quality as three basic principles of education [9]. SWAYAM aims to overcome the hurdles associated with technological backwardness among students who have so far been unaffected by the internet transition and have yet to enter the information economy's mainstream.

The SWAYAM courses are offered via video tutorials, specially designed study materials, self-evaluation by way of examination and quizzes, and a discussion forum to solve misconceptions and problems [10]. The SWAYAM offered programs are freely accessible to learners and the certificate is offered upon successful completion of the examination conducted by the NTA (National Testing Agency). The credits earned through the examination then transferred to the student’s academic credentials. SWAYAM conducted 2,500 teaching-learning courses for more than 12 million students from undergraduates, postgraduates, engineering, law, and other academic classes. Furthermore, in 2018, the online Annual Refresher Programme in Teaching (ARPIT) was initiated by the Government of India, the Ministry of Human Resource Development (MHRD) for a carrier advancement scheme for higher education faculties in 66 disciplines [11].

4. Other ICT platforms for higher education

In the Covid-19 pandemic situation, several other ICT platforms are available for students and teachers (Figure 1).

a) The e-PG Pathshala program offers high-quality, based on curriculum-oriented, immersive e-content in 70 postgraduate science disciplines that comprise 23000, modules.

b) Swayamprabha is a group of 32 DTH (Direct-to-home) and free-of-cost television channels providing high-quality educational materials

for diverse fields of education.

c) The CEC-UGC YouTube channel is another initiative by the MHRD to provide educational lectures.

d) The National Digital Library (NDLI), Shodhganga, e-shodh Sindhu contains a digital repository of instructive materials in the form of an electronic Thesis, a Dissertation and peer-reviewed Journals.

e) The NEAT (National Educational Alliance for Technology) program was initiated by the Government of India to make learning more efficient and customized to the needs of the learner by using artificial intelligence (AI) technologies.

5. ICT in research and development

The most important application of ICT in research is data processing. The augmentation of ICT is due to the unparalleled development in bandwidth and computing power which provides possibilities for the processing of massive information and complex calculations in a way that is very quick, precise and accurate. In the last two decades, in developed and developing countries the use of ICTs in academic research has steadily improved, although there are wide gaps in usage between countries and regions. In research, a literature survey is an important component which shows various analyses and research made in the field of your interest and the findings already reported, after considering the different criteria and scope of the project. Computer data processing not only eliminates researchers from the responsibility of manual data assessments but also data can be analyzed quickly and safely.

Fig 1: Indian Higher Education and Information Communication and Technology

6. Research and Journal Databases

An electronic database such as Scifinder, Reaxys, ScienceDirect, and Scopus for literature review has now been used by Indian higher education institutions. Additionally, Google Scholar, CORE, PubMed, Worldwide Science, Semantic Scholar, Public Library of Science (PLOS), Medline, JSTOR, Science.gov, Baidu Scholar's, Microsoft Academic, BASE (Bielefeld Academic Search Engine), etc. platforms are available for researchers.

7. Challenges and opportunities for Indian higher education

The huge revolutions took place in the ICT sector and, in educational institutions across the globe. The higher education program in India is the third highest in the world. After 1950, the education sector has seen tremendous development in the university, institutions, and colleges [12]. The ample opportunities and scope are available to introduce ICT tools including MOOC courses, e-PG Pathshala, Swayamprabha, CEC-UGC YouTube, National Digital Library, Shodhganga, e-shodh Sindhu to the wider student community, which is still untouched with advanced teaching-learning methods. Higher educational institutes gradually increase the quality and reputation with the help of ICT. In the Coronavirus pandemic situation, these digital platforms play a very productive role in accessing the knowledge for the broader Indian higher education system.

8. Conclusions

ICT supports the teaching-learning process of education and also upgrades knowledge, expertise, and new digital technologies. The teacher may become skilled in teaching-learning through the use and accumulation of knowledge about recent technologies. ICT is one of the most important factors to bring about remarkable social changes. It can change the nature and responsibilities of students and teachers in the education system. Teachers in India have now started to use ICT tools in classroom teaching. The popular devices for teaching-learning processes in educational institutions have been turned into a tablet, LCD screens, mobile, EDUCOM, smart classrooms. Researchers now preferred search engines like Scifinder, ScienceDirect, Reaxys, and Scopus for literature review. Managing large databases which provide a very rapid, consistent and precise way to investigate and process large amounts of information and complex calculations.

As a result, for the next few decades, India's entire educational system will practice information and communication technology. Involvement of ICT in

Indian higher education saves time, stimulates excitement, and makes teaching-learning effective, making it economic as the need of developing countries. It also overcomes the issue of space and therefore facilitates the creation of an autonomous science community.

Acknowledgment

The author is thankful to the Department of Chemistry, B. N. Bandodkar College of Science, (Autonomous) Thane and Vidya Prasarak Mandal, Thane for providing necessary facilities for work.

References

1. Ratheeswari K. Journal of Applied and Advanced Research. 2018;3(1):S45-S47.
2. Yadav BV. International Journal of Applied Research, 2017;3(3):107-109.
3. McFarlane A, Sakellariou S. Cambridge Journal of Education. 2002;32(2):219-232.
4. Bhattacharjee B, Deb K. International Journal of Education and Information Studies. 2016;6(1):1-6.
5. Njelita CB, Emendu NB. The International Journal of Engineering and Science. 2015;4(6):26-30.
6. Usluel YK, Demiraslan Y, Mumcu FK. Integrating ICT into Classrooms: A note from Turkish Teachers PROCEEDINGS. Society for Information Technology & Teacher Education International Conference, 26, 2007 in San Antonio, Texas, USA ISBN 978-1-880094-61-7.
7. Boyd G, Kasraie N. International Journal of Learning and Development. 2013;3(4):87–95.
8. Arya U. Journal of Content, Community & Communication. 2017;6:26-35.
9. Samanta A. International Journal of Research and Analytical Reviews. 2018;5(3):1374x-1379x.
10. Majumder C. International Journal of Trend in Scientific Research and Development. 2019;3(3);2456–6470.
11. Rathore SVS. International Journal of higher education and research. 2020;9(2):135-141.
12. Sheikh YA. Journal of Education and Practice. 2017;8(1):39-42.

Indexing and Abstracting in Following Databases

1. Bowker: A ProQuest Affiliate

2. Crossref

ISBN 9789355705938
₹ 752 US$ 16

Published by
AkiNik Publications,
#169, C-11, Sector - 3, Rohini,
Delhi-110085, India
Toll Free (India) – 18001234070

Peer Reviewed & Refereed

Modern Research and Environmental Sustainability

Chief Editor
Dr. Prachi Parmar Nimje

Volume -2

AKINIK PUBLICATIONS
NEW DELHI

Modern Research and Environmental Sustainability

Volume - 2

Chief Editor

Dr. Prachi Parmar Nimje
Associate Professor
HOD (Department of Chemistry)
Shri Shankaracharya Professional University
Bhilai, Chhattisgarh, India

AkiNik Publications®
New Delhi

Published By: AkiNik Publications

AkiNik Publications
169, C-11, Sector - 3,
Rohini, Delhi-110085, India
Toll Free (India) – 18001234070
Phone No. – 9711224068, 9911215212
Email – akinikbooks@gmail.com

Chief Editor: Dr. Prachi Parmar Nimje

Publication Year: 2023

Pages: 142

ISBN: 978-93-5570-593-8

Book DOI: https://doi.org/10.22271/ed.book.2162

Price: ₹ 752/-

Registration Details

- Printing Press License No.: F.1 (A-4) press 2016
- Trade Mark Registered Under
  - Class 16 (Regd. No.: 5070429)
  - Class 35 (Regd. No.: 5070426)
  - Class 41 (Regd. No.: 5070427)
  - Class 42 (Regd. No.: 5070428)

Contents

Chapter - 8
Graphene and Related Nanomaterials for Water Remediation

Author

Sandeep S. Kahandal
Assistant Professor, Department of Chemistry, V.P.M's B. N. Bandodkar College of Science, (Autonomous) Thane, Maharashtra, India

Chapter - 8

Graphene and Related Nanomaterials for Water Remediation

Sandeep S. Kahandal

Abstract

In view of graphene's remarkable properties, where sp^2-bonded carbon atoms are densely organized into a two-dimensional structure, have been the focus of extensive investigation worldwide. Its large surface area, in particular, has prompted researchers to investigate the viability of employing nanomaterials, such as graphene oxide, reduced graphene oxide, and graphene-based nano-composites, for wastewater remediation. This chapter summarizes studies and technical breakthroughs connected to the possibilities of graphene-based nanomaterials as novel, intriguing adsorbents for the removal of pollutants from wastewater. Strategies to reuse the adsorbents after saturation are also described, with a brief description of the main methods for synthesizing graphene.

Keywords: Graphene, graphene oxide, reduced graphene oxide, removal of pollutants, adsorption, recyclability

1. Introduction: Graphene and Graphene-based nanomaterials for water treatment

The release of effluents containing contaminants from urbanization into bodies of water is a serious environmental issue that has an effect on the ecosystem. There might be a wide range of contaminants, including dangerous metals, anions, steroids, personal care products, pesticides, insecticides, and medical waste [1-2]. Contaminant species concentrations in rivers over permitted limits are commonly recognized to affect people and a range of other living species due to their toxicity, persistence and accumulation in living beings [1]. Furthermore, water scarcity in various locations throughout the world as a result of population and fast urbanization is drawing the consideration of researchers to water recycling [3]. Adsorption has been determined to be robust, low cost, and theoretically straightforward among the methods projected for the removal of small-concentration

pollutants from polluted water, while it requires highly effective adsorbents [4].

Graphene and based materials have been widely employed in wastewater treatment because they offered high specific surface area, adaptability, and relevance for economically viable for production [5]. In the exploration of new, more efficient, and selective alternative adsorbents, graphene and similar nanomaterials have recently emerged as potential nanomaterials with tremendous potential for environmental applications [6]. Its distinct nanostructure endows graphene nano-sheets with extraordinary capabilities including the higher surface area of graphene nano-sheets (2630 m^2/g) that have caught the interest of researchers due to its potential for scientific developments in a variety of areas [7]. Numerous environmental contaminants can be removed using graphene and graphene-based materials, such as graphene oxide (GO), reduced graphene oxide (RGO), and its nano-composites (GNCs) [8]. The key benefits of graphene over carbon nanotubes and its precursor allotrope are its cost-effectiveness and the content of metallic impurities [9]. Presently few researchers reported the review on graphene and associated materials used for the removal of pollutant species to form various wastewater sources [10-11]. The chapter briefly discusses the application of materials produced from graphene as nano adsorbents for wastewater treatment within this paradigm. Despite the two synthesis methods addressed in this work, the chapter focuses on cost-effective, production of graphene material for wastewater treatment. Efforts to improve on existing approaches are also addressed. The pertinent information on the potential of nano-graphene for the removal of different organic pollutants is then discussed.

2. Synthesis of graphene materials

The exceptional properties perspective in the field of material science have always been preferred for the betterment of human health and lifestyle. Graphene carbon atoms sp^2-hybridized arranged into a two-dimensional (2D) honeycomb lattice has been attracted by researchers worldwide since its discovery in 2004 [12]. Graphene oxide as a material was first time reported in the literature in 1913 [13]. After that in 1962 single-sheet graphene was prepared experimentally [14]. Interest in graphene materials was ignited by a research team led by Nobel Laureates Andre Geim and Konstantin Novoselov [15]. The systematic study of the multilayer ultrathin carbon was first reported in the literature as early as 1919 [13]. The synthesis of graphene and graphene-based materials is very important with projected applications of this allotrope of carbon.

Graphene oxide), a two-dimensional carbon nanomaterial with a high specific surface area, is a contender for the removal of dye due to its abundance of O-containing groups and water dispersibility. Electrostatic attraction, π-π stacking and "H- bonding" between nanomaterial and dye are the major origins of dye removal [16-18]. Additionally, new research on the application of GO for the removal of cationic dye revealed ultrahigh adsorption ability [19].

Graphene synthesis routes

The process used to synthesize graphene is significant concerning the characteristics of this unique carbon allotrope and, subsequently, the applications that are anticipated. There are two main ways to make graphene, originating either from graphite or another source of carbon [20]. Mainly top-down and bottom-up [21-22] routes are widely explored for the synthesis of graphene.

3. Water purification using graphene oxide

Microbots based on graphene for water toxic heavy metal removal and recovery

The health of humans and all life forms on earth is seriously threatened by heavy metal contamination of water sources. Current nanotechnology research is generating innovative nano-systems and nanomaterials for the efficient and rapid removal of pollutants and heavy metals from water. According to Sánchez *et al*., self-propelled devices based on graphene oxide for the capture, passage and removal of heavy metals. The nano-sized multilayers of graphene oxide, Ni and Pt that make up the structure of microbots provide many characteristics. For capturing Pb, the inner layer of platinum and external Ni assists for magnetic control. These materials can reduce the Pb content of water from 1000 parts per billion to less than 50 parts per billion in just one minute. Moreover, the graphene oxide microbots may be recycled after being chemically cleaned of lead [23].

Desalination of water using graphene

Nanometer-scale graphene could be utilized to separate NaCl salt from water, although its effectiveness depends on the cavity size, functional group on graphene, applied pressure. The membrane's capacity to stop the passage of salt is significantly dependent on the size of its pores, which must be large enough to allow for water molecules movement while blocking ions. Due to their hydrophilic nature, frequently occurring hydroxyl groups can nearly increase the water flow by a factor of 2. Overall, the findings suggest that

nanoporous graphene may be beneficial for water purifying since it has a water penetrability that is several orders of extent higher than that of conventional reverse osmosis [24].

Adsorption of heavy metals using graphene oxides

Many heavy metals are released into natural water bodies by industries including mining, papermaking, and electroplating [25]. Most of the earlier work majorly focuses on the exclusion of Cu, Cd, Pb, Fe, and Cr as major water pollutants [26-29]. Similarly few other research were carried out on the removal of Au, Pd, Th, U, Ni, Hg and As. [30-33]. The adsorption process was affected by several factors including the pH of the solution. The pH value was often carefully controlled below 6 to prevent the precipitation of the metal hydroxides. Further, some adsorption study at pH 10 was also described. The majority of adsorption processes are endothermic and spontaneous [34]. Sheets of dispersed graphene oxide have a higher capacity to adsorb heavy metal ions [35].

It's critical to comprehend how variations in adsorption capabilities for a particular metal ion relate to both experimental conditions and structural variations in graphene oxide, which is a byproduct of graphite oxidation [36]. The various oxidizing agents and their amounts, the origin of the graphite, as well as the reaction conditions for the synthesis of graphene oxide, all influence how the oxidation works out.

Graphene-based nanomaterials

Graphene oxide nanomaterials are also found to be associated with some disadvantages, which are overcome by the main functionalization of graphene materials with polymers [32, 37]. Tan *et al*. [32] changed the amount of the PVA solution while maintaining a constant proportion of graphene oxide, to functionalize the graphene oxide material. The excellent results were observed at a 1:3 ratio of graphene oxide to polyvinyl alcohol. The experiment was performed with a graphene oxide to polyvinyl alcohol ratio starting from 1:0 to 1:5, and adsorption increased upto 1:3 and further declined upto 1:5. This decrease may be due to the excess polyvinyl alcohol loaded onto the surface of graphene oxide at a higher ration of GO: PVA. The aggregation of nanomaterials is prevented by using polyvinyl alcohol which acts as a supporting pillar. When graphene oxide is functionalized with PVA, the effects on the structure are minimal, and the interactions are a consequence of the hydroxyl groups on the polyvinyl alcohol chains and the O-containing groups on the graphene oxide making hydrogen bonds with one another.

Cheng *et al.* [37] demonstrated that magnetic graphene oxide-polyvinyl alcohol may be used to solve separation issues with graphene oxide nanomaterials. The single-step method for cross-linking graphene oxide with polyvinyl alcohol and producing magnetic iron oxide nanoparticles at the same time. The synthesized material was further used for adsorption and shows excellent results for cationic dyes with a simple scale which is important for industrial applications. The findings of the adsorption studies show that the pseudo-second order kinetic model and the Langmuir isotherm model are the best for the adsorption using the magnetic graphene oxide-PVA catalyst. [Table 1]

Table 1: Adsorption capacity of methylene blue and methyl violet with magnetic graphene oxide-polyvinyl alcohol

Catalyst	Methylene blue	Methyl violet
mGO/PVA-0%	85.64 mg/g	75 mg/g
mGO/PVA-50%	231.12	204.74 mg/g

Li *et al.* functionalized graphene oxide material by coating it with ionic liquid-coated Fe_3O_4@chitosan [38]. The synthesized material was tested for batch adsorption for methylene blue. Due to its characteristics including significant thermal stability and strong ionic conductivity, ionic liquids (IL) have attracted interest in the past decade. They are often employed as environmentally preferable solvents due to their low vapor pressure, superior thermal stability and significant dissolving capability of environmental pollutants [39].

In addition, various IL-based compounds have been investigated for use in wastewater treatment [40]. As a consequence, blending both IL and materials to synthesize magnetic materials is conceivable, and the synergistic material is intended to yield better adsorptive capacity performance. The capacity of ionic liquid-coated Fe_3O_4@chitosan@graphene oxide to eliminate methylene blue from water samples was tested. The equilibrium adsorption was well explained by the Langmuir isotherm model, and a maximum adsorption capacity of 262 mg/g was determined. The investigation explored the role of ionic liquids improve the dispersity of the adsorbent and adsorption.

Mejias Carpio *et al.* [41] reported another approach for the heavy metal's removal through adsorption by using graphene oxide-ethylenediamine tetraacetic acid. The EDTA-GO material exhibits highest adsorption for Cu (II) and Pb (II) evaluated using different parameters such as contact time, concentrations and pH.

Table 2: Adsorption capacity of the GO–EDTA for Cu^{2+} and Pb^{2+} ions

Catalyst	Cu^{2+} (mg/g)	Pb^{2+} (mg/g)
GO-EDTA (Graphene oxide-Ethylenediamine tetra acetic acid.	454.6	108.7

Due to the greater affinity of EDTA-GO for Pb(II) ions, GO-EDTA exhibits higher Pb(II) adsorption when compared to Cu(II) ions. [Table 2] Due to the high density of carboxyl groups given by EDTA, which resulted in more adsorption through chelation, GO-EDTA performed better than graphene oxide. Another study revealed that the -OH present on graphene oxide and N-(trimethoxysilylpropyl) ethylenediamine triacetic acid (EDTA-silane) silanize to form chelating groups that are connected to graphene oxide. It was revealed to be the most effective adsorbent for Pb^{2+} removal, having the highest adsorption capacity. [Table 3] The experimental results and the Langmuir adsorption model correlate rather well [42].

Table 3: Adsorption capacity of the functionalized graphene oxide for Pb^{2+} ion

Catalyst	Adsorption capacity	pH	Time (min)
GO-(EDTA-silane) for removal of Pb^{2+} ion	479 ± 46 mg/g	6.8	20

In Hummer's technique, allyl acetoacetate polymerization and divinyl sulfone modification were put together to produce a poly(allyl acetoacetate)-grafted graphene oxide. The obtained material was investigated as an adsorbent for Hg^{2+} removing from aqueous solutions. Based on its useful functionalities, particularly the dicarbonyl groups, which are major chelating agents, it demonstrated increased adsorption ability in comparison to pure graphene oxide. The obtained material was investigated as an adsorbent for Hg^{2+} removing from aqueous solutions. The Langmuir and pseudo-second-order model were used to explain the adsorption isotherm and kinetics. The excellent adsorption capacity of the adsorbent was computed to be 282.7 mg of Hg^{2+}/unit mass of GO-GAA, which is substantially higher than the 56 mg/g achieved for GO [43].

The adsorption of Pb^{2+}, Cu^{2+}, and As^{3+} was revealed using a magnetic chitosan and graphene oxide [Table 4] material that has been functionalized with EDTA. (Shahzad et. al.) The Pb^{2+} and Cu^{2+} adsorption processes were best characterized by Langmuir isotherms, while the As^{3+} adsorption process was best represented by its Freundlich isotherm [44].

Table 4: Adsorption capacity of the magnetic chitosan and graphene oxide functionalized with EDTA

Catalyst	Pb^{2+} (mg/g)	Cu^{2+} (mg/g)	As^{3+} (mg/g)
Magnetic chitosan and graphene oxide EDTA	206.52	207.26	42.75

Xu *et al.* [45] prepared polyacrylamide-based reduced graphene oxide and explored the adsorption study for the Pb^{2+} ions. Due to the adsorbent's strong water dispersibility and the functional groups on polyacrylamide, maximum adsorption was completed. Zhao *et al*. [46] developed the poly(tert-butyl acrylate) grafted graphene oxide material. Despite the hydrophobic surface modification, the dispersion of the material is noticeable. Nevertheless, due to good dispersion of the residual oxygen-containing groups, the deposit takes place within 40 minutes. The property makes it a material that is simple to separate from reaction mass which makes it environmentally friendly.

The tetrabromobisphenol A successfully removed from the aqueous solution via hydrogen bonding. The adsorbed tetrabromobisphenol A can be immediately desorbed with ethanol, demonstrating its high recyclability, with an experimental adsorption capacity of 22.2 mg/g at pH 7.0 and deposition finished in 30 minutes. Chitosan, is an abundantly available, environmentally benign natural macromolecule, with numerous amino and hydroxyl groups that enable effective chelating or electrostatic adsorption of metal ions and anionic chemical molecules. Chitosan may be mixed with graphene oxide to form composite blocks by electrostatic interaction and chemical functionalization to improve the stability of graphene oxide aerogels in aqueous solutions. Due to the integration of graphene oxide and chitosan, it forms honeycomb-cobweb microspheres exhibiting a high amount of adsorption of various experimental pollutant species including phenol, metal ions, cationic and anionic dyes. The radially directed micro-channels inside the microspheres considerably decrease the internal diffusion path, facilitating rapid dispersion and maximizing the rate of adsorption. GCAMs have exceptional adsorption properties and recyclability for heavy metal ion, cationic, anionic, and phenols. The GCAMs have maximum adsorption affinities for various environmental pollutants including metal ions and various dyes. As compared to the 75 hours needed for the graphene oxide-chitosan monolith, it only takes 5 min to reach equilibrium adsorption capacities of 82 and 89% for Cr^{6+} (292.8 mg/g) and MB (584.6 mg/g), respectively [47].

Other important difficulties for real-world wastewater systems are multi-solute heavy metal adsorption and potential interferences. The adsorption of Cd^{2+}, Pb^{2+} and Cu^{2+} from a mixture was observed to reduce the adsorption capacity of CS. It was shown that the adsorption capacity of the CS/SH-GO composite was smaller than that of the individual metal ions due to competitive adsorption of ions from a ternary mixture [48]. The presence of

multi-ions altered adsorption kinetics; most of them were removed within 10 minutes from single-solute solutions, but removal from ternary solutions required 40 minutes. The other ions had a less significant influence on Cd^{2+}, which had the lowest adsorption among single metal ion environments.

In contrast, background electrolyte cations (Na^{+}, K^{+}, Ca^{2+}, Mg^{2+}, Mn^{2+}, Zn^{2+} and Ni^{2+}) and anions (Cl^{-}, NO_3^{-}, ClO_4^{-}, and PO_4^{3-}). Greatly influenced Cd^{2+} adsorption onto magnetic graphene oxide-supported sulfanilic acid [49] Furthermore, when confronted with actual effluents, the findings may vary dramatically. Luo *et al*. [50] performed selective adsorption tests with various ions in solution and discovered that the effectiveness of adsorption was achieved in the following order: Cu > Pb > Cd > Mn > Zn > Ni. Due to their superior coordination capability, only Pb and Fe (in the presence of eight metallic ions) were removed when a real smelting industry effluent was used as the feeding solution. The presence of additional metal ions was not the main reason for the decreased adsorption ability. Li *et al*. [51] discussed the presence of humic and fulvic acids influenced the adsorption of Cu^{2+} using graphene oxide. Similarly, the presence of aniline influenced Cr^{6+} adsorption, either increasing or decreasing it at lower and higher pH levels, respectively [52].

4. Regeneration and Reutilization of the graphene-based adsorbents

The adsorption experiments in various previously updated articles have been broadened to investigate the possibility of regenerating and reusing graphene-based adsorbents. With this, desorption studies were carried out using adsorbents that were loaded with inorganic and organic contaminants. Generally, graphene-based adsorbents were mostly able to preserve 90% or more of their removal capability after up to three adsorption/desorption cycles. Even after extended six cycles the capacity reduced further up to 10-15% in HCl [53]. Surprisingly magnetic graphene oxide shows constituent results of adsorption for several cycles without any significant weight loss of the graphene [54].

5. Conclusions

The graphene-based materials examined in this chapter have promising futures as high-tech adsorbents for removing various wastewater pollutant species. Despite tremendous progress, more work needs to be done before environmentally acceptable solutions based on pollutant adsorption onto nano-based graphene materials can be employed to treat wastewater on an extensive scale. In this regard, graphene oxide and reduced graphene oxide reveal a good ability to remove pollutants. The large-scale use of the above-

discussed materials is inhibited by challenges relating to the variability of synthesis method, separation, and recycling after adsorption. To allow full-scale implementations, all of the aforementioned difficulties, as well as additional research on the regeneration/reuse of loaded adsorbents and overall cost assessments, should be fully studied.

Acknowledgment

The author is thankful to the Department of Chemistry, B. N. Bandodkar College of Science, (Autonomous) Thane and Vidya Prasarak Mandal, Thane for providing necessary facilities for work.

References

1. Cukierman AL. Development and environmental applications of activated carbon cloths. ISRN Chem. Eng., 2013, 31. Article ID 261523, http://dx.doi.org/10.1155/2013/261523
2. Fernandez ME, Ledesma, Roman BS, Bonelli PR, Cukierman AL. Development and characterization of activated hydrochars from orange peels as potential adsorbents for emerging organic contaminants. Bioresource Technol. 2015;183:221-228. https://doi.org/10.1016/j.biortech.2015.02.035
3. Rashidi Hamidreza, Ghaffarian Hoseini Ali, Ghaffarian Hoseini Amirhosein, Nik Sulaiman, Nik Meriam, Tookey John, *et al*. Application of wastewater treatment in sustainable design of green built environments: A review. Renewable and Sustainable Energy Reviews. 2015;49:845-856. Doi: 10.1016/j.rser.2015.04.104
4. Nunell GV, Fernández ME, Bonelli PR, Cukierman AL. Nitrate uptake improvement by modified activated carbons developed from two species of pine cones. J Colloid Interf. Sci. 2015;440:102-108. https://doi.org/10.1016/j.jcis.2014.10.058
5. Cheng CS, Deng J, Lei B, He A, Zhang X, Ma L, *et al*. Toward 3D graphene oxide gels based adsorbents for high-efficient water treatment via the promotion of biopolymers. J Hazard Mater. 2013;263:467-478. https://doi.org/10.1016/j.jhazmat.2013.09.065.
6. Novoselov KS, Geim AK, Morozov SV, Jiang D, Zhang Y, Dubonos SV, *et al*. Electric field effect in atomically thin carbon films. Science. 2004;306:666-669.https://doi.org/10.1126/science.1102896
7. Batzill M. The surface science of graphene: Metal interfaces, CVD synthesis, nano-ribbons, chemical modifications and defects. Surf. Sci. Rep. 2012;67:83-115. https://doi.org/10.1016/j.surfrep.2011.12.001

8. Yu JG, Yu LY, Yang H, Liu Q, Chen XH, Jiang XY, *et al*. Graphene nano-sheets as novel adsorbents in adsorption, pre-concentration and removal of gases, organic compounds and metal ions. Sci. Total Environ. 2015;502:70-79.

9. Liu J, Liu G, Liu W. Preparation of water-soluble β-cyclodextrin/poly(acrylic acid)/graphene oxide nano-composites as new adsorbents to remove cationic dyes from aqueous solutions. Chem. Eng. J. 2014;257:299-308. https://doi.org/10.1016/j.cej.2014.07.021

10. Wang X, Liu B, Lu Q, Qu Q. Graphene based materials: Fabrication and application for adsorption in analytical chemistry. J Chromatogr. A. 2014;1362:1-15. https://doi.org/10.1016/j.chroma.2014.08.023

11. Ana L Cukierman, Emiliano Platero, María E Fernandez, Pablo R Bonelli. Potentialities of Graphene-Based Nanomaterials for Wastewater Treatment, Smart Materials for Waste Water Applications (edited by Ajay Kumar Mishra), Wiley Publications, 47-86. ISBN: 978-1-119-04118-4.

12. Ana L Cukierman, Emiliano Platero, María E Fernandez, Pablo R Bonelli. Potentialities of Graphene-Based Nanomaterials for Wastewater Treatment, Smart Materials for Waste Water Applications, Wiley Publications.

13. Kohlschütter V, Haenni P. Zur Kenntnis des Graphitischen Kohlenstoffs und der Graphitsäure. Z. Anorg. Allg. Chem. 1919;105(1):121-44.

14. Boehm HP, Clauss A, Fischer GO, Hofmann U. Das Adsorptions verhalten sehr dünner Kohlenstoff-Folien. Z. Anorg. Allg. Chem. 1962;316(3-4):119-27.

15. Novoselov KS, Geim AK, Morozov SV, Jiang D, Zhang Y, Dubonos SV, *et al*. Electric Field Effect in Atomically Thin Carbon Films. Science. 2004;306(5696):666-9.

16. Kohlschutter V, Haenni P. Zur Kenntnis des Graphitischen Kohlenstoffs und der Graphitsaure. Z. Anorg. Allg. Chem. 1919:105(1):121-144.

17. Dreyer Daniel R, Park Sungjin, Bielawski Christopher W, Ruoff Rodney S. The chemistry of graphene oxide. 2009;39(1):228-240. Doi: 10.1039/b917103g

18. Stankovich Sasha, Zimney Eric J, Piner Richard D, Dommett Geoffrey HB, Evmenenko Guennadi, Nguyen Son Binh T, *et al*. Preparation and characterization of graphene oxide paper. 2007;448(7152):457-460. Doi: 10.1038/nature06016

19. Dong Zhihui, Wang Dong, Liu Xia, Pei Xianfeng, Chen Liwei, Jin Jian. Bio-inspired surface-functionalization of graphene oxide for the adsorption of organic dyes and heavy metal ions with a super high capacity. Journal of Materials Chemistry A. 2014;2(14):5034. Doi: 10.1039/c3ta14751g

20. Whitener KE, Sheehan PE. Graphene synthesis. Diam. Relat. Mater. 2014;46:25-34. http://dx.doi.org/10.1016/j.diamond.2014.04.006

21. Razak LA, Tobino D, Ueno K. Improvement of multilayer graphene quality by current stress during thermal CVD. Micro-electron. Eng. 2014;120:200-204. https://doi.org/10.1016/j.mee.2013.08.009

22. Chen J, Li Y, Huang L, Li C, Shi G. High-yield preparation of graphene oxide from small graphite flakes via an improved Hummers method with a simple purification process. Carbon. 2015;81:826-834. https://doi.org/10.1016/j.carbon.2014.10.033

23. Vilela Diana, Parmar Jemish, Zeng Yongfei, Zhao Yanli, Sánchez Samuel. Graphene-Based Microbots for Toxic Heavy Metal Removal and Recovery from Water. Nano Lett. 2016;16(4):2860-2866. https://doi.org/10.1021/acs.nanolett.6b00768

24. Cohen-Tanugi, David Grossman, Jeffrey C. Water Desalination across Nanoporous Graphene. Nano Letters. 2012;12(7):3602-3608. Doi: 10.1021/nl3012853

25. Xueying Li, Zhou Haihui, Wenqin Wu, Shudan Wei, Yan Xu, Kuang Yafei. Studies of heavy metal ion adsorption on Chitosan/Sulfydryl-functionalized graphene oxide composites. Journal of Colloid and Interface Science. 2015;448:389-397. Doi: 10.1016/j.jcis.2015.02.039

26. Xueying Li, Zhou Haihui, Wenqin Wu, Wei Shudan, Yan Xu, Kuang Yafei. Studies of heavy metal ion adsorption on Chitosan/Sulfydryl-functionalized graphene oxide composites. Journal of Colloid and Interface Science. 2015;448:389-397. Doi: 10.1016/j.jcis.2015.02.039.

27. Lei Yinlin, Chen Fei, Luo Yunjie, Zhang. Long Synthesis of three-dimensional graphene oxide foam for the removal of heavy metal ions. Chemical Physics Letters. 2014;593:122-127. Doi: 10.1016/j.cplett.2013.12.066

28. Dong Zhihui, Zhang Feng, Wang Dong, Liu Xia, Jin Jian. Polydopamine-mediated surface-functionalization of graphene oxide for heavy metal ions removal. Journal of Solid State Chemistry. 2015;224:88-93. Doi: 10.1016/j.jssc.2014.06.030

29. Wang Hui, Liu Yun-Guo, Zeng Guang-Ming, Xin-Jiang Hu, Hu Xi, Ting-ting Li, *et al*. Grafting of β-cyclodextrin to magnetic graphene oxide via ethylenediamine and application for Cr(VI) removal. Carbohydrate Polymers. 2014;113:166-173. Doi: 10.1016/j.carbpol.2014.07.014

30. Li Liu, Cui Li, Changli Bao, Qiong Jia, Pengfei Xiao, Xiaoting Liu, *et al*. Preparation and characterization of chitosan/graphene oxide composites for the adsorption of Au(III) and Pd(II), Talenta. 2012;93:350-357. Doi: 10.1016/j.talanta.2012.02.051.

31. Jiang Duo, Liu Li, Pan Ning, Yang Fuqiang, Li Shengke, Wang Ruibing, *et al*. The separation of Th(IV)/U(VI) via selective complexation with graphene oxide. Chemical Engineering Journal. 2015;271:147-154. Doi: 10.1016/j.cej.2015.02.066

32. Tan Ping, Sun Jian, Hu Yongyou, Fang Zheng, Bi Qi, Chen Yuancai, *et al*. Adsorption of Cu2+, Cd2+ and Ni2+ from aqueous single metal solutions on graphene oxide membranes. Journal of Hazardous Materials. 2015;297:251-260. Doi: 10.1016/j.jhazmat.2015.04.068

33. Chen Guiqiang, Liu Yanxia, Liu Fei, Zhang Xiao. Fabrication of three-dimensional graphene foam with high electrical conductivity and large adsorption capability. Applied Surface Science. 2014;311:808-815. Doi: 10.1016/j.apsusc.2014.05.171

34. Baowei Yu, Jing Xu, Jia-Hui Liu, Yang Sheng-Tao, Luo Jianbin, Zhou Qinghan, *et al*., Adsorption behavior of copper ions on graphene oxide–chitosan aerogel. Journal of Environmental Chemical Engineering. 2013;1(4):1044-1050. Doi: 10.1016/j.jece.2013.08.017.

35. Mejias Carpio, Isis E, Mangadlao Joey D, Nguyen, Hang N, Advincula Rigoberto C, Rodrigues, Debora F. Graphene oxide functionalized with ethylenediamine triacetic acid for heavy metal adsorption and anti-microbial applications. Carbon. 2014;77:289-301. Doi: 10.1016/j.carbon.2014.05.032

36. Dreyer Daniel R, Park Sungjin, Bielawski Christopher W, Ruoff Rodney S. The chemistry of graphene oxide. 2009;39(1):228-0. Doi: 10.1039/b917103g

37. Cheng Zehong, Liao Jie, He Benzhao, Zhang Fan, Zhang Faai, Huang Xiaohua, *et al*. One-Step Fabrication of Graphene Oxide Enhanced Magnetic Composite Gel for Highly Efficient Dye Adsorption and Catalysis. ACS Sustainable Chemistry & Engineering. 2015;3(7):1677-1685. Doi: 10.1021/acssuschemeng.5b00383

38. Li Leilei, Duan Huimin, Wang Xiaojiao, Luo Chuannan. Fabrication of novel magnetic nanocomposite with a number of adsorption sites for the removal of dye. International Journal of Biological Macromolecules. 2015;78:17-22. Doi: 10.1016/j.ijbiomac.2015.01.014

39. Cao Xiaoji, Shen Lingxiao, Xuemin Ye, Zhang Feifei, Chen Jiaoyu, Weimin Mo. Ultrasound-assisted magnetic solid-phase extraction based ionic liquid-coated Fe3O4@graphene for the determination of nitrobenzene compounds in environmental water samples. The Analyst. 2014;139(8):19-38. Doi: 10.1039/c3an01937c

40. Mohamed E Mahmoud, Hassan M Al-Bishri. Supported hydrophobic ionic liquid on nano-silica for adsorption of lead. Chem. Eng. J. 2011;166:157-167. Doi: 10.1016/j.cej.2010.10.046.

41. Mejias Carpio, Isis E, Mangadlao Joey D, Nguyen Hang N, Advincula Rigoberto C, Rodrigues Debora F. Graphene oxide functionalized with ethylenediamine triacetic acid for heavy metal adsorption and anti-microbial applications. Carbon. 2014;77:289-301. Doi: 10.1016/j.carbon.2014.05.032

42. Madadrang Clemonne J, Kim Hyun Yun, Gao Guihua, Wang Ning, Zhu Jun, Feng Huan, *et al*. Adsorption Behavior of EDTA-Graphene Oxide for Pb (II) Removal. ACS Applied Materials & Interfaces. 2012;4(3):1186-1193. Doi: 10.1021/am201645g

43. Aghdam Khaledeh, Panahi Homayon Ahmad, Alaei Ebrahim, Hasani Amir Hesam, Moniri Elham. Preparation of functionalized graphene oxide and its application as a nano-adsorbent for Hg2+removal from aqueous solution. Environmental Monitoring and Assessment. 2016;188(4):223. Doi: 10.1007/s10661-016-5226-2.

44. Shahzad Asif, Miran Waheed, Rasool Kashif, Nawaz Mohsin, Jang Jiseon, Lim Seong-Rin, *et al*. Heavy metals removal by EDTA-functionalized chitosan graphene oxide nano-composites. RSC Adv. 2017;7(16):9764-9771. Doi: 10.1039/C6RA28406J.

45. Zhiwei Xu, Zhang Yaoyao, Qian Xiaoming, Shi Jie, Chen Lei, Li Baodong, *et al*., One step synthesis of polyacrylamide functionalized graphene and its application in Pb(II) removal. Applied Surface Science. 2014;316:308-314. Doi: 10.1016/j.apsusc.2014.07.155

46. Zhao Xubo, Liu Peng. Hydrophobic-Polymer-Grafted Graphene Oxide Nanosheets as an Easily Separable Adsorbent for the Removal of Tetrabromobisphenol A. Langmuir. 2014;30(45):13699-13706. Doi: 10.1021/la504077x

47. Ruomeng Yu, Yongzheng Shi, Yang Dongzhi, Liu Yaxin, Qu Jin, Yu Zhong-Zhen. Graphene oxide/chitosan aerogel microspheres with honeycomb-cobweb and radially oriented microchannel structures for broad-spectrum and rapid adsorption of water contaminants. ACS Appl. Mater. Interfaces, 2017, 9(26). https://doi.org/10.1021/acsami.7b04655

48. Xueying Li, Zhou Haihui, Wenqin Wu, Shudan Wei, Yan Xu, Kuang Yafei. Studies of heavy metal ion adsorption on Chitosan/Sulfydryl-functionalized graphene oxide composites. Journal of Colloid and Interface Science. 2015;448:389-397. https://doi.org/10.1016/j.jcis.2015.02.039

49. Hu Xin-Jiang, Liu Yun-Guo, Zeng Guang-Ming, Shao-Hong You, Wang Hui, Hu Xi, *et al*. Effects of background electrolytes and ionic strength on enrichment of Cd(II) ions with magnetic graphene oxide-supported sulfanilic acid. Journal of Colloid and Interface Science. 2014;435:138-144. Doi:10.1016/j.jcis.2014.08.054

50. Shenglian Luo, Xiangli Xu, Guiyin Zhou, Chengbin Liu, Tang Yanhong, Yutang Liu. Amino siloxane oligomer-linked graphene oxide as an efficient adsorbent for removal of Pb(II) from wastewater. Journal of Hazardous Materials. 2014;274:145-155. Doi: 10.1016/j.jhazmat.2014.03.062

51. Guodong Sheng, Jiaxing Li, Dadong Shao, Jun Hu, Changlun Chen, Yixue Chen, *et al*. Adsorption of copper(II) on multiwalled carbon nanotubes in the absence and presence of humic or fulvic acids, Journal of Hazardous Materials. 2010;178(1-3):333-340. Doi: 10.1016/j.jhazmat.2010.01.084

52. Fakhri Ali. Adsorption characteristics of graphene oxide as a solid adsorbent for aniline removal from aqueous solutions: Kinetics, thermodynamics and mechanism studies. Journal of Saudi Chemical Society. 2013-2017;21(1):S52-S57. S131961031300104X–. doi:10.1016/j.jscs.2013.10.002

53. Fan L, Luo C, Sun M, Li X, Qiu H. Highly selective adsorption of lead ions by water-dispersible magnetic chitosan/graphene oxide composites. Colloid Surface B. 2013;103:523-529. Doi: 10.1016/j.colsurfb.2012.11.006

54. Li L, Fan L, Sun M, Qiu H, Li X, Duan H, *et al*., Adsorbent for chromium removal based on graphene oxide functionalized with magnetic cyclodextrin-chitosan. Colloid Surface B. 2013;107:76-83. Doi: 10.1016/j.colsurfb.2013.01.074.

VIDYA PRASARAK MANDAL'S

B.N. BANDODKAR COLLEGE OF SCIENCE

(AUTONOMOUS), THANE

NAAC Re-accredited 'A' Grade, College with Potential for Excellence (CPE),
Best College Award, IS/ISO 21001:2018 Certified (BIS), BEQET Special Citation Award,
Recipient of RBNQA Commendation Certificate from IMC,
Recipient of Jagar Janivancha Awards of Govt. of Maharashtra,
Supported Under - FIST 'O' Level (Min. of Sci. & Tech.) & DBT Star College Scheme.

Proceedings of the National Conference

Applied Mathematics & Statistics

13th & 14th January , 2023

In association with

University of Mumbai

&

Organized by

Department of Mathematics

&

Department of Statistics

Edited by :

Dr. Moses Kolet, Mrs. Minal Wankhede, Ms. Sumaiya Shaikh

ISBN: 978-93-92417-27-6

Contents

Exploratory Data Analysis of Top 5 Crypto Currencies

Ms. Sakshi Rane, Ms. Shreya Nadkarni*&Ms.Sumaiya Shaikh***

VPM's B.N. Bandodkar College of Science (Autonomous), Thane

Shreyanadkarni95105@gmail.com | sakshirane170403@gmail.com| sashaikh@vpmthane.org

Abstract : Crypto currency is the new age digital money which has impacted the financial world Prediction of future prices of crypto currencies using past data is possible with the help of statistical tools and techniques. The aim of this research is divided into two parts. The first part is to determine correlation or association between different crypto currency prices (Bitcoin, Ethereum, Binance coin, Tether, and Ripple), measured using statistical techniques Pearson correlation coefficients and to forecast the prices of the different crypto currencies (Bitcoin, Ethereum, Binance coin, Tether, and Ripple) using Facebook prophet since the significance of forecasting can be deemed one of the essential factors when gaining an edge in any kind of investment. The other part of the research deals with the risk and returns associated with these top 5 currencies many investors looking forward to a correct opportunity to invest in this new age digital money which is now a commodity.

Keywords : *Correlation, Time series analysis, Price Prediction, commerce.*

Introduction

Today, there are different type of crypto currencies with different technologies and functionality. Since their inception in 2008, 'crypto currencies' have become one of the most interesting and perhaps most misunderstood phenomena of the early 21st century. Since the inception of crypto currencies, an increasing number of financial institutions are getting involved in crypto currency trading. It is therefore important to summaries existing research papers and results on crypto currency trading.

Related work has discussed or partially examined literature related to the exchange of crypto currency. Greaves, A. and Au, B.,(2015) gave a brief survey of crypto currency systems using the bit coin transaction graph to predict the price of bit coin. Pichl, L. and Kaizoji, T., 2017 explored cost-effective trading opportunities by doing volatility analysis of bit coin prices using time series. The findings of this related work focused on specific field in crypto currency, including crypto currencies and crypto currency market introduction, crypto currency systems / platforms, bit coin literature review, etc.

This paper provides a comprehensive survey of crypto currency trading research, by covering Correlation analysis which measures the strength of relationship between the currencies ad Time series analysis which is the technique of studying and analysing the time series data collected over a period of time in order to study the trend in the data and extract important characteristics from it.

Objectives

The research project objectives are proposed as follows:

Objective 1: The first objective is to source the price data for Bit coin, Ethereum, Binance Coin, Tether, and Ripple crypto currencies.

Objective 2: Then second most important objective entails the exploration of different price distributions for each of the crypto currencies to identify the trends and to what magnitude (positive/negative) are the different crypto currency prices correlated with each other, measured using statistical techniques (Pearson correlation coefficients) and to predict the prices of the currencies to help smart investing for investors?

Objective 3: This is the final stage which would provide insights about risk and returns associated with these currencies.

Research Methodology

Data Collection

This study is based on secondary data which has been collected from the website https://www.kaggle.com/nshreya788/eda-on-top-5-cryptocurrencies .The dataset contains 5 sheets namely as BTC, ETH, BNB, USDT, XRP. The data attributes are as follows:

1. Date : Date of observation
2. Close : Price on the given day in USD (Also the closing price for that day)
3. Open : Opening price on the given day

 ISBN : 978-93-92417-27-6

4. High : Highest price on the given day
5. Low : Lowest price on the given day
6. Volume : Volume of transactions on the given day

The data from the last five years (from the 9th November, 2017 to 31st December 2021) were included in the study.

Preleminary Work

Data Pre-processing

Data pre-processing for all crypto currencies was done in Google Collab notebook (Python). Once the data was sourced and collected, the dataset was then imported to Google Collab notebook (python) using the most effective data structure and data analysis (pandas) package toolkit, the existing data was first analysed before any cleaning, put within a data-frame. The closing price distribution of each of the crypto currencies was plotted on a graph with a year wise gap using (Plotly) library installed, to analyse the trend amongst these crypto currencies. Later, a correlation matrix heat map for all of these crypto currencies was generated. This was done by configuring the environment with the data visualization library (seaborn) based on matplotlib. For stationarity, statistics and predictive analytics a python library called Facebook Prophet was used.

Expected Outcomes

Analysis and Inference

Exploratory Data analysis entails the exploration of different price distributions to analyse any trends and seasonality. A Price distribution chart gives a glimpse of how the prices have been thought for the past 5 years for all crypto currencies.

Comparison of Closing Price Distributions of Bitcoin, Ethereum, Binance Coin, Tether and Ripple

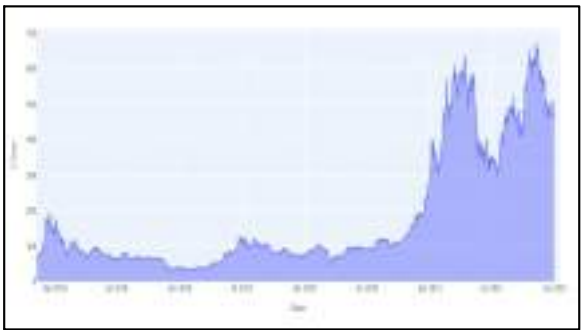


Fig.1. Closing price distribution of Bitcoin (BTC)

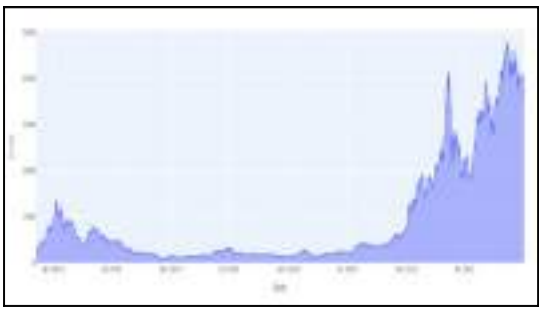


Fig.2. Closing price distribution of Ethereum (ETH)

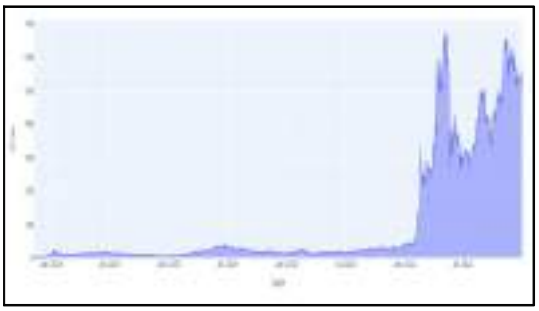


Fig.3. Closing price distribution of Binance Coin (BNB)

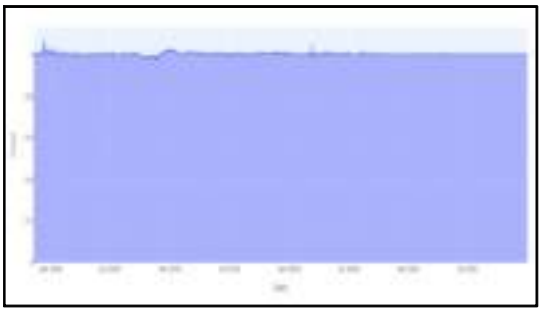


Fig.4. Closing price distribution of Tether (USDT)

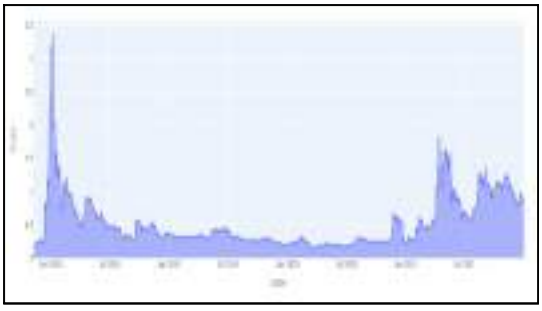


Fig.5. Closing price distribution of Ripple (XRP)

Insights

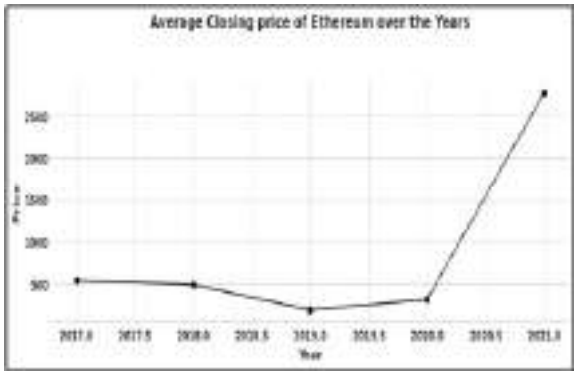
1. As an example, Bitcoin shows peak closer to December 2017, this is when the price of Bitcoin was $20,000 and skyrocketed to almost $65,000 over the last 5 years. Bitcoin(BTC) is leading the crypto market.

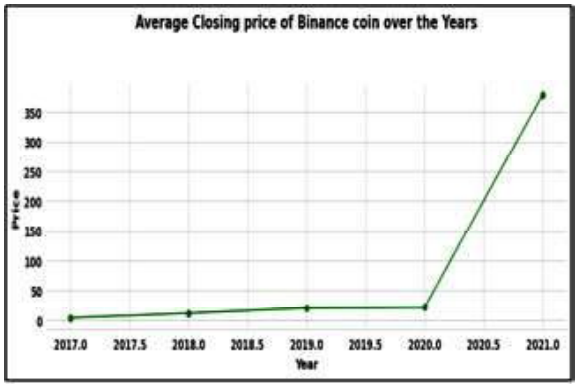
2. Similarly, The price of Ethereum (ETH) booms in late 2021.

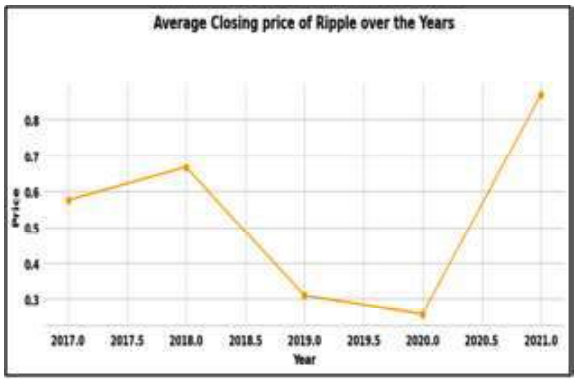
3. Ripple (XRP) shows fluctuating price distributions.

Comparison Of The Average Closing Price Distribution Of Bitcoin, Ethereum, Binance Coin, Tether And Ripple

Year	BTC average price	ETH average price	BNB average price	Usdt average price	XRP average price
2017	12283.936	532.086680	3.483208867	1.01001769	0.5752066
2018	7572.29894	483.5077266	11.17253701	1.000030	0.6662736
2019	7395.24628	181.7701374	20.09297886	1.0048532	0.30970113
2020	11116.3780	307.54297	21.350414	1.001315	0.258398959
2021	47436.93202	2778.35414	378.30497793	1.000530	0.8680094







ISBN : 978-93-92417-27-6

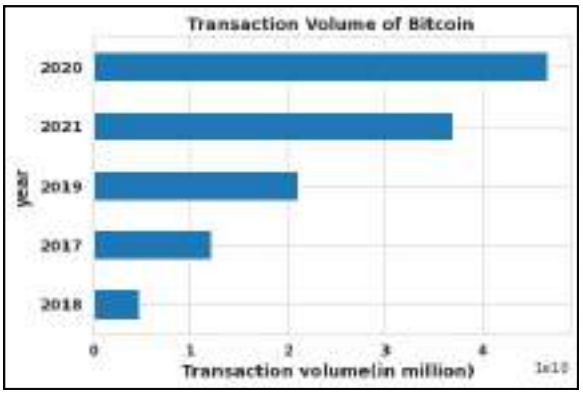
Insights

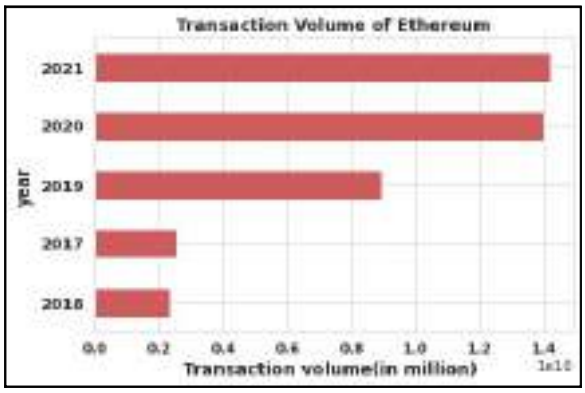
- Here we have taken into consideration the Average Closing prices (in USD) of Bit coin, Ethereum, Binance Coin, Tether and Ripple from the year 2017 to the year 2021.
- An average Price distribution chart gives a glimpse of how the average of prices have been thought for the last five years for all crypto currencies. As an example, Bit coin shows peak closer to $10000 in December 2017, this is when the price of Bit coin skyrocketed to almost $45,000.
- Similarly, other crypto currencies reached their peak closer to this period. However, Binance Coin (BNB)'s chart shows average periodic rise over the years, whereas in case of Tether all price directions are completely on a downside.

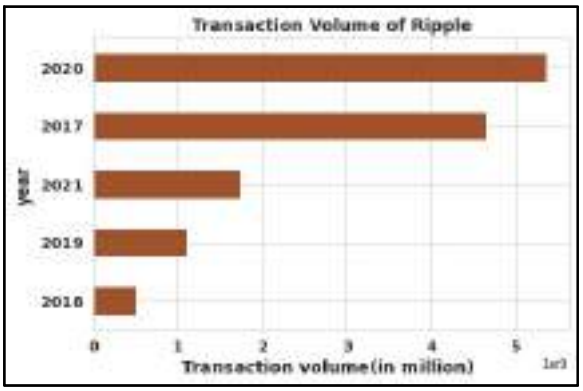
Comparison of Transaction Volume of Bitcoin, Ethereum,

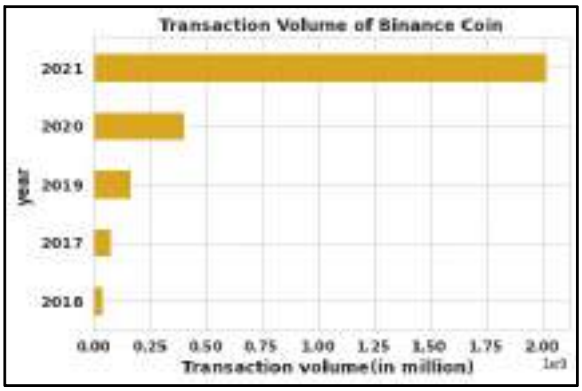
Binance Coin, Tether And Ripple

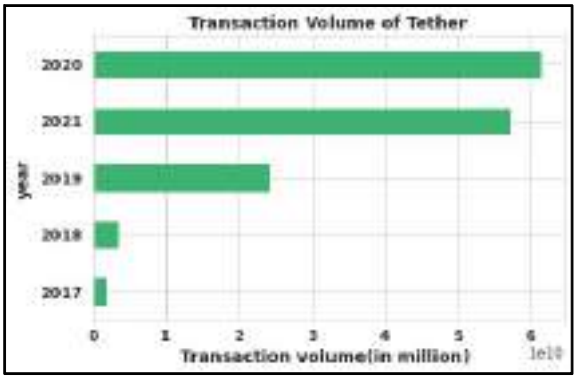
Crypto trading volume indicates interest in a crypto currency. The more people are buying and selling something, the higher the volume, which can drive even more interest in that particular crypto currency. This bar graph depicts how does Crypto trading volume has changed over the last 5 years for all five currencies.











ISBN : 978-93-92417-27-6

Insights

1) Highest transaction volume of Bit coin (BTC) had been observed for the year 2020.
2) Since it has been observed from the Closing Price Distribution graphs that Ethereum is a high beta version of binance coin. Ethereum (ETH) and Binance Coin (BNB) both are have having highest transaction volume in year 2021.
3) Highest trading volume for Tether had been recorded for year 2020.
4) Highest transaction volume for Ripple had been recorded in year 2020 followed by 2017
5) It has been observed from the above graphs that greater the volume of crypto currency transactions leads to fair crypto currency prices.

Correlation Analysis (Pearson Correlation)

Correlation attempt to discover the relationship, patterns, extensive connections, and developments among variables or datasets. There is a positive correlation among variables when an increase in a single variable, results in an increase in the other. On the other hand, a negative correlation means that after one variable increases, the other decreases and vice-versa.

Pearson Correlation is one of the most popular of the correlation statistic techniques

The formula used to calculate correlation coefficient is:

$\rho xy = Cov(x, y) / (\sigma x * \sigma y)$

where:ρxy=Pearson productmoment correlation coefficient

Cov (x, y) = covariance of variables x and y

σx = standard deviation of x

σ y= standard deviation of y

Price values for Bit coin, Ethereum, Binance Coin, Tether and Ripple :

Correlation matrix of Five selected crypto currencies

The table below provides some guidelines for how to describe the strength of correlation coefficients

Correlation Coefficient (ρ)	Description
$\rho = +1$	Perfect Positive Correlation
$\rho = -1$	Perfect Positive Correlation
$\rho = 0$	No correlation
$-1 < \rho < -0.8$	Strong Negative Correlation
$-0.8 < \rho < -0.5$	Moderate Negative Correlation
$-0.5 < \rho < 0$	Weak negative correlation
$0 < \rho < 0.5$	Weak Positive correlation
$0.5 < \rho < 0.8$	Moderate Positive Correlation
$0.8 < \rho < 1$	Strong Positive Correlation

Insights

The above given heatmap shows that:

- Ethereum (ETH) is both highly correlated with binance coin (BNB) and more volatile than Binance coin (BNB). To borrow the lingo of equity markets, this makes Ethereum a high beta version of Binance coin. When Binance coin prices rise, Ethereum prices tend to rise more. When Binance coin prices fall, Ethereum prices tend to fall even further.
- Correlation analysis for Bit coin (BTC), Ethereum (ETH), Binance Coin (BNB), Tether (USDT) and Ripple (XRP) shows that all the currencies except Tether (USDT) are positively correlated to each other.

Benefits to the Society

- Crypto currency is the new age digital money which has impacted the financial world, since the launch of its first crypto-coin called Bit coin. The reason crypto currencies are getting popular is due to their various advantages ranging from being fast, secure, scalable, trustworthy, reliable, decentralized and more.
- With crypto currency, the dealing price is low to nothing at all—unlike, for example, the fee for transferring money from a digital wallet to a bank

ISBN : 978-93-92417-27-6

account. one can easily make transactions at any time of the day or night, and there aren't any limits on purchases and withdrawals. And anyone is liberal to use crypto currency, instead of opening a bank account, which needs documentation and different paperwork.

- Funds transfer among parties can be smooth without the need of the third parties like credit/ debit cards or banks. It is a less expensive as compared to different online transactions Payments are secure and secured and provide an unparalleled stage of anonymity.
- The rise and fall of prices in the stock market is commonplace. Similarly, it's more volatile / speculative with the crypto currencies. Prices vary between 40-80 percent giving a huge factor of precariousness amongst its investors due to its volatile nature. Therefore, the correlation analysis and price prediction of these crypto currencies are often checked by regular investors for smart investing and hence, the returns are to be considered huge which crypto currency investors. The advantage of this project is to help these investors with better investment opportunities, using the correlation analysis and prediction of the top 5 crypto currencies.
- Volume can show the direction and movement of the crypto currency as well as a prediction of future price and its demand. Volume is an extremely important indicator for traders to determine the future profitability of crypto currencies.

Future Scope

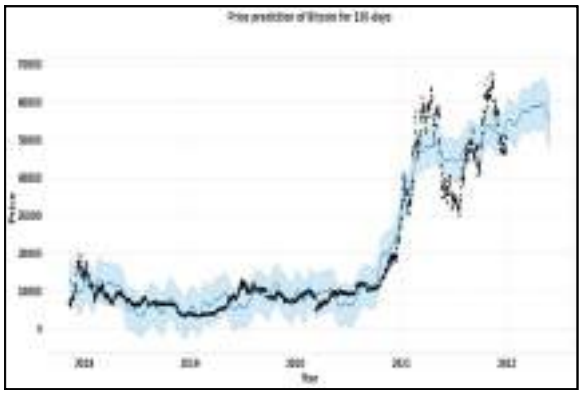
Price Prediction of Bitcoin, Ethereum, Binance Coin, Tether and Ripple for 150 Days:

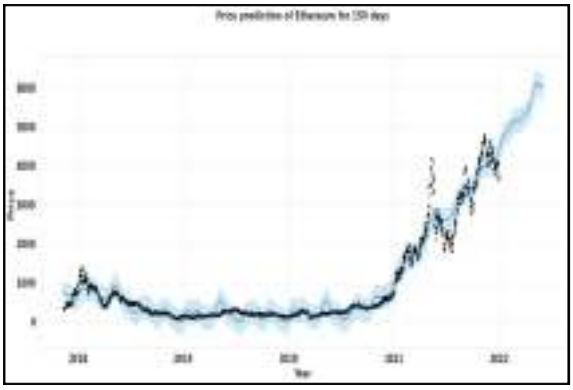
This prediction is done using the Facebook Prophet.

Facebook Prophet

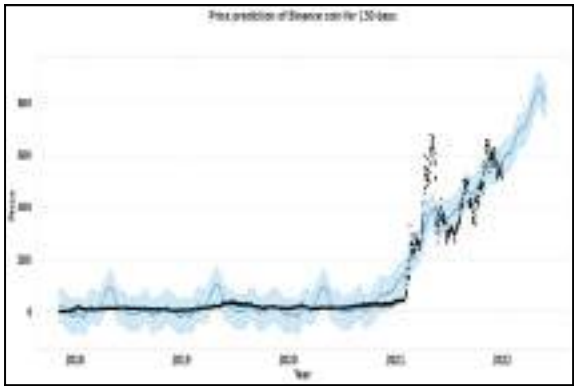
FB Prophet is an open-source library published by Facebook. Prophet is a procedure for forecasting time series data based on an additive model where non-linear trends are fit with yearly, weekly, and daily seasonality, plus holiday effects. It works best with time series that have strong seasonal effects and several seasons of historical data.

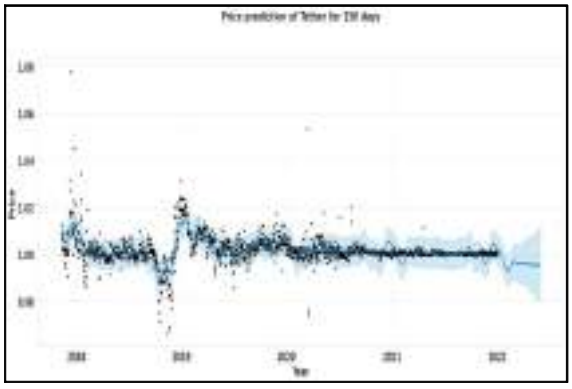
➢ **Bitcoin (BTC) → Ethereum (ETH)**



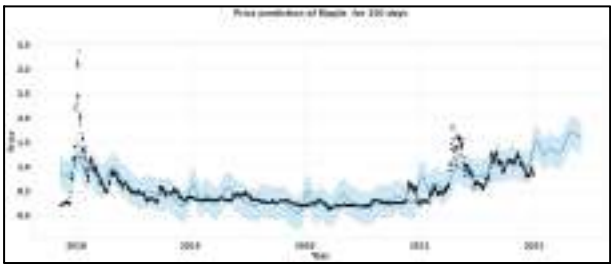


➢ **Binance Coin (BNB) → Tether (USDT)**





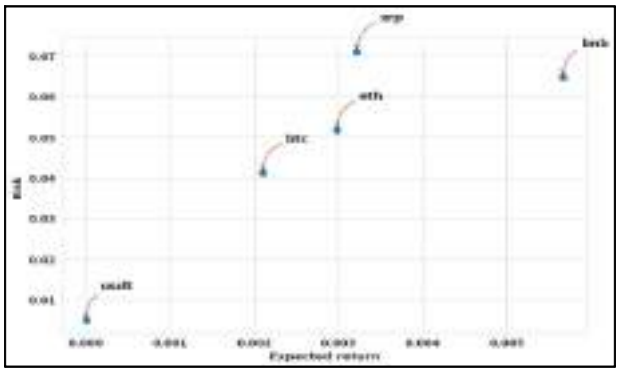
RIPPLE (XRP)



Insights

1. The reason for using Facebook prophet over other algorithms is because crypto currencies are very speculative and Fb prophet provides us with upper and lower limits of the predicted price which might be very helpful to investors.
2. In the graphs shown above black line depicts the actual price values, while this blue line depicts the predicted price values for next 150 days while this light blue Shady area is the upper limit and the lower limit in which prices of currencies might fall.
3. The predictive analysis indicates that the prices (in USD) will show a increasing trend for Bit coin (BTC), Ethereum (ETH), Binance Coin (BNB) and Ripple (XRP) for the next 150 days of year 2022. Where as the prices (in USD) for Tether (USDT) will continue to remain stable for the next 150 days of year 2022.

Risk and Return Analysis of 5 Currencies



Insights

High return comes with High risk!

Average and standard deviation of the price of currencies have been calculated to assess the risk associated with returns. Standard deviation helps determine market volatility or the spread of asset prices from their average price. When prices move wildly, standard deviation is high, meaning an investment will be risky. Low standard deviation means prices are calm, so investments come with low risk.

From this graph concludes that although Ripple (XRP) had very high returns compared to any other currencies, but it is that much risky to invest money in Ripple (XRP) and Binance coin (BNB) as well. Closing Price distribution of Tether (USDT) had stable graph throughout the years hence, it has comparatively very less risk and return.

Swoc Analysis / Limitations

The following figure illustrate the SWOC (Strength, Weakness, Opportunities, Challenges) analysis of Five Currencies :

Conclusion

- The project objectives have been successfully achieved. Dataset have been exploratory analysed in order to identify the trends for each of the crypto currencies. Line plots helps us know the movement of the price and with the application of the necessary techniques to analyse it further for the prediction. The price distribution charts are a good method of exploring the data to understand how the distributions exist within the dataset.
- However, correlation coefficients are very handy in terms of understanding the relationships between different currencies. All crypto currencies were more or less correlated with each other positively or negatively. The highest positive correlation strength within all statistical models were Ethereum (ETH) and Binance Coin (BNB). Correlation

ISBN : 978-93-92417-27-6

analysis for Bitcoin (BTC), Ethereum (ETH), Binance Coin (BNB), Tether (USDT) and Ripple (XRP) shows that all the currencies except Tether (USDT) are positively correlated to each other. While Tether (USDT) is negatively correlated the currencies. This helps us understand that the price movements across crypto currencies are somewhat correlated with each other and hence they follow a similar trend when moving upwards or downwards. Correlation analysis gives valuable information on relationships of variables hence. This data can be used for example, to take advantage of changing market.

- Volume is such an important metric when analysing cryptos and it can help investors in showing a coin's direction. A greater volume of crypto currency transactions leads to fair crypto currency prices and removes the chance of distorted pricing. Investors can also use trading volume to recognize the fruitful opportunities of crypto market which can help them to reap enormous benefits.
- Bit coin is leading the market. Bit coin is probably the best-known crypto currency, and its value has been skyrocketed in recent years. Ethereum is another popular crypto currency worth looking into, as its value has been steadily increasing over the past. Ripple is another exciting option that could potentially see a lot of growth in 2022.
- Bit coin is a decentralized digital currency which can be classified more as an investment asset than a currency. Bit coin's growth and importance in the economy has not been gone unnoticed by the economic literature, where a growing interest around bitcoin arises. Previous literature shows that bit coin is a very volatile asset but an asset that is also valuable for risk management.

Acknowledgement

The authors would like to thank the mentors for their constant support. The author would like to extend their heartfelt thanks to mentor for critically reading the paper and for their valuable suggestions and corrections.

References

- Article on crypto currency from forbes https://www.forbes.com/advisor/investing/top-10-cryptocurrencies/
- Binance Coin official webpage https://www.binance.com/en
- Bitc oin official webpage: https://www.bitcoin.com/
- Crypto currency trading a comprehensive survey on research gate https://www.researchgate.net/publication/34
- Ethereum official webpage https://www.ethereum.org/, https://www.ethereum.org/ether
- Greaves, A. and Au, B., 2015. Using the bit coin transaction graph to predict the price of Bit coin
- Pichl, L. and Kaizoji, T., 2017. Volatility Analysis of Bit coin Price Time Series.
- Primary Data Source: https://finance.yahoo.com/cryptocurrencies/
- Official Webpage of Ripple https://ripple.com/
- Official webpage of Tether https://tether.to/en/
- Volatility Analysis of Bitcoin Price Time Series (aimspress.com)

Excess Specific Acoustic Impedence, for Binary Mixtures of Vinyl Acetate + Ethers

Dr. Ajit N. Bhumkar

Physical Chemistry Research Laboratory, B .N. Bandodkar College of Science, Thane- 400601, INDIA

Abstract : Densities (ρ), viscosities (η) and speeds of sound (u) of binary mixtures of vinyl acetate with ethers (butyl vinyl ether, diisopropyl ether, anisole and dibutyl ether) at (303.15,308.15 and 313.15) K were measured over the entire composition range. From these experimental data, excess specific acoustic impedence Z^E were calculated. These quantities have been fitted to the Redlich-Kister polynomial equation and results analysed in terms of molecular interactions and structural effects. The obtained data for viscosity were fitted to Mc-Allister (4-body) viscosity model.

Introduction

Thermodynamics plays an important role in numerous industries in the design of separation equipment and process as well as for product design and optimizing formulations. Complex polar and associating molecules are present in many applications for which different type of thermodynamic and transport properties need to be known over wide ranges of temperature and pressure. Vinyl acetate is a polar simple aliphatic ester that is full of benefits and find many industrial applications. It is a chemical intermediate used in various dyes. It can be used as a solvent for a number of synthetic and natural resins. It is used as cost effective additive based in the dye sensitized solar cells. Likewise ethers are used for many purposes and find good applications in chemical engineering areas. Due to fast changing trends of the environmental concerns the need for oxygenated compounds (ethers) are becoming important because of diminishing petroleum reserves and increasing air pollution. The oxygenated fuels are mostly octane enhancers and reduce carbon monoxide emission.

Experimental

All chemicals utilized in this study were of analytical grade supplied by Sigma-Aldrich. The binary liquid mixtures were prepared by mixing known masses of pure liquids in airtight stoppered bottles. Densities of pure and their binary mixtures were determined using a density meter (DDM -2910 Rudolph Research Analytical). Viscosities of the pure liquids and their mixtures were determined by using Ubbelohde viscometer. The speeds of sound of pure liquids and liquid mixtures were determined bsy using a single-crystal variable path interferometer (model F-81) supplied by Mittal Enterprises, New Delhi, India operating at frequency of 2 MHz.

Result and Discussion

The variation in excess specific acoustic impedence Z^E Vs mole fraction (x_1) of vinyl acetate are plotted in Figure . It is observed that for the system anisole the Z^E is completely positive over the entire composition range while for all the remaining systems (butyl vinyl ether, diisopropyl ether and dibutyl ether) the Z^E values bare completely negative. The system diisopropyl ether exhibit large negative values while for dibutyl ether these values are less negative. The negative values of Z^E at the studied temperatures for (Diisopropyl ether, dibutyl ether and butyl vinyl ether) suggest the presence of weak interactions between the component molecules of the mixtures.

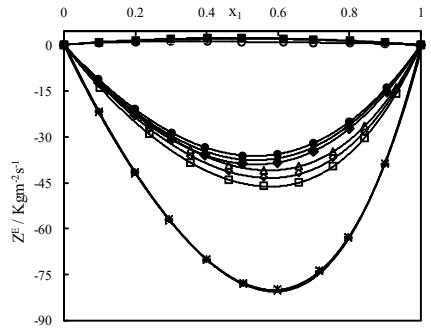


Fig. Curves of excess acoustic impedence(Z^E)Vs mole fraction(x_1) for the binary mixtures of,

ISBN : 978-93-92417-27-6

Vinyl acetate+ Butyl Vinyl ether at (□, 303.15; ◊, 308.15; Δ, 313.15) K,

Vinyl acetate+Diisopropyl ether at (×,303.15; Ж, 308.15 ; –, 313.15) K,

Vinyl acetate+Anisole at (○, 303.15;+, 308.15; ■, 313.15) K,

Vinyl acetate+ DiButyl ether (♦, 303.15; ▲, 308.15 ; ●, 313.15) K

References

[1] Jaime Wisniak , Rene´ D. Peralta , Ramiro Infante, Gladis Cortez Densities and derived thermodynamic properties of the binary systems of 1,1- dimethylethyl methyl ether with allyl methacrylate, butyl methacrylate, methacrylic acid, and vinyl acetate at T = (298.15 and 308.15) K, J. Chem. Thermodynamics, 37 (2005) 729–736

[2] Hamid Reza Raee, Farshid Frouzesh, Shokofeh Miri Volumetric properties for binary mixtures of ethyl acetate, vinyl acetate and tert-butyl acetate with 1-propanol and iso-butanol at T=(293.15–313.15) K and P=0.087 MPa, Journal of Molecular Liquids 213 (2016)255-267

[3] L. Grunberg, A.H. Nissan, Mixture Law for Viscosity, Nature. 164 (1949) 799-800.

[4] V. M. Lobe, M.S. Thesis, University of Rochester, Rochester, New York (1973).

[5] M.R.V. Krishnan, G.S. Laddha, Viscosities of Binary Liquid Mixtures, Prediction from Y-X Data, Ind. Eng. Chem. Fund. 7 (2) (1968) 324-327.

[6] O. Redlich, A. T. Kister, Algebraic representation of thermodynamic properties and the classification of solutions, Ind. Eng. Chem. 40 (1948) 345-348.