

# **Geochemistry of Estuarine sediments: A case study of Cochin Estuary**

**Dissertation submitted to University of Calicut in partial fulfillment**

**for the award of the Degree of**

**MASTER OF SCIENCE IN CHEMISTRY**

**Submitted by**

**KAVYA MANOJ**

**(Reg No CCAVMCH021)**



**POST GRADUATE DEPARTMENT OF CHEMISTRY  
CHRIST COLLEGE AUTONOMOUS IRINJALAKUDA  
THRISSUR 680125**

**Under the Guidance of**

**Dr. Shaju S S**

**Head of Department**

**Department of Chemical Oceanography**

**Co-Guide : Dr Ragi.A.S (Post-Doctoral Fellow)**

**Cochin University of Science and Technology (CUSAT)**

**April 2022**

## **CERTIFICATE**

This is to certify that the dissertation entitled "**Geochemistry of Estuarine Sediments: A Case Study of Cochin Estuary**" is an authentic record of work carried out by **KAVYA MANOJ (Reg No. CCAVMCH021)** under the guidance of **Dr. SHAJU S.S., Head of the Department, Department of Chemical Oceanography (COD), Lakeside Campus, CUSAT**, during the period of April 2022 to June 2023 as partial fulfilment of the requirement for the award of Master of Science in chemical oceanography.

Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree, diploma, or similar title has been awarded earlier to any candidate by any other university.

**External Examiner**

**Head of the Department**

**Internal Examiner**



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COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY  
SCHOOL OF MARINE SCIENCES



DEPARTMENT OF CHEMICAL OCEANOGRAPHY

സമുദ്ര രസതന്ത്ര വിഭാഗം

NO.COD/ 14/PROJECTS/2023-24

08.06.2023

### CERTIFICATE

This is to certify that the dissertation entitled "**GEOCHEMISTRY OF ESTUARINE SEDIMENTS: A CASE STUDY OF COCHIN ESTUARY**" is the bonafide work of Ms. KAVYA MANOJ, who carried out the dissertation work under my supervision at Lakeside campus, School of Marine Sciences, Cochin University of Science and Technology (CUSAT), during April 2022 - June 2023. To the best of my knowledge, the work reported by her, does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any scholar.

HEAD

Department of Chemical Oceanography



**CHRIST COLLEGE (AUTONOMOUS)**

**IRINJALAKUDA**

**CERTIFICATE**

This is to certify that the dissertation entitled "**Geochemistry of Estuarine Sediments: A Case Study of Cochin Estuary,**" submitted to the faculty of science at the University of Calicut in partial fulfilment of the degree of Master of Science in Chemistry, is a bonafide record of work carried out by KAVYA MANOJ. This dissertation was guided and written under my supervision.

**Krishnapriya.K.M**

**Department of Chemistry**

**Christ College, Irinjalakuda**

## **DECLARATION**

I hereby declare that the dissertation entitled "**Geochemistry of Estuarine Sediments: A Case Study of Cochin Estuary**" being submitted to Cochin University of Science and Technology in partial fulfilment for the award of the degree of Master of Science in Chemistry is a bonafide record of research work done by me under the guidance of Dr. Shaju S.S., Head of the Department, Department of Chemical Oceanography, School of Marine Studies, CUSAT. It has not formed part of any other thesis submitted for the award of any degree, diploma, associateship, fellowship, or similar title to any candidate at any university.

**Kochi -22**

**Date**

**KAVYA MANOJ**

**REG. NO. CCAVMCH021**

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I would like to thank Mrs. Krishnapriya.K.M and other staff of Christ College Irinjalakuda. I would like to express heartfelt gratitude to principal of Christ College,

I am thanking the crew members of M V Prashikshani,in which I am able to complete my sampling process.

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I must express my very profound gratitude to my parents for providing me with unfailing support and continuous encouragement throughout my years of study and through the dissertation.

In addition, I would like to thank the office staff of Christ College for their great support. Finally, I thank each and every person who was of great support in deliberating over the problems and findings throughout my dissertation.

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**Spatial variation in soil nitrogen fractions in relation to forest types of central zone of  
Kerala**

Dissertation submitted to **University of Calicut** in partial fulfillment of the requirements  
for the award of the Degree of

**MASTER OF SCIENCE IN CHEMISTRY**

*Submitted by*

**RINSHY T**

**(Register No. CCAVMCH022)**



**Department of Chemistry  
Christ College (Autonomous)**

Irinjalakuda-680125

*Under the Guidance of*

**Dr. Ratheesh Kumar C S**

**Assistant Professor**

**School of Environmental Studies  
Cochin University of Science and Technology**

**May 2022**

**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**

**DEPARTMENT OF CHEMISTRY**

**CERTIFICATE**

This is to certify that dissertation entitled “**Spatial variation in soil nitrogen fractions in relation to forest types of central zone of Kerala**” is an authentic record of the research work carried out by Ms. **RINSHY T (Register No: CCAVMCH022)** under the guidance of Dr. Ratheesh Kumar C S, Assistant Professor, School of Environmental Studies, Cochin University of Science and Technology during the period from May 2022 to August 2022, in partial fulfillment of the requirements for the award of Master of Science in Chemistry. Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other University.

**External Examiner**

**Head of the Department**

**Internal Examiner**

**SCHOOL OF ENVIRONMENTAL STUDIES  
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY  
KOCHI - 682 022, KERALA, INDIA**

Dr. C. S. Ratheesh Kumar  
Assistant Professor



(0) 9447372208

0484 - 2577311

✉ ratheeshes@cusat.ac.in

26/05/2023

**CERTIFICATE**

This is to certify that the dissertation entitled “Spatial Variation in Soil Nitrogen Fractions in Relation to Forest Types of Central Zone of Kerala” is the bonafide record of original work done by Ms. RINSHY T under my supervision and guidance at School of Environmental Studies, Cochin University of Science and Technology, Kerala, during the period from May 2022 to August 2022. To the best of my knowledge, the work reported by her, does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other scholar.



DR. RATHEESH KUMAR C S  
ASSISTANT PROFESSOR  
SCHOOL OF ENVIRONMENTAL STUDIES  
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY  
KOCHI - 682022, KERALA, INDIA



പരിസ്ഥിതി പഠന വിദ്യാലയം  
**SCHOOL OF ENVIRONMENTAL STUDIES**  
 കൊച്ചി ശാസ്ത്ര സാങ്കേതിക സർവ്വകലാശാല  
**COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY**

Director

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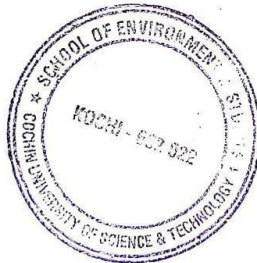
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**CERTIFICATE**

This is to certify that the dissertation entitled “Spatial Variation in Soil Nitrogen Fractions in Relation to Forest Types of Central Zone of Kerala” submitted to University of Calicut in partial fulfilment of the requirements for the degree of Master of Science in Chemistry is a bonafide record of original work done by Ms. RINSHY T, Post Graduate Student (Register No: CCAVMCH022), Department of Chemistry, Christ College (Autonomous) Irinjalakuda, University of Calicut under the guidance of Dr. Ratheesh Kumar C S, Assistant Professor, School of Environmental Studies, Cochin University of Science and Technology during the period from May 2022 to August 2022. Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other University.

Kochi-22

26.05.2023



*Usha*

Dr. Usha K Aravind

Professor & Director

DIRECTOR  
 SCHOOL OF ENVIRONMENTAL STUDIES

# **CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**

## **CERTIFICATE**

This is to certify that dissertation entitled “**Spatial variation in soil nitrogen fractions in relation to forest types of central zone of Kerala**” is an authentic record of the research work carried out by Ms. **RINSHY T (Register No: CCAVMCH022)**. This dissertation was written under my supervision.

**Ms. Krishnapriya. K.M**

**Department of Chemistry**

**Christ College, Irinjalakuda**

## **DECLARATION**

I hereby declare that the dissertation entitled” **Spatial variation in soil nitrogen fractions in relation to forest types of central zone of Kerala**” being submitted to University of Calicut in partial fulfillment of the requirements for the award of degree of Master of Science in Chemistry is a bonafide record of research work done by me under the guidance of **Dr. Ratheesh Kumar C S**, Assistant Professor, School of Environmental Studies, Cochin University of Science and Technology during the period from May 2022 to August 2022. Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

Place: Kochi-22

Date:

**RINSHY T**

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First and foremost, I humbly bow my head before God Almighty who believed me with power to complete this endeavor successfully.

I would like to record my profound and grateful gratitude to my project supervisor, Dr. Ratheesh Kumar C S, for providing me conducive environment for the completion of this project. His friendly guidance and expert advice have been valuable throughout all stages of the work.

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I am extremely thankful to Prof. Greeni K.I., the coordinator of M.Sc. Chemistry, Christ College(Autonomous) for her guidance without which I would not have been able to complete this project. I extend my heartfelt thanks to the other faculty members of our department.

I would like to express my heartfelt gratitude to Ms. Sudha A (Senior Research Fellow), School of Environmental Studies, Cochin University of Science and Technology for her valuable advices and cooperation. Also extend sincere thanks to Ms. Vidya P V and Ms. Roshni Mohan, School of Environmental Studies, for their guidance and encouragement for achieving the goal.

I express my love and sincere gratitude to my parents for their cooperation and the support they gave during my project work. I am most grateful to all my classmates for their cooperation and help. In addition, I would like to thank all teaching and non-teaching staff of the School of Environmental Studies, CUSAT for their great support. Once again, I thank each and every person who was of great support in deliberating over the problems and findings throughout my dissertation.

RINSHY T

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## **LIST OF ABBREVIATIONS**

OC	Organic Carbon
OM	Organic Matter
TOC	Total Organic Carbon
TOM	Total Organic Matter
TON	Total Organic Nitrogen
TRT	Total protein
SOC	Soil Organic Carbon
SOM	Soil Organic Matter

# **IDENTIFICATION OF MICROPLASTIC IN INDOOR SETTLED DUST**

A dissertation submitted to the **university of Calicut** in partial fulfilment of the requirement  
for degree of **master of science in chemistry**

Submitted by

**SAIGAYATHRI.M**

**(Reg No: CCAVMCH023)**



**Department Of Chemistry  
Christ College (Autonomous)  
Irijalakuda– 680125**

**Under the guidance**

**DR USHA K ARAVIND**

Professor

**School of Environmental Science  
Cochin University of Science and Technology  
(CUSAT)**

Kalamassery, Kerala

**DEPARTMENT OF CHEMISTRY**  
**CHRIST COLLEGE (AUTONOMOUS) IRIJALAKUDA**  
**CERTIFICATE**

This is to certify that dissertation entitled “ **IDENTIFICATION OF MICROPLASTIC IN INDOOR SETTLED DUST**” is an authentic record of work carried out by **SAIGAYATHRI.M (Reg No: CCAVMCH023)** under the guidance of **Dr. USHA K ARAVIND, Professor School of Environmental Studies, CUSAT** during the period of May 2022 to June 2022 as partial fulfillment of the requirement for the award of Master of Science in Environmental Science under the Faculty of Climate Variability and Aquatic Ecosystem. Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

**External Examiner**

**Head of the Department**

**Internal Examiner**

**SCHOOL OF ENVIRONMENTAL STUDIES**  
**COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY (CUSAT)**



**CERTIFICATE**

This is to certify that the dissertation entitled “**IDENTIFICATION OF MICROPLASTIC IN INDOOR SETTLED DUST**” is the bonafide work of **SAIGAYATHRI.M** who carried out the dissertation work under my supervision at **Cochin University of Science and Technology (CUSAT)**, Kalamassery, Kerala, during May 2022-August 2022. To the best of my knowledge, the work reported by her, does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any scholar.

**Kalamassery**

**Dr Usha K Aravind**

**Professor**

**Cochin University of Science and Technology**

**Cochin 682033, Kerala**

**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**

**CERTIFICATE**

This is to certify that the dissertation entitled “**IDENTIFICATION OF MICROPLASTIC IN INDOOR SETTLED DUST**” submitted to the faculty of science University of Calicut in partial fulfilment of the degree of Master of Science in Chemistry is a bonafide record of work carried out by SAIGAYATHRI M. This dissertation was guided and written under my supervision.

Ms Famy Francis

Department of Chemistry

Christ College, Irinjalakuda

## DECLARATION

I hereby declare that the dissertation entitled “**IDENTIFICATION OF MICROPLASTIC IN INDOOR SETTLED DUST**” being submitted to Cochin University of Science and Technology in partial fulfillment for the award of degree of master of science in Chemistry is a bonafide record of research work done by me under the guidance of **Dr. USHA K ARAVIND, Professor School of Environmental Studies, CUSAT**. It has not formed the part of any other thesis submitted for the award of any Degree/Diploma Associateship/ Fellowship or similar title to any candidate of any University.

Place: Kalamassery

**SAIGAYATHRIM**

Date:

CCAVMCH023

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I would like to record my profound and grateful gratitude to my project supervisor, Prof. (Dr). Usha K for providing me conducive environment for the completion of this project. Her friendly guidance and expert advice have been invaluable throughout all stages of the work.

I am extremely thankful to prof. Greeni K.I, The coordinator of MSc. Chemistry (self) for her guidance without which I would not have been to complete this project. I extend my heartfelt thanks to the other faculty members of our departments.

I would like to express my heartfelt gratitude to Aradhana K.S (Research Fellow), School of Environmental Studies, CUSAT for her valuable advices and cooperation. She supported me greatly and were always willing to help me.

I must express my love and sincere gratitude to my parents for their cooperation and support they gave during my project work. I am most grateful to all my classmates for their cooperation and help.

In addition, I would like to thank the office staff of School of Environmental Studies for their great support. All glory and honour be to the almighty who showered his abundant grace on me to make this project a success. Once again, I thank each and every person who was of great support in deliberating over the problems and findings throughout my dissertation.

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**SYNTHESIS AND CHARACTERISATION OF ZINC OXIDE  
NANOPARTICLES USING MANGROVE LEAVES AND  
EVALUATION OF THEIR ANTI -OXIDANT POTENTIAL**

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A dissertation submitted to

**UNIVERSITY OF CALICUT**

in partial fulfilment of the requirement for Degree of

**Master Of Science in Chemistry**

By

**SNEHA T.J**

**(Reg. No: CCAVMCH024)**



**Department Of Chemistry**

**Christ College (Autonomous) IRINJALAKUDA – 680125**

Under the guidance of

**Dr. ANU GOPINATH**

**Assistant Professor**

**Chemical oceanography**

**Department of Aquatic**

**environment Management**

**KUFOS, PANANGAD**

**MAY 202**

**CHRIST COLLEGE (AUTONOMOUS)  
IRINJALAKUDA**

**Department of Chemistry**

**CERTIFICATE**

This is to certify that dissertation entitled “**SYNTHESIS AND CHARACTERISATION OF ZINC OXIDE NANOPARTICLES USING MANGROVE LEAVES AND EVALUATION OF THEIR ANTIOXIDANT POTENTIAL**” authentic record of work carried out by SNEHA T J(Reg No:CCAVMCH024) under the guidance of Dr. ANU GOPINATH, Assistant professor in Chemical Oceanography, Kerala university of Fisheries and Oceanographic studies, Panangad, during the period of May 2022 to June 2022 as partial fulfillment of the requirement for the award of Master of Science in Chemistry.

Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

**External Examiner**

**Internal Examiner**

**Head of the Department**

**KERALA UNIVERSITY OF FISHERIES AND OCEAN  
STUDIES SCHOOL OF OCEAN SCIENCE AND  
TECHNOLOGY PANANGAD P.O., KOCHI 682506,  
KERALA, INDIA**



**CERTIFICATE**

This is to certify that the project work entitled “**SYNTHESIS AND CHARACTERISATION OF ZINC OXIDE NANOPARTICLES USING MANGROVE LEAVES AND EVALUATION OF THEIR IN VITRO ANTIOXIDANT POTENTIAL**” is an authentic record of the project work carried out by Ms.SNEHA T J under my supervision and guidance at the department of Aquatic Environment Management, Kerala University of Fisheries and Ocean Studies, PANANGAD, in partial fulfilment of the requirements for the award of degree of Master of Science in pure Chemistry under the faculty of Christ college autonomous Irinjalakuda, during the academic year 2021-2023.

Dr. ANU GOPINATH  
Assistant Professor  
Chemical Oceanography  
Department of Aquatic Environment  
Management  
KUFOS  
PANANGAD

**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA****CERTIFICATE**

This is to certify that the dissertation entitled “**SYNTHESIS AND CHARACTERISATION OF ZINC OXIDE NANOPARTICLES USING MANGROVE LEAVES AND EVALUATION OF THEIR IN VITRO ANTIOXIDANT POTENTIAL**” submitted to the faculty of science University of Calicut in partial fulfilment of the degree of Master of Science in Chemistry is a bonafide record of work carried out by SNEHA T J . This dissertation was guided and written under my supervision.

Ms FAMY FRANCIS

Department Of Chemistry  
Christ College, Irinjalakuda

## DECLARATION

I hereby declare that the dissertation entitled “**SYNTHESIS AND CHARACTERISATION OF ZINC OXIDE NANOPARTICLES USING MANGROVE LEAVES AND EVALUATION OF THEIR ANTIOXIDANT POTENTIAL**” an authentic record of the project work carried out by me under the guidance and supervision of Dr.ANU GOPINATH Assistant Professor, Chemical Oceanography, Department of Aquatic Environment Management, Kerala University of Fisheries and Ocean Studies, Panangad. It has not formed the part of any other thesis submitted for the award of any Degree/Diploma Associateship/Fellowship or similar title to any candidate of any University.

Place: Panangad

SNEHA T J  
CCAVMCH024

Date:

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First of all, let me thank the God Almighty, for showering all his blessings on me till now.

I am extremely thankful to to **Dr. Anu Gopinath**, Assistant Professor, Chemical Oceanography, Department of Aquatic Environment Management, KUFOS, for suggesting this project and for providing the facility to carry out my work.

I extent my sincere thanks to prof. **Famy francis**, The coordinator of Msc. Chemistry(self) for her guidance without which I would not have been to complete this project. I extend my heartfelt thanks to the other faculty members of our departments.

I am gratefully indebted to research scholar, **Ms. Devika J.**, for her guidance, help and constant encouragement throughout the course of this study.

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I would like to take the opportunity to thank all friends and lab mates for their help and motivation. Finally, I would also express my sincere gratitude to my parents, for their encouragement and support throughout, which always inspired me. Once again, I thank each and every person who was of great support in deliberating over the problems and findings throughout my dissertation.

SNEHA T J

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# **Geochemical Characterization of Organic Matter in Forest Soils of Central Kerala**

Dissertation submitted to **University of Calicut** and in partial fulfillment  
for the award of the Degree of

## **MASTER OF SCIENCE IN CHEMISTRY**

Submitted by

**THASLEEMA K T**

**(Register No. CCAVMCH025)**



**Department of Chemistry  
Christ College (Autonomous)  
Irinjalakuda – 680125**

*Under the Guidance of*

**Dr. Ratheesh Kumar C S**

**Assistant Professor**

**School of Environmental Studies**

**Cochin University of Science and Technology**

**May 2022**

**CHRIST COLLEGE (AUTONOMOUS)  
IRINJALAKUDA  
DEPARTMENT OF CHEMISTRY**

**CERTIFICATE**

This is to certify that the dissertation entitled “**Geochemical Characterization of Organic Matter in Forest Soils of Central Kerala**” is an authentic record of the work carried out by Ms. **THASLEEMA K T (Register No: CCAVMCH025)** under the guidance of **Dr. Ratheesh Kumar C S, Assistant Professor, School of Environmental Studies, Cochin University of Science and Technology**, during the period from May 2022 to August 2022, in partial fulfillment of the requirement for the award of the degree of Master of Science in Chemistry. Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

**External Examiner**

**Head of the Department**


**Internal Examiner**

**SCHOOL OF ENVIRONMENTAL STUDIES  
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY  
KOCHI - 682 022, KERALA, INDIA**

**Dr. C. S. Ratheesh Kumar**  
Assistant Professor



 (0) 9447372208

 0484 - 2577311

 ratheeshses@cusat.ac.in

26/05/2023

**CERTIFICATE**

This is to certify that the dissertation entitled “**Geochemical Characterisation of Organic Matter in Forest Soils of Central Kerala**” is the bonafide record of original work done by **Ms. Thasleema K T**, under my supervision and guidance at School of Environmental Studies, Cochin University of Science and Technology, Kerala, during the period from May 2022 to August 2022. To the best of my knowledge, the work reported by her, does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other scholar.



**DR. RATHEESH KUMAR CS**  
ASSISTANT PROFESSOR  
SCHOOL OF ENVIRONMENTAL STUDIES  
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY  
KOCHI - 682022, KERALA, INDIA



പരിസ്ഥിതി പഠന വിദ്യാലയം  
**SCHOOL OF ENVIRONMENTAL STUDIES**  
കൊച്ചി ശാസ്ത്ര സാങ്കേതിക സർവ്വകലാശാല  
**COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY**

Director

Date.....

SES/2023/329


**CERTIFICATE**

This is to certify that the dissertation entitled “**Geochemical Characterisation of Organic Matter in Forest Soils of Central Kerala**” submitted to University of Calicut in partial fulfilment of the requirements for the degree of **Master of Science in Chemistry** is a bonafide record of original work done by Ms.**THASLEEMA K. T**, Post Graduate Student (Register No: CCAVMCH025), Department of Chemistry, Christ College (Autonomous), Irinjalakuda, University of Calicut under the guidance of **Dr. Ratheesh Kumar C S**, Assistant Professor, School of Environmental Studies, Cochin University of Science and Technology during the period from May 2022 to August 2022. Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other University.

Kochi-22

26.05.2023



  
Dr. Usha K Aravind

Professor & Director

DIRECTOR  
SCHOOL OF ENVIRONMENTAL STUDIES

**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**

**CERTIFICATE**

This is to certify that the dissertation entitled “**Geochemical Characterization of Organic Matter in Forest Soils of Central Kerala**” submitted to the faculty of Science, University of Calicut in partial fulfillment of the degree of Master of Science in Chemistry is a bonafide record of work carried out by THASLEEMA K T. This dissertation was written under my supervision.

Ms Rosemol Davis

Department of Chemistry

Christ College (Autonomous)

## DECLARATION

I hereby declare that the dissertation entitled being submitted to University of Calicut in partial fulfillment of the requirements for the award of degree of Master of Science in Chemistry is a bonafide record of research work done by me under the guidance of **Dr. Ratheesh Kumar C.S, Assistant Professor, School of Environmental Studies, Cochin University of Science and Technology**. It has not formed the part of any other thesis submitted for the award of any Degree/ Diploma Associateship/ Fellowship or similar title to any candidate of any University.

Place: Kalamassery

Date:

THASLEEMA K T

CCAVMCH025

## **ACKNOWLEDGEMENT**

First and foremost, I humbly bowed my head before God Almighty who believed me with power to complete this endeavor successfully.

I would like to record my profound and grateful gratitude to my project supervisor, Dr. Ratheesh Kumar C S, Assistant Professor, School of Environmental Studies, Cochin university of Science and Technology for providing me conducive environment for the completion of this project. His friendly guidance and expert advice have been valuable throughout all stages of the work.

I extend my heartfelt gratitude to the Director, School of Environmental Studies, Cochin University of Science and technology for providing facilities for the successful completion of the project.

I am extremely thankful to Prof. Greeni K.I, the Coordinator of MSc. Chemistry, Christ College (Autonomous) for her support without which I would not have been to complete this project. I extend my heartfelt thanks to all other faculty members of our department.

I would like to express my heartfelt gratitude to Ms. Sudha A (Senior Research Fellow), School of Environmental Studies, CUSAT for her valuable advices and cooperation. She supported me greatly and were always willing to help me. Sincere thanks to Ms. Vidya P V and Ms. Roshni Mohan for their guidance and encouragement for achieving the goal.

I must express my love and sincere gratitude to my parents for their cooperation and support they gave during my project work. I am most grateful to all my classmates for their cooperation.

In addition, I would like to thank all teaching and non-teaching staff of School of Environmental Studies, CUSAT for their great support.

Once again, I thank each and every person who was of great support in deliberating over the problems and findings throughout my dissertation.

**THASLEEMA K T**



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## **LIST OF ABBREVIATIONS**

<b>SOC</b>	Soil Organic Carbon
<b>SOM</b>	Soil Organic Matter
<b>OM</b>	Organic Matter
<b>TOC</b>	Total Organic Carbon
<b>TON</b>	Total Organic Nitrogen
<b>CHO</b>	Carbohydrate
<b>LPD</b>	Lipid
<b>PRT</b>	Protein
<b>T&amp;L</b>	Tannin and Lignin
<b>Ch<sub>1a</sub></b>	Chlorophyll a
<b>Ch<sub>1b</sub></b>	Chlorophyll b
<b>Ch<sub>1c</sub></b>	Chlorophyll c

# OCCURENCE OF BISPHENOL A IN INDOOR DUST OF VARIOUS INDOOR MICROENVIRONMENT

---

A dissertation submitted to the university of Calicut in partial fulfilment of the requirement  
for degree of master of science in chemistry

By

**VISMAYA VINAYAN**

**(Reg. No: CCAVMCH026)**



**Department Of Chemistry**  
**Christ College (Autonomous)**  
**Irinjalakuda – 680125**

Under the guidance of

**Dr. Usha K**

**Professor**

**School of Environmental Studies**

**Cochin University of Science and Technology (CUSAT)**

**MAY-2022**

**CHRIST COLLEGE (AUTONOMOUS)  
IRINJALAKUDA**

**Department of Chemistry**

**CERTIFICATE**

This is to certify that dissertation entitled “**Occurrence of Bisphenol A in indoor dust of various indoor microenvironment**” is an authentic record of work carried out by **VISMAYA VINAYAN (Reg No: CCAVMCH026)** under the guidance of **Dr. USHA K ARAVIND, Professor School of Environmental Studies, CUSAT** during the period of May 2022 to August 2022 as partial fulfillment of the requirement for the award of Master of Science in Environmental Science under the Faculty of Climate Variability and Aquatic Ecosystem.

Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

**External Examiner**

**Head of the Department**

**Internal Examiner**

**SCHOOL OF ENVIRONMENTAL STUDIES**

**COCHIN UNIVERSITY OF SCIENCE AND  
TECHNOLOGY (CUSAT)**



**CERTIFICATE**

This is to certify that the dissertation entitled “**Occurrence of Bisphenol A in indoor dust of various indoor microenvironment**” is the bonafide work of **VISMAYA VINAYAN** who carried out the dissertation work under my supervision at Cochin University of Science and Technology (CUSAT), Kalamassery, Kerala, during May 2022-August 2022. To the best of my knowledge, the work reported by her, does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any scholar.

**Kalamassery**

**Dr Usha K Aravind**

**Professor**

**Cochin University of Science and Technology**

**Cochin 682033, Kerala**



**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**

**CERTIFICATE**

This is to certify that the dissertation entitled “ **Occurrence of Bisphenol A in indoor dust of various indoor microenvironment**” submitted to the faculty of science University of Calicut in partial fulfilment of the degree of Master of Science in Chemistry is a bonafide record of work carried out by VISMAYA VINAYAN. This dissertation was guided and written under my supervision.

Ms Rosemol Davis

Department of Chemistry

Christ College, Irinjalakuda



## DECLARATION

I hereby declare that the dissertation entitled **Degradation of Bisphenol A in indoor dust: A laboratory study** being submitted to Cochin University of Science and Technology in partial fulfillment for the award of degree of master of science in Chemistry is a bonafide record of research work done by me under the guidance of **Prof. (Dr). Usha k, School of Environmental Studies, CUSAT**. It has not formed the part of any other thesis submitted for the award of any Degree/Diploma Associateship/ Fellowship or similar title to any candidate of any University.

Place: Kalamassery

VISMAYA VINAYAN

Date :

CCAVMCH026

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I would like to express my heartfelt gratitude to Aradhana K S (Research Fellow), School of Environmental Studies, CUSAT for her valuable advices and cooperation. She supported me greatly and were always willing to help me.

I must express my love and sincere gratitude to my parents for their cooperation and support they gave during my project work. I am most grateful to all my classmates for their cooperation and help.

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# **GREENSYNTHESIS OF ZINC OXIDE NANOPARTICLES: CHARACTERIZATION AND APPLICATIONS**

---

A dissertation submitted to  
**UNIVERSITY OF CALICUT**  
in partial fulfilment of the requirement for Degree of  
**Master of Science in Chemistry**

By  
**AISWARYA RADHAKRISHNAN**  
(Reg. No: CCAVMCH016)



**Department Of Chemistry**  
**Christ College (Autonomous)**  
**IRINJALAKUDA – 680125**

**CHRIST COLLEGE (AUTONOMOUS) IRINJALAKUDA**  
**Department of Chemistry**

**CERTIFICATE**

This is to certify that the dissertation entitled “**SYNTHESIS AND CHARACTERISATION OF ZINC OXIDE NANOPARTICLES USING MANGROVE LEAVES AND THEIR ROLE IN ORGANIC DYE DEGRADATION**” is an authentic record of work carried out by **ANKITHA K A (Reg No: CCAVMCH017)** under the guidance of **Dr. ANU GOPINATH**, Assistant professor in Chemical Oceanography, Kerala university of Fisheries and Oceanographic studies, Panangad, during the period of May 2022 to June 2022 as partial fulfillment of the requirement for the award of Master of Science in Chemistry.

Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

**External Examiner**

**Head of the Department**

**Internal Examiner**



**KERALA UNIVERSITY OF FISHERIES AND OCEAN  
STUDIES SCHOOL OF OCEAN SCIENCE AND  
TECHNOLOGY PANANGAD P.O., KOCHI 682506,  
KERALA, INDIA**



**CERTIFICATE**

This is to certify that the project work entitled “**GREEN SYNTHESIS OF ZINC OXIDE NANO PARTICLES: CHARACTERISATION AND APPLICATIONS**” is an authentic record of the project work carried out by Ms. AISWARYA RADHAKRISHNAN under my supervision and guidance at the department of Aquatic Environment Management, Kerala University of Fisheries and Ocean Studies, PANANGAD, in partial fulfilment of the requirements for the award of degree of Master of Science in pure Chemistry under the faculty of Christ college autonomous Irinjalakuda during the academic year 2021-2023.

PANANGAD

Dr. ANU GOPINATH  
Assistant Professor  
Chemical Oceanography  
Department of Aquatic Environment  
Management  
KUFOS

**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**

**CERTIFICATE**

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This dissertation was guided and written under my supervision.

Ms GREENI K I

Department of Chemistry

Christ College, Irinjalakuda

## DECLARATION

I hereby declare that the dissertation entitled ” **GREEN SYNTHESIS OF ZINC OXIDE NANO PARTICLES: CHARACTERISATION AND APPLICATIONS**” an authentic record of the project work carried out by me under the guidance and supervision of Dr.ANU GOPINATH Assistant Professor, Chemical Oceanography, Department of Aquatic Environment Management.

Kerala University of Fisheries and Ocean Studies, Panangad. It has not formed the part of any other thesis submitted for the award of any Degree/Diploma Associateship/ Fellowship or similar title to any candidate of any University.

Place: Panangad

AISWARYA RADHAKRISHNAN

CCAVMCH016

Date :

## ACKNOWLEDGEMENT

In pursuit of this academic endeavour, I feel that I have been especially fortunate as inspiration, guidance, direction, co-operation, love and care all came in my way in abundance and it seems almost an impossible task for me to acknowledge the same in adequate terms.

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I am gratefully indebted to research scholar, **Ms. Devika** for her guidance, help and constant encouragement throughout the course of this study.

I'm highly indebted to **Sophisticated Test and Instrumentation Centre (STIC-CUSAT)**, Kochi for the technical support they provided in the characterization studies associated with my work.

I would like to take the opportunity to thank all friends and lab mates for their help and motivation. Finally, I would also express my sincere gratitude to my parents, for their encouragement and support throughout, which always inspired me. Once again, I thank each and every person who was of great support in deliberating over the problems and findings throughout my dissertation.

AISWARYA RADHAKRISHNAN

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**SYNTHESIS AND CHARACTERISATION OF ZINC OXIDE  
NANOPARTICLES USING MANGROVE LEAVES AND THEIR  
ROLE IN ORGANIC DYE DEGRADATION**

---

A dissertation submitted to

**UNIVERSITY OF CALICUT**

in partial fulfilment of the requirement for Degree of

**Master Of Science in Chemistry**

By

**ANKITHA K A**

**(Reg. No: CCAVMCH017)**



**Department Of Chemistry**

**Christ College (Autonomous)**

**IRINJALAKUDA – 680125**

Under the guidance of

**Dr. ANU GOPINATH**

**Assistant Professor**

**Chemical Oceanography**

**Department of Aquatic Environment**

**Management**

**KUFOS, PANANGAD**

**MAY 2022**

**CHRIST COLLEGE (AUTONOMOUS)  
IRINJALAKUDA**

**Department of Chemistry**

**CERTIFICATE**

This is to certify that dissertation entitled “**SYNTHESIS AND CHARACTERISATION OF ZINC OXIDE NANOPARTICLES USING MANGROVE LEAVES AND THEIR ROLE IN ORGANIC DYE DEGRADATION**” is an authentic record of work carried out by **ANKITHA K A (Reg No: CCAVMCH017)** under the guidance of **Dr. ANU GOPINATH**, Assistant professor in Chemical Oceanography, Kerala university of Fisheries and Oceanographic studies, Panangad, during the period of May 2022 to June 2022 as partial fulfillment of the requirement for the award of Master of Science in Chemistry.

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**Head of the Department**

**Internal Examiner**



**KERALA UNIVERSITY OF FISHERIES AND OCEAN  
STUDIES SCHOOL OF OCEAN SCIENCE AND  
TECHNOLOGY PANANGAD P.O., KOCHI 682506,  
KERALA, INDIA**



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Dr. ANU GOPINATH  
Assistant Professor  
Chemical Oceanography  
Department of Aquatic Environment  
Management  
KUFOS, PANANGAD

# **CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**

## **CERTIFICATE**

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Ms GREENI K I

Department Of Chemistry

Christ College, Irinjalakuda

## **DECLARATION**

I hereby declare that the dissertation entitled “**SYNTHESIS AND CHARACTERISATION OF ZINC OXIDE NANOPARTICLES USING MANGROVE LEAVES AND THEIR ROLE IN ORGANIC DYE DEGRADATION**” an authentic record of the project work carried out by me under the guidance and supervision of Dr.ANU GOPINATH Assistant Professor, Chemical Oceanography, Department of Aquatic Environment Management, Kerala University of Fisheries and Ocean Studies, Panangad. It has not formed the part of any other thesis submitted for the award of any

Degree/Diploma Associateship/ Fellowship or similar title to any candidate of any University.

Place: Panangad

ANKITHA K A

CCAVMCH017

Date:

## ACKNOWLEDGEMENT

In pursuit of this academic endeavour, I feel that I have been especially fortunate as inspiration, guidance, direction, co-operation, love and care all came in my way in abundance and it seems almost an impossible task for me to acknowledge the same in adequate terms.

First of all, let me thank the God Almighty, for showering all his blessings on me till now.

I am extremely thankful to to **Dr. Anu Gopinath**, Assistant Professor, Chemical Oceanography, Department of Aquatic Environment Management, KUFOS, for suggesting this project and for providing the facility to carry out my work.

I extent my sincere thanks to prof. **Greeni K.I**, The coordinator of Msc. Chemistry (self) for her guidance without which I would not have been to complete this

project. I extend my heartfelt thanks to the other faculty members of our departments.

I am gratefully indebted to research scholar, **Ms. Devika J.**, for her guidance, help and constant encouragement throughout the course of this study.

I'm highly indebted to **Sophisticated Test and Instrumentation Centre (STICCUSAT)**, Kochi for the technical support they provided in the characterization studies associated with my work.

I would like to take the opportunity to thank all friends and lab mates for their help and motivation. Finally, I would also express my sincere gratitude to my parents, for their encouragement and support throughout, which always inspired me. Once again, I thank each and every person who was of great support in deliberating over the problems and findings throughout my dissertation.

ANKITHA K A

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# **CHEMICAL FRACTIONATION OF TRACE METALS IN SEDIMENTS OF THE ARABIAN SEA**

---

A dissertation submitted to the **University of Calicut** in partial fulfilment of the  
requirement for degree of

**MASTER OF SCIENCE IN CHEMISTRY**

Submitted by

**AYSHA ABEER A S**

**(Reg. No: CCAVMCH018)**



**Department Of Chemistry  
Christ College (Autonomous)  
Irinjalakuda – 680125**

*Under the guidance of*

**Dr. SHAJU S S**

**Professor**

**Department Of Chemical Oceanography  
Cochin University of Science and Technology (CUSAT)**

**MAY-2022**

**CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA**  
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This is to certify that dissertation entitled “**Chemical Fractionation Of Trace Metals In Sediments Of The Arabian Sea**” is submitted to the faculty of science University Of Calicut in partial fulfilment of the degree of Master Of Science in Chemistry is a bonafide record of work carried out by **AYSHA ABEER A S**. This discretion was guided and written under my supervision.

MS GREENI K I  
Department Of Chemistry  
Christ College, Irinjalakuda

**COCHIN UNIVERSITY OF SCIENCE AND  
TECHNOLOGY (CUSAT)**



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This is to certify that the dissertation “**Chemical Fractionation of Trace Metals in Sediments of the Arabian Sea**” is the bonafide work of **AYSHA ABEER A S** who carried out the dissertation work under my supervision at Cochin University of Science and Technology (CUSAT), Kalamassery, Kerala, during May 2022-August 2022. To the best of my knowledge, the work reported by her, does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any scholar.

**Kalamassery**

**Dr. SHAJU S S**

**Professor**

**Department Of Chemical Oceanography**

**Cochin University of Science and Technology**

**Cochin 682033, Kerala**



## DECLARATION

I hereby declare that the dissertation entitled **Chemical fractionation of trace metal in sediments of Arabian sea** being submitted to University of Calicut in partial fulfilment for the award of degree of master of science in Chemistry is a bonafide record of research work done by me under the guidance of **Dr. Shaju S S, Professor, Department of Chemical Oceanography, School of Marine Science, Cochin University of Science and Technology (CUSAT)** during the year 2022. It has not formed the part of any other thesis submitted for the award of any Degree/Diploma Associate ship/ Fellowship or similar title to any candidate of any University.

Place: Kalamassery  
Date:

AYSHA ABEER A S  
CCAVMCH018

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**AYSHA ABEER A S**

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# HEAVY METAL ANALYSIS OF THE COMMERCIALY AVAILABLE CANNED FISH

A dissertation submitted to the university of Calicut in partial fulfillment of the  
requirement  
for degree of master of science in chemistry

By

HASNA SHAJAHAN  
(Reg. No: CCAVMCH019)



Department Of Chemistry  
Christ College (Autonomous)

Irinjalakuda – 680125

Under the guidance of

Dr. Shaju S S

Head of Department

Department of chemical oceanography

School of marine sciences

Cochin University of Science and Technology (CUSAT)

APRIL-2022



**CHRIST COLLEGE (AUTONOMOUS)**  
**IRINJALAKUDA**  
**Department of Chemistry**

**CERTIFICATE**

This is to certify that dissertation entitled **“Heavy metal analysis of the commercially available canned fish”** is an authentic record of work carried out by **HASNA SHAJAHAN (Reg No: CCAVMCH019)** under the guidance of **Dr.SHAJU S S , Head, Department of chemical oceanography (COD), lakeside campus, CUSAT** during the period of April 2022 to June 2023 as partial fulfillment of the requirement for the award of Master of Science in chemical oceanography.

Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or similar title has been awarded earlier to any candidate by any other university.

**External Examiner**

**Head of the Department**

**Internal Examiner**



# CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA

## CERTIFICATE

This is to certify that the dissertation entitled **“Heavy metal analysis of the commercially available canned fish”** submitted to the faculty of science University of Calicut in partial fulfillment of the degree of Master of Science in Chemistry is a bonafide record of work carried out by HASNA SHAJAHAN. This dissertation was guided and written under my supervision.

Dr. Bhagyesh.V.B  
Department of Chemistry  
Christ College, Irinjalakuda





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I hereby declare that the dissertation entitled **Heavy metal analysis of the commercially available canned fish: A laboratory study** being submitted to Cochin University of Science and Technology in partial fulfillment for the award of degree of master of science in Chemistry is a bonafide record of research work done by me under the guidance of **Prof. (Dr). Shaju S S, Head of the department, department of chemical oceanography, School of marine sciences , CUSAT**. It has not formed the part of any other thesis submitted for the award of any Degree/Diploma Associateship/ Fellowship or similar title to any candidate of any University.

Place: Kochi

HASNA SHAJAHAN

CCAVMCH019

Date :



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**ADSORPTION OF CHLORPYRIFOS ONTO GRANULAR  
ACTIVATED CARBON: CHARACTERISATION &  
KINETIC STUDIES**

A DISSERTATION SUBMITTED TO **UNIVERSITY OF CALICUT** IN PARTIAL  
FULFILLMENT FOR THE DEGREE OF MASTER OF SCIENCE IN CHEMISTRY

BY  
**INDRAJITH K B**  
**(Reg. No: CCAVMCH020)**  
Year: 2021-2023  
**Department of Chemistry**  
**Christ College ( Autonomous), Irinjalakuda**



**Under the Guidance of**

**Prof. Dr. V. SIVANANDAN ACHARI**  
**Dean & Professor**  
**School of Environmental Studies**  
**Cochin University of Science And Technology**  
**Kochi- 682022**  
**May 2023**

# **CHRIST COLLEGE (AUTONOMOUS)**

**IRINJALAKUDA**

**Department of Chemistry**

## **CERTIFICATE**

This is to certify that dissertation entitled “**Adsorption of Chlorpyrifos onto Granular Activated Carbon: Characterisation and Kinetic Studies**” is an authentic record of work carried out by **INDRAJITH KB (Reg No: CCAVMCH020)** under the guidance of **Prof. Dr. V. SIVANANDAN ACHARI**, Dean and Professor, School of Environmental Studies, Cochin University of Science and Technology, Kochi - 682022 during the period of March 2023 to May 2023 as partial fulfillment of the requirement for the award of Master of Science in Chemistry.

Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

**External Examiner**

**Head of the Department**

**Internal Examiner**

**CHRIST COLLEGE (AUTONOMOUS)**  
**IRINJALAKUDA**

**CERTIFICATE**

This is to certify that the dissertation entitled “**ADSORPTION OF CHLORPYRIFOS ONTO GRANULAR ACTIVATED CARBON: CHARACTERISATION & KINETIC STUDIES**” submitted to the faculty of Science, University of Calicut in partial fulfillment of the degree of Master of Science in Chemistry is a bonafide record of work carried out by **INDRAJITH K B**. This dissertation was written under my supervision.

**Dr. BHAGYESH V B**

**Department of Chemistry**

**Christ College(Autonomous)**

## DECLARATION

I INDRAJITH K B hereby declare that this project report entitled “**Adsorption of Chlorpyrifos on to Granular Activated Carbon: Characterisation and Kinetic Studies**” is a bonafide record of Project Work carried out at the School of Environmental Studies, Cochin University of Science and Technology, under the supervision and guidance of **Prof. Dr. V. SIVANANDAN ACHARI, Dean and Professor**, School of Environmental Studies, Cochin University of Science and Technology, Kochi 682022 and the same has not been submitted elsewhere for any degree or diploma earlier.

**INDRAJITH KB**

Reg No: CCAVMCH020

MSc Chemistry Student, Department of Chemistry,  
Christ College (Autonomous), Irinjalakuda

Place: Irinjalakuda

Date:



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## ABSTRACT

Chlorpyrifos, an organophosphorus pesticide, is significantly important due to its wide distribution, extensive household & agricultural use & persistence. It is registered for use in different pesticide formulations. The wide range use of pesticides overtime pollutes air, water & soil, contaminates terrestrial & aquatic environments and affects many organs of the human body. Activated carbon produced from various precursors has been proven to be an effective adsorbent for the removal of a wide variety of pollutants. The present study covers the adsorption of pesticide Chlorpyrifos from aqueous solution onto Cashew Nut Shell Carbon activated with Phosphoric acid and Zinc Chloride. The basic and activated carbons are characterized using SEM, XRD, CHNO and FTIR analysis. The surface morphology was studied using a scanning electron microscope. The SEM images of the carbon display the porous structure. The crystallinity was determined by XRD analysis. XRD patterns exhibit that broad peaks are at  $27^{\circ}$  and  $43^{\circ}$  showing its amorphous nature. The amount adsorbed & the % reduction of the adsorbate is calculated in this study. The estimation of chlorpyrifos is done using high performance liquid chromatography method (HPLC) method. The HPLC separation was achieved on Shimadzu Prominence-i LC 2030 plus. C 18 column (250 x 4.6 mm, 5  $\mu$ ) as stationary phase and mobile phase consist of acetonitrile: water (70: 30,v/v ) at flow rate 1 ml/min and the eluent was monitored at 219nm using UV detector with retention time 20 minutes. The column temperature is maintained at  $24^{\circ}\text{C}$  and the injected sample volume is 20  $\mu\text{l}$ . The calibration curve is found to be linear in the range 5- 40 mg/l with correlation coefficient 0.99986. The decrease in the concentration of pesticide at different contact times is determined using calibration curve & regression equation of linearity graph. The basic & activated carbons are characterized & subjected to batch adsorption study at various time intervals using the organo phosphorous pesticide chlorpyrifos as adsorbate. A sharp peak is obtained for chlorpyrifos at 16.3 minutes The time dependent data was applied to pseudo first order & pseudo second order kinetic models. The  $q_e$  value obtained from the pseudo second order equation shows a good agreement between experimental & calculated  $q_e$  values. The correlation coefficient ( $R^2$ - 0.98) of the pseudo second order kinetics rate equation indicates that the mechanism of adsorption follows a pseudo second order phenomena. Reduction of peak intensity after the adsorption using the adsorbent was studied. Phosphoric acid & Zinc Chloride activated Cashew Shell carbon has got highest % reduction of 36.8% & 34.3% respectively and  $q_e$  value 6 mg/g & 5.5 mg/g at 48 hours contact time. As the dosage is increased to 10 g/l, % reduction increased up to 82 %.

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