Conference proceedings

International Conference on Water :

From pollution to purification

December 12 - 14, 2020

Organised by:

Inter University Instrumentation Centre (IUIC)
School of Environmental Sciences (SES)
Advanced Centre of Environmental Studies and
Sustainable Development (ACESSED)
Mahatma Gandhi University, Kottayam, Kerala, India
Society of Environmental Chemistry and Allied Sciences
(SECAS), Kottayam,Kerala, India.

International Conference on Water: From pollution to purification

(ICW-2020)

December 12-14, 2020 (*ONLINE)*

Organized by

Inter University Instrumentation Centre (IUIC)

School of Environmental Sciences,

Advanced Centre of Environmental Studies and Sustainable Development

(ACESSD) &

Society of Environmental Chemistry and Allied Sciences (SECAS)

Mahatma Gandhi University, Kottayam, Kerala, India

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PREFACE

Dear Participants,

Welcome to the *Fourth International Conference on Water: From Pollution to Purification*, Dec.12-14, 2020, jointly organized by the Inter University Instrumentation Centre (IUIC), Advanced Centre of Environmental Studies and Sustainable Development: An Inter University Centre (ACESSD), the School of Environmental Sciences, Mahatma Gandhi University, Kottayam, and the Society of Environmental Chemistry and Allied Sciences (SECAS). The *Inter University Instrumentation Centre* is an organization of the Government of Kerala and the Mahatma Gandhi University which promotes high quality research by providing state-of-the-art equipment facilities in the University's schools/Centres and affiliated colleges in our country. This provides intellectual input for research activities on interdisciplinary areas of scientific research which require highly sophisticated scientific equipment. School of Environmental Sciences is one among the prominent statutory departments of the Mahatma Gandhi University having a mission to develop appropriate technology and skilled human resource for conservation of nature, prevention of pollution and sustainable utilisation of natural resources for development. ACESSD is an Inter University Centre of the Government of Kerala and it caters all the researchers across the state in the field of environmental studies and sustainable development. SECAS is a profession body of researchers and technologists in the field of environment science having members from all over India. This is the first time that we conduct ICW in the virtual space!! I hope the situation will soon change and we would be able to meet in person for the next conference.

Water pollution and potable water scarcity are two issues which have been in the limelight for so many decades. Rapid industrialisation, population explosion and unscientific water resource management are the major reasons for the situation. A wide array of pollutants from nutrients (nitrates and phosphates) to emerging contaminants is affecting the quality of global water resources. All these issues are of particular concern in India too. In this context water pollution and treatment technologies are two important areas of interest. The involvement of several sophisticated equipments in recent years helped to detect trace amount of pesticides, pharmaceutical products, heavy metals and other emerging pollutants in water bodies. A wide variety of water treatment technologies are also being developed. However, an economically viable as well as highly efficient water treatment technique for treating all the chemical water contaminants is still under intense research. On the other hand, it is really a paradox that when there is a cry for cheaper water purification technologies, a high price is being given to tackle water born diseases. The main objective of the conference is, therefore, to bring together experts in diversified areas of environmental science. Another component of this conference is a discussion on environmental awareness and education. With this idea, we have conducted the first international conference on the same topic during January 23-26, 2015. The concluding session of that conference decided to have this conference again after 2 years and to have such conferences once in every two years. The second International was, thus, conducted during Dec.12-15, 2016 in Kottayam, and the third during Dec.7-10, 2018. The participants of ICW2020 are from several countries. Indian participants are from mainly national research organizations, industrial R&Ds and from central and state Universities.

ICW2020 connects researchers from chemistry, physics, engineering, environment, geology and many more due to its interdisciplinary nature. We are thankful to all the speakers and delegates for accepting our invitation and gather in this part of the world. Research on any field of interest grows with effective interaction among researchers. We hope this will a good avenue for efficient interactions and exchange of views and ideas, although in the online mode. We hope you would fully utilize these four days of conference.

We wish you a very pleasant stay in the “*virtual space*” and a fruitful conference, and looking forward to future interactions.
Sincerely,

Prof. C.T. Aravindakumar
Convener, ICW2020

ORGANIZING COMMITTEE

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Prof. (Dr.) Sabu Thomas
Hon. Vice Chancellor
Mahatma Gandhi University, Kottayam, Kerala, India

Co-Patron & Convener
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Hon. Pro Vice Chancellor
Mahatma Gandhi University, Kottayam, Kerala, India

Chairman
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Advanced Centre of Environmental Studies and Sustainable Development (ACESSD), Mahatma Gandhi University, Kottayam, Kerala, India

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School of Environmental Studies, Cochin University of Science and Technology (CUSAT)

Student Coordinator
Arya M. S
School of Environmental Studies, Mahatma Gandhi University, Kottayam, Kerala, India

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John Richard Thomas, MGU, Kottayam
Mary Lidiya Mathew, MGU, Kottayam
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Arya M. S., MGU, Kottayam
Shiny Thomas, MGU, Kottayam
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Vishnu Sreejith M., MGU, Kottayam

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P. K. TEWARI, Mumbai, India

MOHAMED EL SHAER, Zagazig University, Egypt

Technical Programme

:

Technical Programme

DAY 1 - December 12th 2020, Saturday

Link for the meet

https://mgu.webex.com/mgu/j.php?MTID=m46ee960141d5592107090283cde06c02

2 pm – 2.30 pm (IST) : Inauguration

Welcome :Prof.C.T.Aravindakumar(Convenor,ICW2020),ProVice-Chancellor,Mahatma Gandhi University.

Inauguration : Prof.Sabu Thomas,Vice –Chancellor, Mahatma Gandhi University

Introductory Remarks : Dr.Kerala Varma, Member Syndicate ,MGU

: Prof.A.P.Thomas (Chairman, ICW 2020,Director, Advanced Centre of

Environmental Studies and Sustainable Development , MGU

: Prof.E.V. Ramaswamy, Dean, Faculty of Environmental and Atmospheric Sciences, MGU

: Prof.Usha K Aravind (Coordinator,ICW 2020) SES,Cochin University of Science and Technology, Kochi

: Dr. K.R. Baiju, Director, School of Environmental Sciences, MGU

Session 1 :- 2.30 pm – 4.40 pm (IST)

2.30 pm - 3.05 pm (IST)

10.00 am - 10.35 am (CET)

Plenary Talk, PL 1 : Roland Kallenborn, Norwegian University of Life Sciences (NMBU), Norway

“New circular bio-econonomy strategies – pollutants as indicators for sustainability”

3.05 pm - 3.40 pm (IST)

10.35 am - 11.10 am (CET)

Plenary Talk, PL 2 : Mehmet A. Oturan University of Gustave Eiffel, France

“Recent Trends and Applications in Electro-Fenton Process for Water Purification”

3.40 pm - 4.05 pm ((IST)

7.10 pm - 7.35pm (JST)

Invited Talk, IT 1 : Toshifumi Igarashi, Hokkaido University, Japan

"Heavy Metal Leaching from Hydrothermally Altered Rocks and Its Countermeasures"

4.05 pm - 4.30 pm (IST)

Invited Talk, IT 2 : Amritanshu Shriwastav, Indian Institute of Technology Bombay ,India

"Microplastics in the Marine and Freshwater Ecosystems"

4.30 pm – 4.40 pm (IST)

11.00 am – 11.10 am (CET)

Short Talk, ST 1 : Rayco Guedes Alonso, University of Las Palmas de Gran Canaria, Spain

"Evaluation of the Presence and Removal of Steroid hormones in a Natural Waste water Treatment Plant of

Gran Canaria (Spain)"

Session 2 :- 5pm – 6.45 pm (IST)

5 pm – 5.35 pm (IST)

11.30 am – 12.05 pm (GMT)

Plenary Talk, PL 3 : Michael John Whelan, University of Leicester, UK

"Health risks associated with hydrophobic organic chemical (HOC) exposure via microplastics in the human food chain"

5.35 pm – 6.10 pm (IST)

12.05 pm – 12.40 pm (GMT)

Plenary Talk, PL 4 : Suresh C. Pillai , Institute of Technology Sligo, Ireland

"Semiconductor photocatalysis for environmental applications"

6.10 pm - 6. 35 pm (IST)

8.40 pm –9.05pm (CST)

Invited Talk , IT 3 : S. Steplinpaulselvin, Huazhong University of Science and Technology,Wuhan ,China

"Ag_3PO_4 Based Materials for the Removal of Organic Contaminants"

6.35 pm - 6. 45 pm (IST)

6.05 pm - 6.15 pm (UZT)

Short Talk, ST 2 : Rakhimova Latofat , Tashkent State Technical University, Uzbekistan

"Waste water Treatment from Heavy Metal Ions by Using Ion-Exchangers"

Session 3:- 7.25 pm – 8.20 pm (IST)

7.25 pm -7.50 pm (IST)

7.55 am - 8.20 am (NST)

Invited Talk , IT 4 : Lee D. Wilson , University of Saskatchewan, Saskatoon,Canada

"Biopolymer Adsorbents with Tunable Properties for Controlled Removal of Environmentally Relevant Anions"

7.50 pm - 8.00 pm (IST)

Short Talk, ST 3 : Dr. Sanigdha Acharya, Guru Gobind Singh Indraprastha University, Dwarka, India

"Electrocoagulation Treatment of Ground Water and its Comparison with Chemical Coagulation"

8.00 pm – 8.10 pm (IST)

Short Talk, ST 4 : J. Selvakumar, Bhabha Atomic Research Centre, Kalpakkam, India

"Removal of Radionuclides from Acidic Radioactive Waste Using Inorganic Ion – Exchangers"

8.10 pm – 8.20 pm (IST)

5.40 pm – 5.50 pm(EAT)

Short Talk, ST 5 : Chala Dab, College of Medicine and Health Sciences Wollo University, Dessie, Ethiopia

"Removal Efficiency of Selected Parameters of a Brewery Waste water Treatment Plant in Kombolcha Ethiopia"

DAY 2 - December 13th 2020, Sunday

Link for the meet

https://mgu.webex.com/mgu/j.php?MTID=mb7073db36f8c03331d6b0acb42484000

Session 4 :- 11 am – 1.00 pm (IST)

followed by discussion for 30 min (1.00 pm – 1.30 pm)

Online Poster Presentation

Session 5 :- 2.00 pm – 4.05 pm (IST)

2.00 pm – 2.25 pm (IST)

Invited Talk , IT 5 : Satyajit Shukla , NIIST Thiruvananthapuram, Kerala, India

“Persulfate Activation using Flyash- Fe_3O_4-Ag/Cu Magnetic composite Particles for Abatement of Industrial Azo Reactive Dyes from Aqueous solutions”

2.25 pm - 2.50 pm (IST)

Invited Talk , IT 6 : B. Neppolian , SRM Institute of Science and technology, Chennai, India

“Sono-Photocatalysis for Environmental Remediation”

2.50 pm -3.15 pm (IST)

Invited Talk , IT 7 : Anbazhagi Muthukumar, Central University of Kerala Kasaragod, India

“Emerging Contaminants in Water and their Associated Health Effects”

3.15 pm -3.25 pm (IST)

Short Talk , ST 6 : P. Kalaiselvi, Tamil Nadu Agricultural University Coimbatore, India

“Assessing the status of Ground Water Quality in Tannery Industrial Effluent Contaminated areas of Ambur

Taluk of Vellore District”

3.25 pm - 3.35 pm (IST)

Short Talk, ST 7 : E. Parameswari, Tamil Nadu Agricultural University Coimbatore, India

“Efficiency of Hexavalent Chromium Removal using Ferric Chloride Treated Water Hyacinth Biochar”

3.35 pm -3.45 pm (IST)

Short Talk , ST 8 : Shibu G. Pillai ,Institute of Technology, Nirma University, Ahmedabad, India

"A novel Calixresorcinarene Derivative: An Efficient Extratactant for Vanadium ions"

3.45 – 3.55 pm (IST)

Short Talk , ST 9 : Pooja Chavan Satose, Bhabha Atomic Research Centre, Kalpakkam, Tamil Nadu ,India

"Physiological and Biochemical changes in chaetoceros Lorenzianus on Exposure to Antifouling

Biocides,Chlorine and Chlorine Dioxide"

3.55 – 4.05 pm (IST)

Short Talk , ST 10 : Adwitiya Kar, Nuclear Recycle Board, BARC, Kalpakkam, Tamil Nadu, India

"Treatment Optimisation of Tc^{99} Rich Low Level Radioactive Waste Containing Organics and Ru^{106} by Chemical Precipitation"

Session 6: - 4.30 pm – 6.05 pm (IST)

4.30 pm - 4.55 pm (IST)

Invited Talk , IT 8 : Raju Kumar Gupta, Indian Institute of Technology Kanpur, India

"Novel Photocatalytic Systems Towards Remediation of Toxic Aquatic Pollutants"

4.55 pm -5.20 pm (IST)

Invited Talk , IT 9: Abhijit Maiti ,India Indian Institute of Technology Roorkee, UP, India

"Latarite and Ferromanganese Slag –Based Low Cost Technology for Arsenic and Fluoride Removal from Contaminated Ground Water"

5.20 pm - 5.35 pm (IST)

4.50 pm – 5.05 pm (UZT)

Short Talk , ST 11 : Sadritdin M. Turabdjanov/ Rector, Tashkent state technical university, Uzbekistan

"Water Resource Issues of Uzbekistan"

5.35 pm - 5.45 pm (IST)

7.05 pm - 7.15 pm (MSK + 4)

Short Talk , ST 12 : Irina Sokolova, National Research Tomsk State University, Russia

"Influence of UV Radiation on the Spectral Properties of Herbicide Mecoprop"

5.45 pm – 5.55 pm (IST)

Short Talk , ST 13 : M. M. Shahansha, NIIST Thiruvanathapuram, Kerala, India

"Removal of Industrial Azo Reactive Dyes from Aqueous solution Using Persulfate and Hydrogen Peroxide as mixed Oxidants Activated by Fly ash -Pd"

5.55 pm – 6.05 pm (IST)

Short Talk, ST 14 : V. Davamani, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

"Effect of treated paper mill effluent on soil properties, yield and quality of Turmeric"

Session 7: - 6.15 pm -8.05 pm (IST)

6.15 pm -6.40 pm (IST)

Invited Talk , IT 10 : K. Balakrishna, Manipal Institute of Technology, Manipal, India

"Pollution of Antarctic waters and sea-ice from emerging contaminants - a review"

6.40 pm – 7.05 pm (IST)

Invited Talk , IT 11 : Jothivenkatachalam K, Bharathidasan Institute of Technology ,Anna University,Thamilnadu, India

"Biopolymer based metal nanocomposites: a promising plasmonic photocatalyst for environmental application"

7.05 pm - 7.15 pm (IST)

2.00 pm - 2.10 pm(CET)

Short Talk , ST 15 : Sergio Santana Viera, University of Las Palmas de Gran Canaria, , Spain

"Combination of Ion Exchange Solid Phase and ICP-MS for Simultaneous Determination of Cytostatic Platinum Compounds in Waste Waters"

7.15 pm – 7.25 pm (IST)

Short Talk , ST 16 : K. Indulekha, Mahatma Gandhi University, Kottayam ,Kerala,India

"Impact of land use changes on subsurface drainage flows and the landscape scale pollution of subsurface water"

7.25 pm - 7.35 pm (IST)

Short Talk , ST 17 : Xavy Borgohain , Rajiv Gandhi University, Arunachal Pradesh, India

"Remediation of Fluoride from Aqueous Media by Using Low Cost Porous Nanoadsorbent "

7.35pm – 7.45 pm (IST)

Short Talk , ST 18 : Salman Farissi, Central University of Kerala, Periye, Ksaragaod

"Oxidative Degradation of Emerging Micropollutant, Naproxen found in Waste Water"

7.45 pm – 7.55 pm (IST)

9.15 am -9.25 am (EST)

Short Talk , ST 19 : Karthik R. Yadavar, Boston University, USA

"Fate of Coronavirus in water and waste Water – A global concern"

7.55 pm – 8.05 pm (IST)

Short Talk , ST 20 : Manju Mary Joseph, Cochin University of Science and Technology ,Cochin,

"Phytoremediation Coupled Microalgal Cultivation-A Novel and Promising Approach for Sustainable Biodiesel Production"

DAY 3 - December 14th 2020, Monday

Link for the meet

https://mgu.webex.com/mgu/j.php?MTID=m020095a621f076a239d4b241667bc2a5

Session 8:- 2.30 pm - 4.20 pm

2.30 pm – 2.55 pm (IST)

Invited Talk , IT 12 : Soumyakanti Adhikari, Bhabha Atomic Research Centre Mumbai,India

"Investigation on the mechanism of degradation of selected dyes through electron beam irradiation"

2.55 pm - 3.20 pm (IST)

Invited Talk , IT 13 : Ramaswamy Babu Rajendran , Bharathidasan University, Tamilnadu, India

"Perfluorinated Compounds (PFCs) in Indian Environment"

3.20 pm - 3.30 pm (IST)

Short Talk , ST 21 : Aneek Kuila, Environmental Nano-tech Research Laboratory, IIT (ISM), Dhanbad

"Visible –Light Sensitive Ce MOF / mc BiVO4 Type II Staggered Heterostructure for Photocatalytic Waste Water Treatment"

3.30 pm - 3.40 pm (IST)

Short Talk , ST 22 : K.Suganya, Tamil Nadu Agricultural University, Coimbatore, Tamilnadu, India

"Assessing the Effect of Pre-Sown and Post- sown Application of Distillery Spent wash on the Nutrient Uptake of Maize Crop"

3.40 pm - 3.50 pm (IST)

Short Talk , ST 23 : Bukke Vani, Indian Institute of Chemical Technology Hyderabad , Telangana, India

"Development of Antifouling Ultrafiltration Membranes from Titanium Dioxide Incorporated Polyphenylsulfone for Greywater Treatment"

3.50 pm - 4.00 pm (IST)

Short Talk , ST 24 : Cinnie Susan Antony, Mahatma Gandhi University, Kottayam ,Kerala,India

"Impact of Aquatic Heavy Metal Pollution on the Hematological Parameters of the Fish,Orechromis Niloticus"

4.00 pm - 4.10 pm (IST)

Short Talk , ST 25 : Parteek Singh, Punjab Engineering College, Chandigarh ,India

"An interactive database management system for groundwater pollution control"

Session 9 :- 4.20 pm – 7.25 pm

4.20 pm – 4.45 pm (IST)

12. 10 pm- 12.35 pm

Invited Talk , IT 14 : Martina Zelenakova, Technical University of Kosice, Slovakia

"Environmental risks from water pollution"

4.45pm – 5.10pm (IST)

6.15pm -6.40 pm (ICT)

Invited Talk , IT 15 : Chavalit Ratanatamskul, Chulalongkorn University of Bangkok, Thailand

"Water Demand Management for Industrial and Urban Areas in Eastern Economic Corridor (EEC) Zone in Thailand"

5.10 pm – 5.35 pm(IST)

Invited Talk , IT 16: Halan Prakash, BITS Pilani, Goa Campus, Goa

5.35 pm –5.45 pm (IST)

Short Talk, ST 26 : Athira. K.R., Government College Kasaragod, Kerala ,India

“Water Quality Index of Pre-Monsoon Ground water Samples in the Lower Reaches of Periyar river Basin in

Thrissur District, Central Kerala,India “

5.45pm –5.55pm (IST)

Short Talk, ST 27 : Akhilghosh K. A, Central University of Kerala, Kasaragod, Kerala, India

“Detection and Quantification of Per-and Polyfluoroalkyl Substances in the Indian Aquatic Environment –A Need of the Hour”

5.55pm – 6.05pm (IST)

Short Talk , ST 28 : N. Nimmi, CWRDM, Kozhikode, Kerala, India

“Assessment of Pollution and Preparation of Health Score Card of Biyyam Wetland and,Kerala , India”

6.05pm – 6.15 pm (IST)

Short Talk , ST 29 : Nisha B. K, Manipal Institute of Technology, Manipal, India

“Trace metal concentration in the sediments of a small tropical Western Ghat

river system in South-west coast, India”

6.15pm - 6.25pm (IST)

Short Talk , ST 30 : Ankit Dilaware, Pondicherry University, Pondicherry, India

“Ecotoxicological assessment of Green CuO Nanoparticles Using Hydra as Model Organism”

6.25 pm - 6.35 pm (IST)

Short Talk , ST 31 : Shilpa.Santhosh ,Mahatma Gandhi University, Kottayam, Kerala, India

"Effect of Mn Doped Ni-Co Mixed Oxide Catalysts on Urea Oxidation"

6.35 pm –7.00 pm (IST)

1.40 pm – 2.05 pm (CET)

Invited Talk , IT 17 : Petr Hlavínek, Technical University of Brno, Czech Republic

7.00 pm -7.25pm(IST)

2.05 pm– 2.30 pm (CET)

Invited Talk , IT 18 : Irena Petrinić, University of Maribor, Slovenia

7.25 pm - 7.50 pm (IST)

4. 30pm - 4.55 pm (AST)

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PL 2 *Recent Trends and Applications in Electro-Fenton Process for Water Purification* *4*

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PL 3 *Health risks associated with hydrophobic organic chemical (HOC) exposure via microplastics in the human food chain* *5*

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PL 4 *Semiconductor photo catalysis for environmental applications* *6*

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Plenary Lectures

PL-1

New circular bio-econonomy strategies – pollutants as indicators for sustainability

Roland Kallenborn

Norwegian University of Life Sciences (NMBU) - Faculty of Chemistry, Biotechnology and Food Sciences (KBM)

As an important societal measure for establishing sustainable future circular bioeconomy strategies, recycling and reuse of both non-renewable and renewable resources mainly derived from organic residues is considered an important prerequisite. Thus, applying, reusing and refining organic residues, previously considered as wastes, is an important research and societal focus on the national and international level. In many countries, biowastes are currently applied as preferred soil amendment and fertilizer for the effective recycling the nutrients incl. nitrogen and phosphorous in modern sustainable agricultural applications. However, such soil amendments may also lead to dispersal and accumulation of contaminants in agricultural soils if not properly monitored and treated. From soils, these contaminants may be absorbed and accumulated into food and fodder plants, ultimately resulting in animal and human exposure. The development of suitable production and refinement pathways for recycling and renewable energy production in recent years still do not take potential associated pollutant transfer sufficiently into account when commercialising their refined products. Various technologies have been promoted and applied with the potential of uncontrolled emission of anthropogenic pollution. For instance, the use of biological (waste) materials in anaerobic digestion processes, both as decentralized farm based as well as municipal biogas plants is currently marketed as new pathway for sustainable energy production. Hence, among others, organic household waste, as substrates for biogas production has increased significantly in Europe, Asia and the North Americas. This development leads not only to an increasing amount of bioenergy produced, but also to a considerable amount of production waste to be handled properly as starting material for new products. Also recent development in large scale Urban Agriculture (UA) for greening of large cities is expected to develop into an important new pathway for bioeconomic production in an urban context. AS part of UA related urban sustainable strategies, agricultural substrate soil, fertiliser and infrastructures from the respective urban areas are utilised or reused. However, pollutant associated aspects of the soils and the potential for uptake in commercially available consumer products are not sufficiently implemented in the current international UA strategies. Possible consequences of organic pollutants in UA installations and commercially distributed products will be discussed as case studies in the presentation.

PL-2

Recent Trends and Applications in Electro-Fenton Process for Water Purification

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The removal of toxic/persistent organic pollutants from water constitutes one of major challenge in water purification. Electro-Fenton process have been designed and developed in this context and received great attention during the last decades due to their environmental safety, compatibility and high oxidation/mineralization power to destroy persistent/toxic organic micropollutants [1,2]. The main future of this processes is in situ electrocatalytic generation of the hydroxyl radical ($^\bullet$OH), a very strong oxidant species with standard oxidation potential of 2.8 V/SHE. Hydroxyl radical can be produced in the solution homogeneously from electrochemically generated (H_2O_2) and regenerated (Fe^{2+}) reagents through Fenton reaction and heterogeneously from water oxidation on the surface of an appropriate cathode. These homogeneous ($^\bullet$OH) and heterogeneous (M($^\bullet$OH)) are able to oxidize/mineralize any organic pollutants in water.

$^\bullet$OH/(M($^\bullet$OH) + RH/ArH $\rightarrow$ oxidation intermediates $\rightarrow \rightarrow \rightarrow$ CO_2 + H_2O + inorganic ions

The principle and application of electro-Fenton will be presented. Electrode material and current are among the main influent parameters. The effect of main influent parameters, such as current and electrode materials (cathode and anode) will be presented. Particularly, the performance of new cathode material (carbon sponge) and anode material (non-stoichiometric titanium oxides) on the degradation kinetics and mineralization efficiency will be discussed. The performance of these emerging electrodes will be considered in comparison with other conventional electrodes in oxidation/mineralization of different persistent organic pollutants including a new reaction mode of $^\bullet$OH allowing oxidation of perhologenated organic compounds

To get a cost effective process and to enhance pollutants removal effectiveness, a new trend consisting of coupling electro-Fenton with other technologies is attracting great interest. Some of these hybrid processes, in particular, the bio-electro-Fenton process [3] will be exemplified based on the recent studies. Besides, the use of solid catalysts, such as pyrite, allowing the application of electro-Fenton process at large pH scale has recently been developed. Finally a new finding related to the regeneration of activated carbon and its application to the treatment of low pollutant concentration effluents will be discussed [4].

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PL-3

Health risks associated with hydrophobic organic chemical (HOC) exposure via microplastics in the human food chain

Michael John Whelan[1] and Todd Gouin[2]

[1]University of Leicester, Leicester, UK, [2]TGE, Sharnbrook, UK

It has been suggested that micoplastics (MPs) can act as a vector for hydrophobic organic contaminant (HOC) transport in the ocean system and for HOC exposure and effects in marine organisms. MPs can also find their way into the human food chain but the importance of this pathway as a HOC exposure route for humans is currently unknown. Here, we assess the potential exposure and health risks to humans associated with HOC ingestion via MPs, with a specific focus on quantifying the MP seafood pathway. We modified ACC-HUMAN$_{\text{STEADY}}$, a steady state multi-media numerical model of HOC behaviour in the complete human food chain (aquatic and terrestrial) to describe HOC transfer between MPs and fish or humans based on two-film resistance theory and assuming MPs are present as spheres. The magnitude of HOC transfer to the body via this pathway was calculated relative to the total uptake (via food, water and air). The relative potential contribution of HOC transfer from MPs to humans was evaluated for 23 HOCs with a representative range of properties and for 117 hypothetical chemicals over a range of "partitioning space". We also estimated the changes in the absolute concentrations of the 23 HOCs in humans resulting from the presence of MPs and evaluated the associated human health risks by comparing the predicted chemical body burden with toxicological effect thresholds.The relative magnitude of predicted HOC contribution to total intake in humans varied with HOC properties (HOC uptake from MPs is predicted to be highest for compounds with log K_{OW} values of about 5) and the assumptions made about MP size and number in fish and in the human diet. Predicted MP contribution is small for most chemicals but could be significant (under some assumptions of chemical transfer) where humans are regularly exposed to large numbers of fine MPs. Predictions of absolute HOC concentration in humans suggests that toxic thresholds are unlikely to be exceeded, when the model was driven by typical concentrations of the selected compounds in the environment. The presence of MPs did increase the predicted steady state human concentration of many compounds but typically by < 10%.The extent to which MPs represent an important vector for HOC exposure in humans is still uncertain and critically depends on the values chosen for the partial mass transfer coefficients describing chemical transfer between the MPs and the body and vice versa. Particle size distribution is also important.

PL-4

Semiconductor photocatalysis for environmental applications

Suresh C. Pillai

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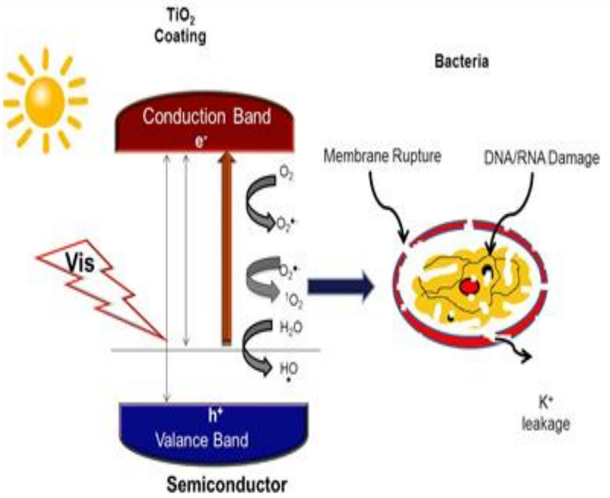
Photocatalysis technology is widely employed as a clean methodology for degrading organic pollutants including various pesticides and industrial effluents. [1-5] It can also be employed for the degradation of the bacteria and other microbes. Anatase phase titanium dioxide (bandgap of 3.2 eV) is capable of bacterial decontamination under ultraviolet irradiation. Efficiency of a photocatalytic material mainly depends on the ability of the semiconductor to yield long-lasting electrons and holes, which result in the formation of various free radical species. As part of a programme to develop highly efficient photocatalytic materials, investigations were aimed at preparing new photo-catalytically activate antimicrobial materials for disinfection applications. High thermal stability of the anatase phase is one of the requirements for making coatings on ceramic surfaces. For example, anatase phase which is stable up to the sintering temperature of the substrate (*e.g.*, bathroom tile) is highly beneficial for anti-bacterial building materials. The preparation of a range of novel photocatalytic materials by engineering the band-gap using various dopants such as N, S, C and F will be discussed.



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Invited Talks

IT-1

Heavy Metal Leaching from Hydrothermally Altered RocksAnd Its Counter measures

Toshifumi Igarashi

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Hydrothermally altered areas are widely distributed in Japan. In particular, Hokkaido has a number of active volcanoes, closed mines, and hot springs, which are popular destinations for tourists. We have an ongoing Shinkansen project connecting Hakodate located south of Hokkaido with Sapporo, the capital of Hokkaido. The total distance of railway to be built is 212km, over 170 km of which will pass through tunnels. This means that a huge volume of excavated rocks, including hydrothermally altered ones, would be excavated in this project. Thus, reasonable disposal of excavated rocks should be carried out. However, heavy metals and metalloids are released from hydrothermally altered rocks once they are exposed to oxygen and water. Therefore, the leaching of the hazardous elements and their mobility in the surrounding environment should be evaluated. In this presentation, the leaching behaviors of hazardous elements from a variety of rocks and adsorption of these hazardous elements by natural and artificial adsorbents are introduced. This knowledge would be instrumental in the development of reasonable disposal methods for hydrothermally altered rocks. The adsorption layer method, by which a special reactive layer that adsorbs hazardous elements is constructed underneath excavated rocks, is proposed as one promising approach.

IT-2

Microplastics in the Marine and Freshwater Ecosystems

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In recent times, microplastics have been receiving lot of increasing attention of the scientific community as a pollutant of emerging concern. It is since their presence is being reported from almost all environmental matrices throughout the world, including freshwater, marine water, terrestrial, atmosphere, polar regions, and even the deep oceans. Their potential for being ingested by various organisms and subsequent trophic transfer is also of concern. Human exposure to microplastics is thus a reality. However, only a few studies are available on their occurrence and concentration levels in different environmental matrices in India. This poses a limitation on getting the real sense of the problem and any effective remediation or prevention. In this talk, I will present some of our results for the occurrence of microplastics in marine and freshwater ecosystems of Mumbai. Their abundance, morphological characteristics, and spatiotemporal variation will be discussed.

IT-3

Ag_3PO_4 Based Materials for the Removal of Organic Contaminants

Steplinpaulselvin Selvinsimpson and Yong Chen

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Silver phosphate (Ag_3PO_4) is a novel visible light responsive photocatalyst that has in recent times become the research attention for its outstandingabilities in the photodecomposition of organic pollutants and super high O_2 evolution efficacy of almost 90% from water splitting, which is considerablygreatercompared to other reported semiconductors (20%). And also it has been widely considered owing to its narrow band gap, visible light absorption capacity, and the positive valence potential. Basically, in the conduction band the photo-generated electrons have high mobile ability, which further leads to high separation efficiency of photoinduced carriers and shows excellent photocatalytic oxidation ability of the bare Ag_3PO_4. But, the uncontrolled photocorrosion of Ag_3PO_4 will put an end to its structure and lead to the deposition of Ag^0 on its surface, unavoidably preventing the light absorption and decreasing its photocatalytic activity. In this work, Herein, the incorporation of carbon materials to form composite shows an excellent photocatalytic activity over the organic contaminants and also counter attackthe photocorrosion of the materials.

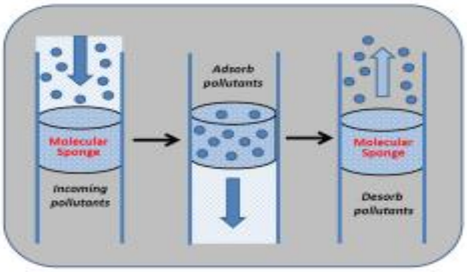
IT-4

Biopolymer Adsorbents with Tunable Properties for Controlled Removal of Environmentally Relevant Anions

Lee D. Wilson

University of Saskatchewan, Department of Chemistry, Saskatoon, SK. CANADA

Concerns for human and ecosystem health are related to the fate and transport of oxyanion species such as orthophosphate (P_i) in aquatic environments. The uncontrolled release of nutrients in aquatic environments globally and the resulting effects of eutrophication and excessive algae growth [1,2]. Biopolymer flocculants and adsorbents offer a unique green chemistry strategy for the controlled removal of oxyanion species in water and wastewater due to their molecular tunability and sustainability. In the case of solid-liquid treatment systems, the use of chemical additives and occurence secondary pollution is reduced relative to conventional treatment methods. This presentation will provide an overview of research progress at the University of Saskatchewan (U of S) related to the design and characterization of biopolymer platforms as adsorbent materials for uptake of environmentally relevant anions. In particular, case studies of sorbents with high affinity toward orthophosphate are described, where synthetic modification of biopolymers reveals enhanced physicochemical properties related to adsorption and responsive behaviour to external stimuli (pH, ionic strength, temperature, etc.) [3,4]. Sustainable materials that show reversible adsorption–desorption processes and high efficiency P_i removal using green chemistry (surface functionalization, cross-linking, and composite formation). This research is anticipated to contribute to advanced functional materials for oxyanion waterborne contaminants for controlled removal and targeted water treatment processes [5].



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1. *Agbovi HK, Wilson LD (2018) Design of amphoteric chitosan flocculants for phosphate and turbidity removal in wastewater. Carbohydrate Polymers. Vol. 189: 360−370.*
2. *Kong D, Wilson LD (2018) Structural Study of Cellulose-Iron Oxide Composite Materials. Journal of Materials Science & Chemical Engineering, Vol. 6: 65-77.*
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IT-5

Persulfate activation using flyash-Fe_3O_4-Ag/Cu magnetic composite particles for abatement of industrial azo reactive dyes from aqueous solutions

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Organic synthetic-dyes are extensively used in various industries such as the textile, leather tanning, paper production, food technology, agri cultural research, light harvesting arrays, photo-electrochemical cells, and hair coloring. Due to their large scale production, extensive use, and subsequent discharge of colored wastewaters, the toxic and non-biodegradable organic synthetic-dyes cause considerable environmental pollution and they are health risk factors. Therefore, the removal of highly stable organic synthetic-dyes from the aqueous solutions is of prime importance. In the present investigation, the magnetic Flyash-Fe_3O_4-Ag and Flyash-Fe_3O_4-Ag-Cu composite particles have been synthesized via the combination of inverse co-precipitation, UV-reduction, and electroless deposition techniques. The samples have been characterized by using SEM, EDX, XPS, XRD, BET and PPMS techniques to determine their surface morphology, surface elemental composition,

oxidation states, phases, specific surface-area, pore volume, average pore size, and magnetic properties. The samples have been utilized for the removal of three different industrial azo reactive dyes such as Corafix Red ME4B, Corazol Golden Yellow, and Corazol Black BX via adsorption as well as Fenton-like advanced oxidation process (AOP) involving the activation of persulfate anions ($S_2O_8^{2-}$) using different catalysts. A strong correlation between the amount of dye adsorbed on the catalyst-surface and pore volume / size has been established which has been further correlated with the kinetics of dye degradation obtained via the activation of $S_2O_8^{2-}$ anions. The mechanism of degradation of azo reactive dyes has been studied via the radical-trapping experiments. The recycling of catalysts has been demonstrated for five consecutive cycles of dye adsorption and dye degradation. The magnetic separation of catalysts from the treated aqueous solution and the reduction of chemical oxygen demand (COD) levels have also been demonstrated. The magnetic Flyash-Fe_3O_4-Ag composite particles exhibit the best performance in the removal of azo reactive dyes from the aqueous solutions.

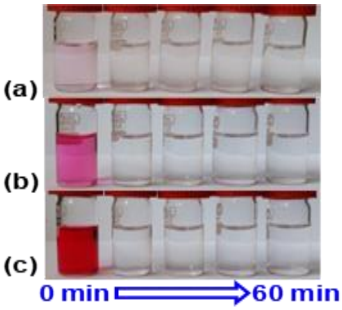

Figure.1. Digital photographs showing the degradation of Corafix Red ME4B dye via the activation of $S_2O_8^{2-}$ anions by using Flyash-Fe_3O_4-Ag magnetic composite particles as catalyst. The initial dye concentration is varied as – 0.003 g l^{-1} (a), 0.03 g l^{-1} (b), and 0.3 g l^{-1} (c).

IT-6

Sono-Photocatalysis for Environmental Remediation

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Photocatalytic oxidation of organic pollutants is a simple and effective method over the conventional treatment techniques for the degradation of contaminants. At the same time, thedegradation of organic pollutants using photocatalystsconsiderably takeslong time for complete oxidation,which is quiteineffective due to the strong adsorption of pollutants on the surfaceof photocatalysts that can easily block the active sites of the photocatalysts.It is well known that mass transport of pollutants on the catalysts surface is yet another issue during the photocatalysis.Recently,the sonochemicalassisted degradation of organic pollutants has been employed as an advanced oxidation processes (AOP) for the removalof organic pollutants. The chemical reactionsinduced by ultrasound in aqueous solution are due to formation of acousticcavitation process. Generally, the ultrasound assisteddegradation pathway is mainly mediated by the oxidative free radicalsand the thermal conditions induced by acousticcavitation. However, the individual effect of ultrasound alonefor the degradation process is relatively low compared to other AOPs. To overcome thedrawbacks associated with individual role of photocatalysis andsonolysis processes, combined effects of ultrasound with photocatalysishas been studied widely. Ultimately, the simultaneoususage of sonolysis and photocatalysis process could possiblyincrease the generation of reactive radicals, thereby increasingthe reaction rate and the physical forces of ultrasound also controls for mass transport limitations. In recent years, several sono-photocatalysts havebeen developed for the degradation of organic pollutants. In several cases, a synergistic enhancementwas achieved while ultrasound was combined with highenergy UV light as a source of irradiation. Recently, we have developed mixed oxide semiconductor photocatalysts that work efficiently under diffused sunlight or natural sunlight for complete degradation of pollutants in the presence of ultrasound. In addition, ultrasound is also usedfor controlled synthesis of metal oxide, metallic nano-paritcles, reducing metal precursors and graphene oxide, etc. Those materials can be effectively used for the degradation of pollutants.

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IT-7

Emerging Contaminants in Water and their Associated Health Effects

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We are not aware of the number of unidentified chemicals to which we are continuously exposed. Scientists and concerned Citizens have been steadily raising awareness about the dangers of thousands of unknown chemicals in our lives. Emerging Contaminants (ECs) are synthetic or naturally occurring chemicals or any microorganisms that are not routinely monitored in the environment but can potentially enter the environment and cause known or suspected adverse ecological and human health effects. ECs are being derived from three broad categories, namely a) Pharmaceuticals (PhACs) b) Personal Care Products (PCPs) and c) Endocrine Disrupting Compounds (EDCs). However, they are not confined to the above and may comprise of nanomaterials (NMs), metabolites of ECs, illegal drugs, engineered genes, etc.Due to anthropogenic activities, ECs are discharged into the environment continuously. The widespread occurrence of ECs in water has a high probability of incorporating crops irrigated with contaminated water and poses a risk to human health upon consumption. ECs can cause harmful impacts on aquatic and terrestrial wildlife and human communities. ECs such as Endocrine-disrupting chemicals cause several reproductive and sexual abnormalities in wildlife and humans. Exposure to these ECs can impair the endocrine system's development and signalling, which are permanent and sometimes irreversible.

The data on ECs and their human risk assessment are, to a great extent missing. The absence of relevant data on the impacts, fate, and concentration levels of emerging contaminants makes it troublesome for governments to control their utilization and manage the already persisting levels in the environment. No laws or mandates illustrate the upper limits of concentrations of emerging contaminants in wastewater discharge, drinking water, or the environment. With advanced analytical instruments like mass spectrometry, it is possible to quantify the emerging contaminants in the drinking waters even at the nanoscale. It is necessary to understand the potential health effects of the individual and combined effects of the ECs for the consumers. There is no significant correlation regarding the relationship between adverse effects of ECs on humans; therefore, we need to evaluate the associations between human health outcomes and emerging environmental contaminants in the future.

IT-8

Novel Photo catalytic Systems towards Remediation of Toxic Aquatic Pollutants

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Water pollution is an emerging problem across the world due to rapid population growth and modern industrialization. Waste water contains organic (such as phenolic derivatives, polycyclic aromatic hydrocarbons etc.) and inorganic compounds (e.g. heavy metals) which can cause serious disorder. Photocatalysis is an advanced oxidation process, considered an effective technique for treating wastewater laden with organic contaminants. The method successfully harnesses abundant and sustainable solar energy for water purification. ZnO and TiO_2 are well known photocatalysts to degrade organic and inorganic pollutants. However, these materials still require modifications with other nanomaterials because these materials absorb only ultraviolet part of sun light due to wide bandgap and the excitons created under the UV light recombinerapidly. In this talk, I will present our group's recent work about visible light activated nanostructured photocatalystsfor removal of dyes, toxic heavy metals and emerging pharmaceutical pollutants. Photocatalytic activity was enhanced through sensitization with carbon/quantum dots, doping withtransition metals and functionalization with metal nanoparticles. Developed materials are reusable, and their nanostructures do not change after repetitive usage. Finally, development of inexpensive prototype photochemical reactor will bediscussed towards continuous flow operation. Our current research focus is to develop visible light activated low-cost and scalable photocatalysts to treat effluent water from industries in particular, textile, pharmaceutical and tannery.

IT-9

Latarite and ferromanganese slag-based low-cost technology for Arsenic and Fluoride removal from contaminated groundwater

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Arsenic and fluoride contamination in groundwater and its health impact on human is a well-known global issue. Extensive studies based on various methods have been explored by numerous researchers in last two decades, but low cost highly efficient technology capable to applyin real is still in search. Most of the methods are costly and suffer by inferior efficiency in real field application. Adsorption using low-cost but effective material is found to be very much effective because of its simplicity in operations. Extensive study has been conducted using abundantly available laterite and an industrial waste namely ferromanganese slag to treat arsenic and fluoride contaminated groundwater [1-2]. These two materials were chemically modified and adsorption capacity for both arsenic and fluoride were improved lots compared to its raw counterparts. Treated laterite showed superior adsorption for arseniate species compared to arsenite, but treated ferromanganese slag (TFS) showed oxidizing power towards arsenite and simultaneous adsorption of arsenic species [2]. The freshly prepared Mn(IV) oxides in TFS were mainly responsible for the oxidation of arsenite into arsenate and simultaneous coprecipitation of Mn(II)with arsenic species in the aqueous medium or also the coprecipitation with the Fe(III) and Al(III) oxides/hydroxides. The Langmuir isotherm model estimates the maximum adsorption capacities at the equilibrium concentration of 10 μg/L are 1.010±0.004 mg/g and 1.614±0.006 mg/g for As (III) and As(V), respectively. Arsenic adsorption kinetics reveals the faster adsorption even at the low arsenic concentration (<100 μg/L) in arsenic-

contaminated groundwater. The As (III) adsorption by TFS was found to be faster compared to As (V) species because; the oxidation step of As (III) increases the active surface sites of TFS for adsorption of more arsenic species. The process for the preparation of TFS is simple, and an efficient adsorbent has been prepared from low-cost industrial waste, namely ferromanganese slag. The preparation method of TFS is easy to scale-up at the industrial scale, which provides sustainable approaches to minimize the industrial waste as well as to produce drinking water from arsenic-contaminated groundwater. A novel mixed treated material is also developed from laterite and ferromanganese slag, which is much superior than treated laterite and TFS alone in terms of maximum adsorption of both arsenic species namely arsenite and arsenate. Fluoride is a contaminant in water which occurs either naturally through the weathering of natural rocks or anthropogenic activities of human. Wastewater from various industries like glass manufacturing, fertilizer, electroplating, and steel producing industries can also contribute excess fluoride in water bodies. Fluoride in drinking water is not completely forbidden. At lower concentration (0.5 to 1.5 mg/L), fluoride is beneficial for bone health, but more than 1.5 mg/L can have various adverse health effects such as dental and skeletal fluorosis. Nano Fe-Al-Mn-oxyhydroxide is prepared from above said two materials and dispersed in chitosan matrix to remove fluoride effectively from contaminated groundwater [3]. Same composite material is also used to prepare mixed matrix membrane to remove fluoride more effectively [4]. Both arsenic and fluoride concentration of treated water is found to be much below the maximum permissible limit of drinking water. These two materials could be very effectively explored to mitigate health impact of affected rural people due to consumption of arsenic and fluoride contaminated groundwater.

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IT-10

Pollution of Antarctic waters and sea-ice from emerging contaminants - a review

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Pharmaceuticals and personal care products (PPCPs) have found their way into the coastal oceans of Antarctica from the wastewaters of Antarctic research stations, tourists and cargo ships. They have caused unknown genetic effects on the already limited bio diverse aquatic flora and fauna of Antarctica. This talk reviews studies as on date that have reported the PPCPs in the wastewaters and the adjacent coastal oceans in the Northern and Southern Antarctica. Fifty-six PPCPs are determined in the wastewaters of Antarctic research stations and 23 in the adjacent coastal waters and sea ice. Concentrations at the levels of micrograms per literis recorded in the wastewaters for UV filters, metabolites, alkyl phenolic compounds and stimulants. Concentrations in the coastal waters and sea ice are several times lower than the wastewater because of dilution and degradation.

IT-11

Biopolymer based metal nanocomposites: a promising plasmonic photocatalyst for environmental application

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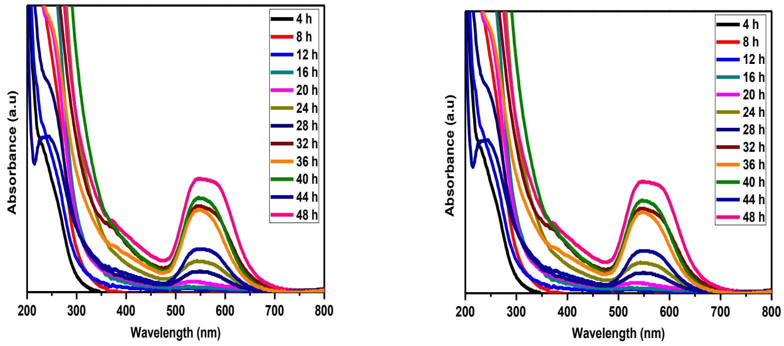
Nanotechnology is a rapidly growing field with its wide range of application in science and technology for the purpose of built-up of new materials with nanometric size. Metal nanoparticles are tremendous notice due to their application in various fields ranging from environmental to medicinal applications such as waste water treatment, cancer therapeutics, biosensing, biodiagnostic and targeted drug delivery. They are advantageous due to their localised surface plasmon resonance (LSPR), surface enhanced Raman scattering (SERS) and enhanced Rayleigh scattering of metal nanoparticles.

Nobel metals such as Ag and Au receiving much attention in the field of nanotechnology due to its surface plasmonic effect. Chitosan is a natural polysaccharide widely being used in environmental and biomedical applications because of its distinctive excellent film-forming ability, high permeability, good mechanical strength, nontoxicity, and biocompatibility, low cost and easy availability. The ecofriendly synthesis of CS-Ag and CS-Au nanocompositesinvolved in the reduction of metal nanoparticles with chitosan. The optical analysis confirms the reduction of Ag and Au nanoparticles with a biocompatible chitosan results with an SPR peak centered at 420 and 530 nm. The XRD pattern of CS-Ag and CS-Au nanocomposite shows face centered cubic structure, and the crystalline size was 20 and 19 nm. The morphological studies prove the existence of spherical metal nanoparticles in the polymeric chitosan matrix.The XPES analysis confirms the presence of metals and all elements of chitosan in the nanocomposite.

The prepared CS-Ag and CS-Au nanocomposites act as a photocatalyst for decolourisation of reactive dye that occurred under visible light irradiation due to surface plasmonic photocatalytic activity of metal nanoparticles. The kinetics was found to follow pseudo-first-order according to Langmuir–Hinshelwood (L–H) model. The CS-Ag nanocomposite also proved to be an excellent antimicrobial agent against both Gram-positive and Gram-negative bacteria. The synergistic effect of chitosan and metals as a composite having nanometric size showed inhibition effect against A549 lung cancer cell line, resulting in potent anticancer activities.



(a) (b)

Figure.UV-Visible absorption spectra of synthesised CS-Ag (a) and CS-Au (b) nanocomposite at room temperature for different time intervals

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IT-12

Investigation on the mechanism of degradation of selected dyes through electron beam irradiation

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Textile units use a number of dyes, chemicals, and other materials to impart colour to fabrics. In the disposal of textile wastewater, intense colour is of very important due to aesthetic deteriorations and obstruction of penetration of dissolved oxygen and sun light into natural water bodies. Therefore they are not easily degradable by ordinary treatments. Ionising radiation is a promising tool for the treatment of textile dye effluents. The radiolysis of water is very well documented and it has been known that it produces OH, e_{aq}^-, H, H_2, H_2O_2, HO_2, H_3O^+ in varying concentrations depending upon linear energy transfer value of the radiation. Studies on the large scale degradation of different textile dyes in aqueous solution through the usage of high energy industrial electron beam accelerator have been initiated at BARC. This is an attempt towards the application of electron beam accelerator for the environmental remediation. In this context, it was obvious to explore the mechanism of such radiation-induced dye degradation, and therefore electron pulse radiolysis studies have been initiated. Radiation induced degradation of textile dyes such as, procion MX-8G (yellow), procion-MX-8B (Fuchsia) and procion-MX-G (Torquoise) and the mechanism of their degradation have been investigated *via* pulse radiolysis under various experimental conditions. It was found that the degradation takes place through the reactions of all primary radicals of water radiolysis (i.e. hydrated electrons, hydrogen and hydroxyl radicals) with the dye molecule and subsequent reactions among the dye intermediates. However, the reaction with the OH radicals was found to be more efficient in degrading these dyes. Kinetics of the degradation of dyes have been studied by measuring the absorbance values of the dyes at their peak position after each irradiation. The radiolytic degradation yields (G_{-dye}) of dyes under various conditions have been estimated from these studies, and it was observed that these yields were very less as compared to the radiation chemical yields of the respective primary radicals. The radiolytic products in the dye solution have been analyzed by the LCMS measurements and are found to be low molecular weight compounds, which do not have absorption in the visible region.

IT-13

Perfluorinated Compounds (PFCs) in Indian Environment

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Perfluorinated compounds (PFCs) are a group of synthetic compounds that enterthe environment via various pathways.Due to stronger carbon-fluorine bonds PFCs are chemically stable, resistant to degradation and persist in the environment with longer half-life.Comprehensive monitoring of PFCs in Indian environment are scarcely reported. A recent study was intended to observe the spatio-temporal trend of PFCs in water, sediment and biota from the rivers in India (Kaveri, Vellar and Tamiraparani). The PFOA and PFOS levels in the Kaveri, Vellar and Tamiraparani River were lower than the reported levels from other countries. Thus, the study suggests that Indian rivers are far less contaminated with respect to PFOA/PFOS than rivers of other countries. Further, the risk assessment needs to be performed to understand the safety status. Since PFCs are bioaccumulative in nature, it is important to gain a better understanding of the environmental and biological risk of PFCs for human and environmental health. Due to ubiquitous contamination of PFCs, further, study warrants detailed continuous monitoring to check the environmental quality.

IT-14

Environmental risks from water pollution

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The framework of environmental risk assessment presents a good overview of the process and provides a good foundation for conducting assessments for individual chemical or physical stressors and single endpoints. This article provides guidance for all types of environmental risk – single stressor as well as multiple stressors. Environmental risk assessment facilitates this approach first by providing a logical method for estimating risks, but moreover, by providing clear links from this method to activities that typically occur in watershed management.

The developed model that determines concentrations of pollutants in water stream is based on dimensionlessanalysis. Fundamentals of the modeling of the pollutants prediction in water stream consist in derivation of function dependency from expressed dimensionless arguments. Dimensionless arguments are stated from variables, which influence the occurrence of pollutants. From this function dependency is possible to obtain values of concentrations of the pollutant in water stream. In generally, this dependency has exponential status. Its transformation to logarithmical coordinate system is equivalent to linear status that allows working with model easier and more simply to determine parameters of linear status. Prediction of nitrogen concentration in water stream was performed in LaborecRiver (eastern Slovakia).

IT-15

Water Demand Management for Industrial and Urban Areas in Eastern Economic Corridor (EEC) Zone in Thailand

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Water demand for industrial and urban areas in EEC zone is rising more in the future when full development is achieved. At present, industrial,

tourism, urban water demand in three provinces of EEC area has reached higher than 800 million cubic meter per year. For next 20 years, the water demand will be higher than 1,000 million cubic meter per year. Therefore, water shortage will occur if without new alternative water resources. The objective of this research is to manage water demand by water reduction, saving and wastewater reclamation for the EEC area.From the research investigation and data analysis for domestic, service and industrial sectors, the appropriate wastewater treatment and recycling for urban area can be suggested for 3 models as a large scale wastewater treatment with water recycling unit; a cluster wastewater treatment with water recycling unit for small-scale community; an individual on-site wastewater treatment and water recycling unit for office and commercial buildings.High potential of water demand management will be achieved for water saving of 600 million cubic meter per year in 2020 when water consumption can be reduced by 15% for industrial sector, 10% for service sector and 10% for agricultural sector together with urban wastewater recycling in the case of 7 large cities in EEC with large volume of wastewater (larger than 40,000 m3/day). Moreover, legal and economic measures are also important to support the water saving and wastewater reclamation policy for efficient water demand management in EEC zone.

IT-16

Visible light promoted copper based photo-Fenton inactivation of bacteria

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Ultraviolet (UV) light has been used for disinfection of water. DNA dimers are formed in the bacteria under UV irradiation that cause inactivation of bacteria. However, DNA repair of the dimers back to normal DNA is possible in bacteria. Mainly, UV light is delivered using a mercury vapor lamp. Importantly, advanced oxidation processes (AOPs) are known to induce irreversible damage to DNA and other components of the bacterial cell by hydroxyl radical that cause permanent inactivation of bacteria. Thus, AOPs are important to achieve the complete inactivation of emerging microbial species. Visible light AOPs, with ability to generate hydroxyl radical, as well as sulphate radical anion have been reported to degradae organic pollutants. Particularly, charge transfer photolysis of metal complexes can eject electrons without undergoing rapid self-

decomposition under visible light, and utilized in AOPs. Illustration of Cu(II) bacterial complex centers as visible light photoactive species for photo-Fenton reactions, and disinfection that promote photo-Fenton like reactions via charge transfer photochemistry will be discussed. The application of LEDs in this photolytic process will be discussed. Abilities of metal to ligand charge transfer, and ligand to metal charge transfer photolysis under visible light for activation of persulphate and hydrogen peroxide, and irreversible damage to the components of bacteria in water will be compared.

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Short Talks

ST-1

Evaluation of the Presence and Removal of Steroid Hormones in a Natural Wastewater Treatment Plant of Gran Canaria (Spain)

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The release of wastewaters containing emerging pollutants into the environment has become a concerning issue for scientists and legislators. Some of those emerging pollutants are steroid hormones which could produce harmful effects over exposed biota when treated or untreated wastewaters reach aquatic ecosystems [1]. Wastewaters are one of the main pathways of introduction of emerging pollutants into the environment because, in most cases, the treatment facilities are not 100% efficient in their removal. This problem is emphasised in rural and isolated areas where conventional treatment systems cannot be set up, and natural wastewater treatment systems could be a great solution [2]. Facultative ponds and constructed wetlands (CWs) are some of these natural treatment systems which could be used in these areas because of their low cost and easy maintenance. Moreover, there is growing interest in combining the two technologies to make a more robust system [3].

In this work, a combined macrophyte pond-CW system was evaluated for the presence of fifteen steroid hormones through the whole system. The studied natural wastewater treatment system is located in a university campus and collects the wastewater produced in university buildings and laboratories, cafeterias and sport facilities. Eight different steroid hormone compounds were detected at concentrations up to several cents of $ng{\cdot}L^{-1}$ in influent samples while the concentrations at the effluent were significantly lower. The pond-CW system showed high elimination rates of steroid hormone residues and this was confirmed by performing the ecological risk assessment of the different sampling points. Final effluents showed a low ecological risk associated with steroid hormones in contrast to the medium-high ecological risks found in the influent samples.

ST-2

Waste water treatment from heavy metal ions by using ion-exchangers

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Purification of industrial solutions and wastewater from heavy metal ions using available, inexpensive ion-exchangers(IE) is a solution to pressing problems of the national economy and environment.From this point of view, the creation and implementation of new effective IE that allow the intensification of the processes of purification of industrial and waste waters of chemical, hydrometallurgical and other industries is of priority importance.Despite the successes achieved in recent years in the synthesis of IE, many of them do not satisfy the tasks and needs of industries in terms of availability, efficiency, and thermal and chemical resistance, which necessitates the search for new IE.Research on the use of secondary raw materials of the industry in order to obtain new IE on their basis, followed by their use in the purification of various waters is the basis for the organization of waste-free technological processes. The aim of this research devoted to the production of new IE based on furfural, as well as the study of their properties in order to find new areas of their effective practical application in the processes of demineralization, purification of various waters at elevated temperatures and aggressive environments. Were achievedsynthesis of a polymer matrix by a chemical mechanism takes place on the basis of nucleophilic substitution between electrons. Quantum chemical calculations in the study of spatial and graphical states of the polymer shows strong stable chemical bondsbetween monomers [1]. Samples of the obtained IE were examined on a scanning electron microscope (SEM-EVO MA 10) at magnifications of 500 times, 1000 and 3000 times. The samples are mounted on the surface of the holder. Then the surface was sprayed with a carbon layer 5-20 nm thick. Each sample was examined by SEM. The determination of the composition of the polymer for identification was also carried out by a high-performance express analysis in a Fourier-IR-spectrometer System-2000 from Perkin-Elmer (USA). Samples of ion exchangers were used in the form of compressed tablets with KBr.The sorption properties of the obtained IE to copper, nickel, cobalt ions were studied depending on the pH-medium and ionic form. The distribution coefficients were found and the selective series of the action of the cation exchanger to the ions of the studied metals was established.

ST-3

Electrocoagulation treatment of groundwater and its comparison with chemical coagulation

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In the present study, the performance of electrocoagulation (EC) for hardness removal from groundwater is explored and compared with conventional chemical coagulation (CC). The effect of various parameters such as current density, electrode type, pH and electrolysis time on hardness removal efficiency (HRE) has been studied. In EC, different combinations of electrodes such as Al-Al, Al-Fe, Fe-Al and Fe-Fe were used. Aluminum sulphate (Alum) was used as the coagulant to compare hardness removal efficiencies obtained by EC and CC. It was found that EC treatment gave better removal efficiency as compared to CC method. The HRE 86.7% was obtained at an electrolysis time of 3 hr at 1 A current using Fe-Al electrodes. These results indicate that EC process can be effective in removing water hardness. Further, Alum coagulation was found ineffective to remove hardness for retention time of 2 hours. (Upto 6 %).

ST-4

Removal of radionuclides from acidic radioactive waste using inorganic ion-exchangers

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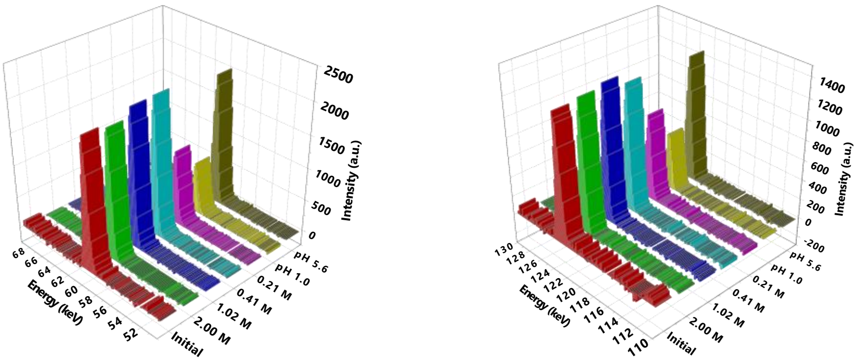
This paper details the feasibility of utilizing inorganic ion-exchangers, such as Ammonium Molybdo-Phosphate (AMP) and Niobium-doped Crystalline silicotitanate (Nb-CST), for the removal of radionuclides from

waste effluents generated in the spent fuel reprocessing plants. The study includes the effect of acidity on the selective removal of radionuclides from High-level Liquid Waste (HLW). Comparatively large monovalent cations (K^+, Rb^+, Cs^+, Tl^+, Hg_2^{2+} and Ag^+), thorium, neptunium (+4 and +5), uranium, bivalent and rare earth elements absorb on (AMP) or (Nb-CST) by replacing ammonia or sodium, respectively [1-3]. Among these elements studied, Cs^+ shows a stronger affinity for both ion exchangers in condition of high acidic. The phase purity and thermal stability of both ion exchangers were studied using an X-ray diffractometer (XRD) and simultaneous thermal analyzer (STA: Netzsch STA 449 F5 Jupiter). The acidity of the test solution was adjusted using diluted NaOH and HNO_3 solution. The separation experiments were performed with the diluted HLW (test solution) with a liquid-to-solid ratio of 100. In separation studies, the mixture was agitated for 60 minutes and allowed to settle for 12 hours. The removal efficiency of ^{137}Cs, ^{134}Cs, ^{154}Eu, ^{241}Am, and ^{125}Sb was investigated based on the radionuclide's initial and final concentration (activity–Ci/L) analyzed using HP-Ge-gamma-Spectrometer. AMP efficiently extracted ^{241}Am and ^{154}Eu in the acidic region of pH5.6>H^+<0.21 M (Fig. 1); there is no signature below pH 5.6, which may be due to the low stability of AMP in alkaline solution. In Nb-CST, a gradual increase of ^{241}Am and ^{154}Eu uptake was observed at <pH 1.0. It reveals that Nb-CST is stable and can be used in alkaline conditions. Both the ion exchangers extracted Cs in a single contact in all acidic conditions. Under all studied conditions, there was no uptake of ^{125}Sb with AMP or Nb-CST. From the above studies, it is observed that both AMP and Nb-CST are good at removing the radionuclides ^{241}Am, ^{154}Eu and Cs from HLW at different acidic conditions (>5.6 pH).



(a) **(b)**

Figure 1. HPGe spectrum of AMP effluent (a) ^{241}Am and (b) ^{154}Eu

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ST-5

Removal efficiency of selected parameters of a brewery wastewater treatment plant in Kombolcha, Ethiopia

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The process of brewing involves the production of beer by the fermentation of malted grains with yeast and water resulting in huge amounts of wastewater. Brasserieset Group Industry (BGI). Kombolcha, Ethiopia has been a continued source of pollution to the nearby Borkena River over the years. Surrounding residents depend on this water to fulfill their domestic purposes as well as for small scale farming. In spite of the fact that there is an effluent treatment plant in place, efficiency of the BGI brewery wastewater treatment plant has never been investigated and there is no documentation of their compliance to standards. Thus, the goal of this study was to evaluate the removal efficiency of certain key parameters after their treatment process. Compositewastewater samples were collected from the inlet and outlet of the treatment plant using sterilized plastic bottles from February to March 2020 and selected physico-chemical parameters were analyzed. The obtained results showed that treated brewery wastewater had mean values of Biochemical Oxygen Demand (BOD_5) (23.3±12.3mg/L),Chemical Oxygen Demand (COD) (111.9±33.8mg/L), Total Suspended Solid (TSS) (725.9±501.7mg/L), Total Nitrogen (TN) (92.4±21mg/L), Total Phosphorus (TP) (12.8±5.1mg/L) and Nitrate Nitrogen (NO_3-N) (22.5±5.2mg/L). The treatment plant removed high amounts of organic material such as BOD_5 (98.6%) and COD (96.7%), and only small amounts of TSS (57.2%), TP (49.8%) and TN (19.9%) and NO_3-N (9.3%) were removed. The results indicated that apart from BOD and COD, the treatment was not effective for other parameters such as the nutrients and did not meet the Ethiopian permissible discharge limits. This has led to damaging effects on ecology and habitats at the downstream areas

of Borkena River. It is therefore advised that the industry enforces stricter regulations or improve their treatment efficiency with the inclusion of state or the art methods.

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ST-6

Assessing the status of ground water quality in tannery industrial effluent contaminated areas of Ambur taluk of Vellore district

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Groundwater is ultimate, most suitable fresh water resource with nearly balanced concentration of the salts for human consumption. Safe drinking water is primary need of every human being. Ground water was considered to be very clean and safe in past but nowadays it is getting polluted with rapid growth of urban and industrial activities, particularly in the developing countries where proper waste disposal measures are not followed. Groundwater pollution is an introduction of certain pollutants into the groundwater which reduces the quality of groundwater making its use very limited, or in some cases impossible many different chemicals and various synthetic products we use today are usually the main causes of groundwater pollution (Jamshidzadeh and Mirbagheri, 2011). In the current study, the Amburtaluk, was assessed for its water quality status. In this area, majority of the industries are tanning and leather Industries. In the present study, 20 locations have been chosen within the Amburtaluk, for monitoring the ground water quality for assessing the pollution potential. The water samples were collectedand analyzed to determine the various physic-chemical parameters like concentration of pH, Electrical Conductivity, Turbidity, Total Dissolved Solids, Chlorides, Chromium, Total Hardness and Sulphatesin the ground water. The results were compared with the Bureau of Indian Standards (BIS) to check whether the samples are

within the prescribed limits. The water quality index was also calculated to conclude the water quality status during the sampling period (Pei-Yue*et al.*, 2010). Among the 20 locations collected 3 locations (Chinnavarigam, Ayithumpattu, Somalapuram) showed all the parameters with in the permissible limit and the water quality is excellent. Except two location near to tannery areas the ground water quality is very poor not suitable for drinking purpose. The reaming other samples were showed all the parameters within the permissible limit but not suitable for drinking purpose.

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ST-7

Efficiency of Hexavalent Chromium removal using Ferric Chloride treated water hyacinth biochar

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Biocharprepared from water hyacinth (*Eichhornia crassipes*) has been widely explored to remove heavy metal pollutants from water in recent days. Hence, the present work was carried out to improvise the study by enhancing the biochar using ferric chloride for hexavalent chromium removal. Biochar was modified with 1 M ferric chloride solution and tested for sorption efficacy. Characterization of the biochar was done to study the surface properties for enhanced sorption. The pH of pristine water hyacinth biochar (P-WBC) was found to be greater than the point of zero charge (pH_{ZPC}) which indicates the dominance of negative charges. This might decrease the sorption by creating repulsion between negatively charge biochar surface and negatively charged anions [Cr (VI)](Zhu*et al*, 2012). Incontrast, point of zero charge (pH_{ZPC}) was greater than pH in ferric chloride treated biochar ($FeCl_3$-WBC) supporting the hexavalent chromium adsorption in a greater manner favoured by attraction of positive surface charge. Specific area of $FeCl_3$-WBC (423 m^2g^{-1}) was 67.19 % greater than P-WBC (253 m^2g^{-1}). Batch study was

conducted to understand the effect of pH and concentration on adsorption. It confirmed that sorption is maximum at pH 2. Increasing concentration decreases the adsorption due to lack of sites at higher concentration (Premalatha*et al.*, 2018; Li*et al.*, 2020). Isotherm study showed that adsorption is favoured by monolayer sorption. This is because correlation coefficient is higher for Langmuir isotherm. Maximum adsorption capacity of $FeCl_3$-WBC (41.6 mg g^{-1}) was greater compared to P-WBC (35.7 mg g^{-1}). This reveals that $FeCl_3$-WBC sounds good in hexavalent chromium ion sorption.

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ST-8

A novel Calixresorcinarene derivative: an efficient extractant for Vanadium ions

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A novel resorcinarene derivative N-p-chlorophenyl-calix[4]resorcinarene-hydroxamic acid (NPCPCRHA) is reported for the extraction and preconcentration of Vanadium (*V*) ions from environmental samples in the presence of numerous interfering ions. The determination of Vanadium (*V*) ion in the extract is done using UV-Vis absorption spectrophotometry and inductively coupled plasma atomic emission spectrometry (ICP-AES). Significant parameters for the extraction (pH, solvent effect, mixing time and concentration of reagent) are optimized. Calculation of thermodynamic parameters as well as transportation studies have also been carried out for the metal complex. The validity of the method was ensured by determination of vanadium (*V*) ions in some environmental samples, biological samples, and some standard reference materials from NIST and BCS.

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ST-9

Physiological and biochemical changes in *Chaetoceros lorenzianus* on exposure to antifouling biocides, Chlorine and Chlorine dioxide

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Antifouling biocide, chlorine is extensively used to control biofouling in marine waters. But formation of chlorination by-products raises environmental concern. In this view, chlorine dioxide would be suggested as one of the ideal biocides. But inadequate toxicity data of chlorine dioxide on non-target organism at anticipated concentrations withdraw its use over chlorine. In this aspect, microalgae, *Chaetoceros lorenzianus* was used to study the potential environmental effects of residual concentrations of chlorine and chlorine dioxide. The physical changes (analysed by cell viability) and biochemical changes (by antioxidant enzymes) were used as endpoints. Cells were treated with residuals of biocide concentrations at 0.1, 0.2, 0.5 and 1 mg/L for 30 min. The enzyme activities were analysed during exposure and post-exposure period. Membrane damage was increased along with enhanced cellular defence during action of biocides. The trend of higher enzyme activities was observed during post exposure period with sufficient improvement in membrane viability for chlorine but not for chlorine dioxide. The data indicated that chlorine up to 0.5 mg/L and chlorine dioxide up to 0.2 mg/L imparted only sub-lethal toxicities and does not damage the cell beyond its endurable capacity. The results further suggested that *C. lorenzianus* cells were able to protect themselves against biocide attack by enhancing activities of antioxidant enzymes at these sub-lethal

concentrations, but inhibition of the same at higher concentrations along with complete loss of membrane integrity.

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ST-10

Treatment optimisation of Tc^{99} rich low level radioactive waste containing organics and Ru^{106} by chemical precipitation

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The alkaline low level radioactive liquid waste (LLW) generated during the ion exchange treatment of intermediate level radioactive liquid waste (ILW) at Waste Immobilisation Plant (WIP), Kalpakkam is transferred to Centralised Waste Management Facility (CWMF) for further treatment. After the treatment, it is discharged to sea. Major radionuclide found to be present in this stream is Tc^{99} (with specific activity ~ 1000-7000 Bq/mL) with small quantities of Cs^{137}, Ru^{106} and traces of Sr^{90}- Y^{90} and Sb^{125}. A suitable chemical treatment has been optimized using SO_3^{2-} 80 ppm, Fe^{2+} 375 ppm, $(Fe(CN)_6)^{4-}$ 60 ppm, Fe^{3+} 50 ppm at a pH 8.5. Ferrous hydroxide precipitate under reducing conditions removes radionuclides Tc^{99}, Ru^{106}, Sb^{125} present in anionic forms [1]. The treatment procedure has been implemented in the plant successfully. The presence of organics like Dibutyl Phosphate (DBP) and its degradation products in the wastes causes interference in the decontamination of Tc^{99} using the above composition. This paper discusses the characterisation of this waste stream (Table-I) and its DF under optimised chemical dosing & different pH conditions (Fig.1). pH was analyzed using Eutech Cyber-Scan pH510 pH-meter and Total Dissolved Solid (TDS) content was analysed gravimetrically. Radiometric analysis of gross β was done with end window GM-tube based counter and of Cs^{137} using a Single Channel Analyser with NaI(Tl) detector. Ru^{106} was analysed using Gamma spectrometry with HPGe detector. Tc^{99} was analysed by extraction in

0.8% Tetraphenylarsonium chloride (TPAC) in nitrobenzene followed by beta counting in GM counter. A two stage chemical precipitation with a chemical dosing of SO_3^{2-} 80 ppm, Fe^{2+} 375 ppm, $(Fe(CN)_6)^{4-}$ 60 ppm, Fe^{3+}50 ppm at an optimised pH of 8.5 as first stage followed by addition of SO_3^{2-} 80 ppm, Fe^{2+} 250 ppm , Cu^{+2} 80 ppm, Fe^{3+} 50 ppm at pH 8.5 as second stage to the first stage supernatant yielded net decontamination factors (DF) of 240.4, 290, 67.5, 34.5 w.r.t. Gross β, Tc^{99}, Cs^{137} and Ru^{106} respectively. The percentage removal of Tc^{99}, Cs^{137} and Ru^{106} was found to be 99.6, 98.5 & 97 respectively. Pre-treatment of waste by acidification to pH 2 and addition of 150 ppm Fe^{3+} and the supernatant being subjected to a combined chemical precipitation yields a DF of 37.7, 8.3, 141.7, 1.86 w.r.t. Gross β, Tc^{99}, Cs^{137} & Ru^{106} respectively. Addition of Fe^{+3} leads to formation of Fe^{+3}-DBP complex and thereby a faster settling. It removes the interference of organic in removal of radionuclides during chemical treatment. A further precipitation with the chemical dosing of second stage will aid in the removal of remaining Tc^{99} & Ru^{106}.

Table.1. Characteristics of LLW

pH	7.43
TDS	8.24%
Gross β	6492 Bq/mL
Cs-137	87.8 Bq/mL
Alpha	1.36 Bq/mL
Tc-99	6084 Bq/mL
Ru-106	192 Bq/mL
DBP	211 ppm

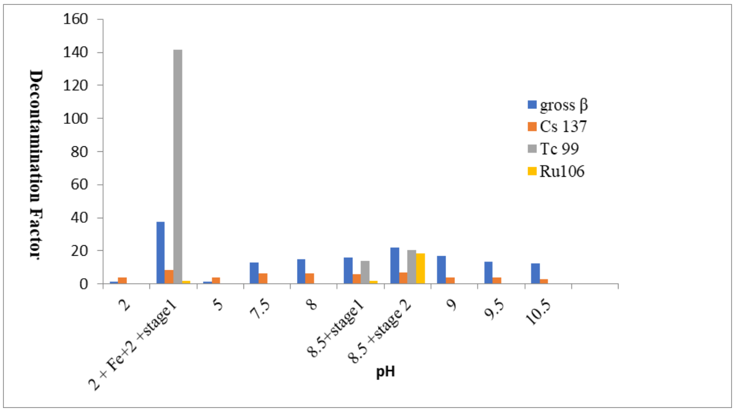

Figure.1. Effect of pH on DF

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ST-11

Water resource issues of Uzbekistan

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According to the World Resources Institute, Uzbekistan ranked 25th out of 164 in the ranking of countries suffering from water stress. For Uzbekistan, water shortage is a very urgent problem, given that its shortage in a number of regions of Uzbekistan, in particular in Karakalpak, can lead to a social and environmental crisis. Already today there is a lack of water not only for agricultural purposes, but also for the household needs of the population. Hydropower resources of Uzbekistan make up only 4.92% of the entire territory of the country, total water resources - 50-60 km^3 per year, of which only 12.2 km^3 are formed on the territory of the republic, and the rest of the water volume comes from outside - from the Tien Shan and Pamir mountains. Altai, from melting snows and glaciers in summer.The problem of the Aral Sea, which acquired political meaning in the late 80s, caused by inefficient and irrational use of water resources for irrigation, concerns not only Uzbekistan but also neighboring countries. 135-145 million tons of salt are dumped into the Amu Darya and the Syr Darya annually, making it about 17-20 tons for 1 ha of irrigated land per year. If by 1960 the average annual river flow into the Aral Sea was about 55 km^3 or 45-50%, then by 1990 the inflow had decreased to 6-12 km^3 was approaching zero in dry years. Currently, sea level is declining at a rate of about 0.5 m per year, reaching 37.0 m; the sea surface area has been reduced to 32,000 km^2; salinity increased to 40 or more g/l and is still growing.Joint efforts of all countries of Central Asia can prevent further drying up of the Aral Sea but, unfortunately, the countries of the region do not go beyond the signing of common declarations and memorandums.[1]The industry of Uzbekistan draws 1.2 km^3 of water annually, of which only 0.58 km^3 is consumed. Almost half of the withdrawn water is returned in the form of industrial effluents, which pose an ecological threat to the environment. Five hundred and two industrial enterprises discharge about 0.14-0.17 km^3/year of poorly treated wastewater containing salts of heavy metals, fluorides, phenol, oil products, the entire nitrogen group, as well as biological and other pollutants specific to certain industries, into surface reservoirs. From 1 to 5% of industrial water from one hundred enterprises is discharged into watercourses without any treatment.The collector-drainage network is considerably polluted in a zone of farmland with high soil salinity where the mineralization of water is higher in comparison with the standard norms by 3-5 times. The contents of biogenic mineral, organic substances, mineral oil and heavy metals by 3-5 times is higher than standard norms.

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ST-12

Influence of UV radiation on the spectral properties of herbicide Mecoprop

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Every year thousands of organic substances are synthesized for subsequent use as insecticides, herbicides, detergents, etc. They remain in the environment for a long time, and when they get into the atmosphere or into water sources they can lead to serious ecological consequences. The application of herbicides plays an important role in a productivity increase in agriculture. It should be noted that production, application, and assortment of pesticides, including herbicides, increases in the world every year. From the total production and application of pesticides in the world, herbicides account for more than 50 % [1]. Over the last decades, the application of pesticides and herbicides in agriculture has led to a significant increase of stable organic compounds in natural water. A study of transformations of stable toxic compounds in nature and a choice of optimal methods of herbicide utilization are important problems of environmental protection and rational use of natural resources. Ultraviolet (UV) radiation with quantum energy comparable to the energy of a chemical bond is the unique tool for initiating and performing many physical and chemical processes on the surface and in the volume of various media. UV radiation can be used not only for disinfection of water and air, that is, for removal of pathogenic microorganisms, but also for decomposition of complex organic compounds. This method can be used both independently and in combination with other technologies [2]. In this regard, a study of the efficiency of new UV radiation sources that may influence various electronically excited states of organic molecules becomes relevant. Such sources are exciplex lamps that are increasingly used for toxicant photolysis [3].The influence of UV radiation on the spectral properties of 2-methyl-4-chlorophenoxy propionic acid (herbicide mecoprop) in water solutions has been studied. As the UV radiation source, the pulsed excilamp on working KrCl molecules (222 nm) was used. It was established that the process of phototransformation of herbicide occurred faster when the concentration decreased. The use of the flow-through photoreactor led to a more effective degradation of the examined herbicide than irradiation in the stationary mode. The degree of photodegradation depended on the exposure time. The method of ecotoxicant photodegradation with application of UV radiation sources can be used both independently and in combination with other modern technologies. Among the complex methods, technologies based on combined oxidizing processes [4] or advanced oxidation processes (AOP) are most promising.

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ST-13

Removal of industrial azo reactive dyes from aqueous solution using persulfate and hydrogen peroxide as mixed oxidants activated by flyash-Pd

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Azo reactive dyes, which contribute to about 70% of all used dyes, are difficult to degrade via the common physical processes such as the adsorption and coagulation-flocculation. Moreover, latter mechanisms result in the generation of solid waste which requires further handling, treatment, and reuse. Even though the Fenton-like advanced oxidation processes (AOPs) are found to be effective for the degradation of dyes from the textile wastewater without the generation of solid waste, they are very expensive processes. The cost reduction of AOPs is highly essential and can be achieved by the use of mixed oxidants and recyclable catalysts. By mixing the oxidants such as the costlier hydrogen peroxide (H_2O_2) and cheaper persulfate ($S_2O_8^{2-}$) to generate both the non-selective ($^\bullet OH$) and selective ($SO_4^{\bullet -}$) radicals, it is possible to bring the cost down while maintaining higher activity during the treatment of textile effluents which contain cocktail of highly concentrated dyes. Hence, in this work, Flyash-palladium (FA-Pd) composite particles have been synthesized via the electroless process and characterized by using the SEM, EDX, and XPS. The composite particles have been utilized as catalyst for the degradation of industrial azo reactive dyes from the aqueous solution by using H_2O_2 and $S_2O_8^{2-}$ as mixed oxidants. The values of different parameters such as the oxidant molar ratio, oxidant dosage, pH, and catalyst dosage have been optimized for three different azo reactive dyes (Corafix Red ME4B, Corazol Black BX, Corazol Golden Yellow). At the end, the simultaneous degradation of all three reactive dyes in the aqueous solution have been demonstrated by using the most optimum conditions common to all three reactive dyes.

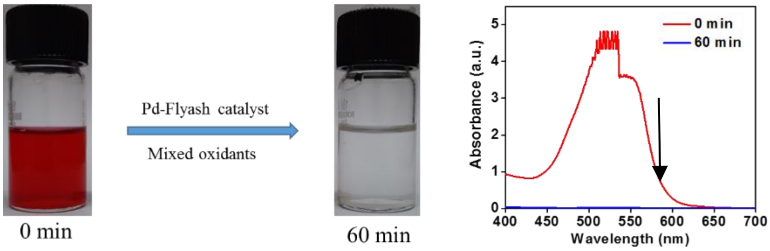

Figure.1

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ST-14

Effect of treated paper mill effluent on soil properties, yield and quality of Turmeric

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A field experiment was conducted to study the influence of press mud compost, MLSS and treated papermill effluent on turmeric. The experiment has been laid on a randomized block design with BSR-1 as test variety with 8 treatments *viz.*, T_1 - 100 % RDF (Recommended Dose of Fertilizer) + well water; T_2 – 50%RDF + 50% Pressmud compost + well water; T_3 – 50%RDF+50% MLSS (Mixed Liquor Suspended Solids) + well water; T_4– 50% Pressmud compost +50% MLSS +well water; T_5 – 100% RDF + Effluent; T_6 – 50%RDF+50% Pressmud compost+ Effluent; T_7 – 50%RDF+50% MLSS + Effluent and T_8 – 50% Pressmud compost +50% MLSS + Effluent. The available nitrogen, phosphorus and potassium content of the soil was significantly higher in the vegetative stage of turmeric growth and recorded lower in post-harvest sampling. The available nitrogen, phosphorus and potassium content of the soil was significantly higher (273 kg ha^{-1}, 16 kg ha^{-1}, 265 kg ha^{-1}) in 50% RDF + 50% Press mud compost + effluent (T_6). The yield of rhizomes was influenced by the different treatments and maximum was recorded in T_6 (36 t ha^{-1}) which received 50% RDF + 50% pressmud compost + effluent. The T_6 which received 50% RDF + 50% pressmud compost + effluent recorded the highest curcumin content of 3.9% which was on par with T_1 (3.8%). The effluent irrigated treatments performed better compared to the well water irrigated treatments with significant increase in the soil nutrient availability to the crop which was resulted in higher yield of turmeric crop. The treated paper mill effluent irrigation with 50% pressmud compost and 50% RDF can be suggested for obtaining highest turmeric yield of 36 t ha^{-1} which is 20 % higher than 100% RDF with well water.

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ST-15

Combination of ion exchange solid phase and ICP-MS for simultaneous determination of cytostatic Platinum compounds in wastewaters

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Cytostatic platinum compounds (CPCs) are anticancer pharmaceuticals used in 50% of cancer patients[1]. The main CPCs are three: cisplatin (Cis-Pt), carboplatin (Car-Pt) and oxaliplatin (Oxa-Pt). After chemotherapy treatment, these compounds are excreted by patients in both forms, as parent products and as active metabolites, reaching the wastewater and therefore, the wastewater treatment plants. In addition, these compounds have been demonstrated to have important side effects at trace level for different organisms. For instance, mussels exposed to 0.1 $\mu g \cdot L^{-1}$ of Cis-Pt experimented neurotoxicity and DNA damage[2].

CPCs have been detected in effluents from hospital by inductively coupled plasma tandem mass spectrometry (ICP-MS)[3], detecting concentrations of up to 762 $\mu g \cdot L^{-1}$ of Pt[4]. However, their determination in wastewater treatment plants (WWTPs) has not been performed. The direct injection of CPCs into the ICP-MS do not allowed to achieve the limit of quantification needed to measure them in WWTPs and an extraction and preconcentration procedure is required. The inconvenient is that CPCs are very polar compounds that cannot be efficiently extracted by conventional SPE cartridges.

The objective of this work was to combine the extraction by ion exchange SPE cartridges and ICP-MS for the determination of CPCs in WWTPs. In the optimal conditions, a relative recovery of 47 – 90% in wastewater was obtained, with relative standard deviations lower than 15%, without almost matrix effect and achieving the lowest limit of quantification to date (0.74 $ng \cdot L^{-1}$). Finally, the method was used for the determination of CPCs in wastewater from a WWTP and hospital wastewaters of Gran Canaria Island (Spain). Concentrations of Pt ranging from 3.97 – 75.79 $ng \cdot L^{-1}$ were detected in WWTPs and from 81.94 – 13913 $ng \cdot L^{-1}$ in hospital effluents.

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ST-16

Impact of land use changes on subsurface drainage flows and the landscape scale pollution of subsurface water

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Life sustaining activities like agriculture as well as livelihoods like commercial agriculture and industry can lead to pollution of water bodies, soil as well as air. Drainage has an important role to play in controlling the pollution of water. Faster drainage reduces the concentration of contaminants and also allows greater aeration by distributing the contaminants over a larger volume of soil. Hydraulic conductivity is a key soil characteristic that controls the drainage characteristics of a watershed. Kerala is one of the top ranked regions of the world in hosting a large population density over a large area. Population pressure impacts soil physical characteristics. The impact of land use changes on subsurface soil water and subsurface drainage flow is examined.

ST-17

Remediation of Fluoride from Aqueous Media by Using Low Cost Porous Nanoadsorbent

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Fluoride is a non-metal that can be found in groundwater posing a serious environmental health hazard world-wide. Excess fluoride in groundwater is a worldwide problem and fluorosis can occur anywhere. Thus, it is essential to regulate the fluoride concentration level in drinking water and monitor at a permissible limit. To address this issue, the synthesis of effective porous nanoadsorbent has been reported herein via hydrothermal method for defluoridation from water. The as-synthesized nanoadsorbent were characterized by different microscopic, spectroscopic and diffractometric analysis. The treatment of the experimental data with different isotherms and kinetic models suggests that these nanoadsorbents are efficient and exhibited very high adsorption capacity compared to similar adsorbents. The effect of various parameters such as the concentration of adsorbent, initial pH and the presence of co-existing ions has been well investigated. The as-synthesized adsorbents are reusable without losing much of its adsorption capacity.

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ST-18

Oxidative degradation of emerging micropollutant, Naproxen found in wastewater

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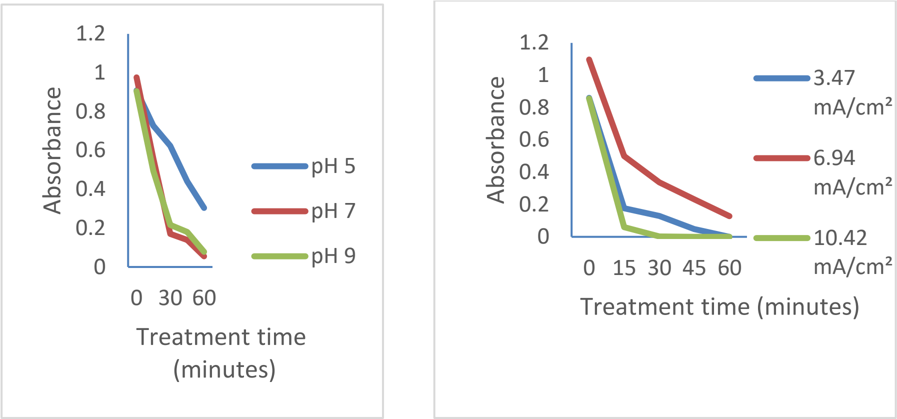
Advanced Oxidation Processes (AOPs) are known for their clean, sustainable and efficient removal of organic pollutants in wastewater. Electrochemical Oxidation is one among them. In this study, Naproxen, a non-steroidal anti-inflammatory drug (NSAID) was used as a model compound for degradation of emerging micropollutants. Graphite is made of carbon and degradation using it is environmentally sustainable. Sodium chloride was used as the electrolyte because it produces potent oxidants and it is naturally found in wastewaters. 20μM was the target compound concentration. pH, current density, treatment time, and electrolyte concentration was the variables used for the assessment of optimum condition for degradation. Hydrochlorous acid-induced degradation and anodic oxidation mechanisms are analyzed. Hydrochlorous acid and hydroxyl radicals were found to be at work for the oxidation of Naproxen. UV-Vis spectra analysis showed the initial peak for Naproxen at 230 nm. Within the treatment time of 60 minutes, 96.7% decrease was noted in the peak. The electrolyte concentration of 1mM NaCl with the current density of 10.42 mA/cm^2 at acidic pH was found to be the most favourable for the degradation of naproxen. Increase in electrolyte concentration had a dampening effect on degradation. Increasing treatment time and current density were found to cause damage to the surface of the graphite electrodes.



(a) (b)

Figure.1. Comparison of UV-VIS absorption graphs at (a) different pH and at (b) different Current densities.

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ST-19

Fate of Coronavirus in water and waste Water – A global concern

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The COVID19 pandemic has taken over our lives and is changing the way we interact in public spaces. Mask wearing and social distancing have become a part of daily life around the world in order to reduce human contact and curb the spread of this virus. Prior knowledge about the coronavirus has shown that it has the ability to travel through droplets in the air and infect the respiratory system of exposed individuals. While a large emphasis is being made in detecting SARS-Cov2 in air droplets, studies are showing the presence of the virus in wastewater as well. In order to holistically treat this virus,we must look into the coronavirus as being a water contaminant. There is a need to study whether the SARS-Cov2 has the ability to contaminate our

drinking water, and it can ultimately enter into our food chain. If this were to happen globally, then there will be a multitude of individuals who are exposing themselves to the virus unknowingly.By doing so, the numbers of infected individuals will keep climbing and this pandemic will be prolonged even more. This should be a cause for concern, which must move us to focus the fate of coronavirus and other emerging pollutants in water sources and wastewaters.

ST-20

Phytoremediation coupled microalgal cultivation-a novel and promising approach for sustainable biodiesel production

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Microalgae have gained enormous attention as a sustainable feedstock for biodiesel production because of their higher lipid content, carbon neutrality and zero competition with arable land in comparison to the land based biodiesel feedstock (Li et al., 2008). However, microalgae are unable to accomplish sustainable large-scale algal biofuel from an economic and environmental perspective due to the high reliance on freshwater and nutrients for cultivation (Chisti, 2007). Successful commercial algal growth demands the availability of locally abundant strains with high biomass and lipid productivity, suitable fatty acid profile and maximum survival rate. Marine diatom *Thalassiosira weissflogii* isolated from Cochin estuarine system were screened for biodiesel potential on the basis of FAME profiles and growth kinetic parameters. Biomass productivity and lipid productivity recorded were 10.78±0.05 and 37.76±0.34 mg L^{-1} day^{-1} respectively. It also showed higher lipid content (32.84 ± 0.06 %). Moreover, fatty acid (FA) profiles showed very low levels of PUFAs and a fair balance between saturated and mono unsaturated FAs. Fuel characteristics of *T. weissflongii* like cold flow properties, oxidative stability, ignition quality, saponification value etc. were well within the standard specifications for biofuel. Previous studies established that *Thalassiosira weissflogii*has great affinity for metal ions (Ben-Chekroun and Baghour, 2013) producing phytochelatins and helps in minimizing or decreasing the toxic effects of heavy metal contamination. Thus, coupling of microalgae with phytoremediation is a novel and promising approach for cost-effective microalgal biodiesel production.

ST-21

Visible-light sensitive Ce MOF / mc $BiVO_4$ type II staggered heterostructure for photocatalytic wastewater treatment

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An n-type Ce MOF co-catalyst based Ce MOF/BiVO4 3D heterostructure was successfully synthesised using facile hydrothermal technique and visualised through FESEM. The superiority of this 3:1 composite was evaluated against removing methyl orange methylene blue and phenol. The results showed that 94.5%, 86.23% and 56.35% degradation was achieved for respective compounds. Density function study and molecular modelling was carried out to understand the electronic structure and chemical bonding environment of ntype BiVO41 semiconductor. Further, the detailed electrochemical study was performed to understand the role played by Ce MOF as co-catalyst in enhancing the charge carrier lifetime in the composite. Band edge position calculation backed by time resolved PL study revealed the formation of type II staggered heterojunction which give rise to a built-in-electric field that enhance the semiconducting property of the composite2. Active species trapping shows the major effect of h+ in the removal of pollutant from water3. These pollutants are proven to be water contaminants that threaten the environment and possess a serious health hazard. Thus the advance oxidation imparted by the type II 3D micro-heterostructure photocatalyst can be a well suitable path to tackle these burning issues.

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ST-22

Assessing the effect of Pre-Sown and Post-Sown application of distillery spentwash on the nutrient uptake of Maize crop

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A large network of distilleries established in India utilizes molasses, by product of sugar industries for alcohol production. These distilleries emit huge quantities of distillery spent wash (DSW) which causes a serious risk and search for effective treatment of DSW (Hiremath and Joshi, 2020). Spent wash contains high amount of nutrients like nitrogen, phosphorus, potassium, calcium and sulphur (Santiago Mahimairaja and Nanthi Bolan, 2002). In addition, it contains sufficient amount of micronutrients like iron, zinc, copper and manganese. This dark colored, acidic, high BOD and COD liquid consisting of biodegradable organics and inorganics constituents, it could not be disposed off directly into water bodies. Hence this present investigation was undertaken to assess the possibility of utilizing the distillery spent wash as one time application for field crop (Maize) and to study the effect of pre-sown and post application of distillery spent wash on the nutrient uptake of maize crop.

A field experiment was conducted with different doses of distillery spent wash along with inorganic nitrogen (N) and phosphorus (P) fertilizer without potassium (K) using Maize variety COH (M) -5 as test crop at Research and Development Farm, M/s Sakthi Sugars Limited., Sakthi Nagar, Erode district, Tamil Nadu. The experiment was formulated with seven treatments with three replications, laid out in Factorial Randomised Block design. The method of application of distillery spent wash *viz.*, M_1: pre-sown (before sowing) and M_2: post-sown (30 days after planting in standing crop as fertigation) was taken as Factor A. The factor B was different doses of distillery spent wash *viz.*, 25, 50, 75,100 Kilolitres (KL) ha^{-1} along with recommended dose (RD) of NP for four treatments and 75 % of recommended dose of NP for two treatments and

RD dose of NPK was treated as one treatment (control). Results of the field experiments revealed that the application of distillery spent wash @ 100 KL ha^{-1} + RD-NP (T_5) and distillery spent wash @ 100 KL ha^{-1}75% RD-NP (T_7) significantly increased the soil N, P, K, Ca, Mg and Na and micronutrients *viz.*, Cu, Fe, Zn and Mn after the harvest of maize. Application of DSW (T_5) registered the highest N uptake (203.4 kg ha^{-1}), P uptake (55.9 kg ha^{-1}), K uptake (705.0 kg ha^{-1}) compared to T_1 which recorded the N uptake of 128.1 kg ha^{-1}, P uptake of 36.7 kg ha^{-1} K uptake of 142.0 kg ha^{-1} . The treatment T_5 registered the maximum Calcium (Ca) and Magnesium (Mg) uptake of 87.8 kg ha^{-1} and 51.4 kg ha^{-1} respectively. An increase of 75.3, 19.2, 563, 33.0 and 19.8 kg ha^{-1} of N, P, K, Ca and Mg uptake, respectively were observed in distillery spentwash applied @ 100 KL ha^{-1} + RD-NP over the control. These could be due to more absorption of nutrients by the crop, supplied through nutrient rich distillery spent wash. Results corroborates with findings of Murugaragavan (2002). Thus the land application of distillery spent wash offers benefits of water pollution control and its utilization for agricultural production

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ST-23

Development of Antifouling Ultrafiltration Membranes from Titanium Dioxide Incorporated Polyphenylsulfone for Greywater Treatment

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Greywater treatment has gained significant mileage of late owing wide variety of uses such as irrigation of plants, domestic, laundry and other industrial applications. The present work focused on the synthesis of titanium dioxide (TiO_2) incorporated polyphenylsulfone (PPSU) mixed matrix membranes (MMMs) for greywater purification by ultrafiltration (UF) process. The membranes were synthesized indigenously by varying the TiO_2 nanoparticles (NPs) concentration ranging from 1- 5 wt. % with respective polymer weight denoted as PPSU-T0 to T5 by phase inversion method. Further, characterized by Scanning Electron Microscopy (SEM), porosity, pore size, X- Ray Diffraction (XRD), contact angle, mechanical strength, and % elongation break for morphological, nature of the polymer, hydrophilicity and mechanical properties of the membrane, respectively. From the characterization, permeation of pure water flux, % Bovine serum albumin (BSA) rejection, flux recovery and fouling mitigation studies, the 3 wt. % of TiO_2 loaded composite membranes were optimized for further continuation of experiments. From the experimental results, 80 % water recovery was achieved with removal of 95.54 % turbidity, 94.20 % color, 95.54 % TSS and complete bacterial removal from greywater. The overall characterization, experimental and analytical observations it can be demonstrated that the optimized 3 wt. % TiO_2 loaded PPSU-T3 membrane exhibited higher membrane performance efficiency, low fouling tendency, hydrophilicity, high water recovery, high flux, with low flux declination. Hence, TiO_2 nanoparticles (NPs) incorporation into PPSU- T3 membrane played a vital role, in greywater purification which can be further extended to desalination, surface water purification, protein concentration, and pretreatment for nanofiltration (NF) or reverse osmosis (RO) applications. The results obtained from the study can emerge as an alternative for fresh water used in gardening, laundry, washing, and other industrial applications.

ST-24

Impact of aquatic heavy metal pollution on the haematological parameters of the fish, Oreochromis Niloticus

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The increasing aquatic pollution is of great concern world over. The present study aims to assess the impact of two heavy metals, lead and cadmium, singly and in combination on the haematological parameters of the fish, Oreochromis niloticus. The effect of the heavy metals was studied after exposure of the fishes to sublethal dose of the selected metals, singly

and in combination after one week and three weeks of exposure. The major haematological parameters viz,.haemoglobin (Hb) content, total red blood corpuscle (RBC) count, white blood corpuscle (WBC) count, packed cell volume(PCV), mean cell volume (MCV), mean cell haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) were studied. The RBC count, haemoglobin content and PCV decreased in all the groups upon exposure to the heavy metals whereas the WBC count increased. The impact was highest in the metal mixture group. Differential variations were observed in MCV, MCH and MCHC upon exposure to the metals, singly and in combination. It was found that the impact of the metals is more significant when applied in combination rather than individually indicating the synergistic effect.

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ST-25

An interactive database management system for groundwater pollution control

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Groundwater is the most exploited source of fresh water which fulfills majority of the domestic, agricultural and industrial needs. The geogenic causes which change the quality of groundwater is normally considered natural. However, there are several anthropogenic activities which degrade the quality of groundwater with different types of pollutants. The quality of groundwater is considered as the cumulative effect of these two influences which are normally dynamic. This has necessitated an improved groundwater management system which can deal with diverse and complex database related to groundwater. The present study was initiated to improve the existing groundwater database management system in Punjab with a view to develop an interactive as well as integrated model for groundwater management. The Geographical Information System (GIS), which is a versatile and potential tool to deal with such huge and complex database, was used in this study. The various models such as Water Quality, Lithology, Groundwater Potential, and Recharge Potential were developed on the GIS platform. The groundwater data of Ludhiana and Sangrur districts were analysed as part of this study. The GIS based models developed and presented in this study are beneficial for groundwater management and planning.

ST-26

Water quality index of pre-monsoon groundwater samples in the lower reaches of periyar river basin in Thrissur district, central Kerala, India

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Groundwater is one of the primary sources of water for human consumption, agriculture and industrial uses in Kerala. Periyar is the longest river and the river with the largest discharge potential in Kerala. Lower reaches of Periyar River Basin is prone to problems related to saline water ingression as like any low-lying coastal stretches of Kerala. The main objective of this study is to calculate the water quality index of lower reaches of Periyar river basin in Thrissur district. Water quality index is considered as one of the most effective tool to understand the suitability of water for drinking purposes. It is an indicator of water quality in terms of index numbers and it represent overall quality of water used for various purposes. The WQI has been calculated using the drinking water quality standard recommended by Bureau of Indian Standards (BIS), World Health Organization (WHO), and Indian Council for Medical Research (ICMR). The weighted arithmetic index method has been used for the calculation of WQI. During pre-monsoon season (April, 2016), 22 groundwater samples were collected from open wells for hydro-geochemical analysis and water quality index calculation. Coastal

Samples shows very poor water quality and this degradation in quality indicates the pollution due to the saline water intrusion. Three samples are coming under unfit for drinking (UFD) category. This suggests adequate management techniques have to be implemented to maintain the water quality at its sustainable level.

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ST-27

Detection and Quantification of Per-and Polyfluoroalkyl Substances in the Indian Aquatic Environment –A Need of the Hour

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Many of the chemicals we use are the offspring of World War II. Many of them are popular because of their chemical composition and are widely used in production all over the world. These substances are dangerous to the environment and organisms in many ways, from production to consumption to destruction. It is in this specific context that environmental contamination should be addressed in the latest “Emerging Pollutants” category. These objects do not require such discrimination. This category includes chemicals that can be altered by current, environmental, or biochemical activities. Their uniqueness is that this new pollution can adversely affect the biotic and abiotic components, even in small quantities (one trillion parts). The scientific community has become profoundly aware of the adverse effects of these chemicals over the past couple of decades. As such, the category of chemicals that use in our daily life is per-and Polyfluoroalkyl Substances (PFAS). Studies also have shown that the impact of these chemicals on the environment and population are seen in western countries. The

United Nations and western countries have performed research on perfluoroalkyl substances to recognise the adverse effects of these kinds of emerging pollutants and have put restrictions on them. These controls have been successful in preventing the spread of many emerging contaminants. International environmental treaty signed by countries at the Stockholm Convention on Persistent Organic Compounds declared PFOS and related compounds as target chemicals for a regulation aimed at regulating the production and use of persistent organic pollutants and government organizations in developed countries regulated the spread of PFAS. Life time permissible limit of PFAS in water given by USEPA is 70 ppt (parts per trillion) to reduce the exposure in sensitive populations. The situation has not improved in developed countries. Studies have shown that the presence of these deadly toxins is evident in our Indian waters, aquatic life and human blood samples. These studies indicate that substances belonging to the category of emerging pollutants are not being significantly removed through traditional water treatment processes and that the Indian people are less aware of these toxic chemicals. This Scientific review analyses the occurrence of these compounds globally and compares them with the studies conducted in Indian environment. Our country has not made any significant attempts to detect and regulate PFAS spread in the environment, hence we are in an attempt to detect and quantify the PFAS in the surface water systems.

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ST-28

Assessment of pollution and preparation of health score card of Biyyam wetland and kerala, India

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The study was carried out with an objective to prepare the Management Action Plan of Biyyama wetland in the southwest coast of India.The wetland is uniquebecause of its ecological and economiccharacteristics. Biyyam is a wetland of which is being considered to be notified by Govt of Kerala and Indian Government. The area extends between 10°43'21.38"N to 10°40'26.13"N latitudes and 75°56'22.48"E to 76°04'15.23"E longitudes. This green fringed waterway is situated at the downstream end of the kole lands, the low-lying areas located 0.5 to 1 m below Mean Sea Level (MSL). The kole lands have been recognized as Important Bird Area (IBA), Important Coastal and Marine Biodiversity area (ICMBA) and Key Biodiversity Area (KBA). To evaluate the pollution status of Biyyam wetland, 14surface water samples and4 sediment samples were collected from different stations and analyzedfor various parameters. Higher values for Total Dissolved Solids (TDS) were observed in water samples collected from areas where the influence of sea water is high. Comparison of the mean valuesof water quality characteristics indicated the dominance of major cations and anions were in the order of $Na^{+}>Mg^{2+}>Ca^{2+}>K^{+}$ and $Cl^{-}>SO_4^{2-}>NO_3^{-}>PO_4^{3-}$ respectively. But most of them showed high variations from the Bureau of Indian Standards (BIS) values. All the samples were contaminated with Total coliforms and Escherichia coli. Canadian Council of Ministers of the Environment (CCME) water quality index was calculated,andvalues revealed that the majority of the samples (57%) are reported with marginal water quality index.29% of the samples are in the poor and 14% are inthe fair category. No samples were reported with good or excellent water quality, represents the inferior water quality. Analysis of sediment quality parameters especially, the heavy metal analysis indicated the presence of iron, manganese, copper, lead, cadmium, nickel, and zinc. The results indicated that the mean concentrations of Ni, Pb &Cd exceeded the world average shale value. The status of heavy metal contamination was evaluated based on numeric Sediment Quality Guidelines, Degree of Contamination and Pollution Load Index.Serious anthropogenic

pollution was interpreted in the study area.The ecologically important wetland acts as a natural drainage system for nearby cities, resulted in the deterioration of the environmental quality of the area. Discharges from domestic and urban pollution sources, run-off from the agricultural areas are the major factors responsible for the poor environmental quality of the wetland. We calculated the Health score value based on various criteria such as, the extent of wetland area used for non-wetland uses, water regime, biodiversity and governance. The Health score value of 0.87, implicit that various anthropogenic activities influence the quality of the wetland.Conservation of the wetland area is the key step in the integration of the biodiversity, ecosystem services and economic security of the people dependent on the wetland resources.

ST-29

Trace metal concentration in the sediments of a small tropical Western Ghat river system in South-West coast, India

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A study was made to generate baseline data for the trace metal concentration in the sediments of the river Payaswini-Chandragiri, Southwestern India. The Payaswini- Chandragiri river system is originating from Western Ghat with an elevation of 1350 m MSL and is an area of 1409 km2. Less research has been done into the geochemistry of the Western Ghat river sediments. We have collected 6 river bed samples, were used to identify trace elements concentration, distribution, source and pollution status. We have analyzed As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn using ICP-OES with > 5% accuracy and precision. The river bed sediments of Payaswini- Chandragiri shows significant enrichment with Fe and Mn, input from silicate rock weathering. The person correlation coefficient of the metals data confirmed that the Fe and Mn of the sediments are significantly correlated with the OC. Geochemical approaches were used to investigate the characterization of pollution, risk and sources of heavy metals in the study environment. Igeo value, contamination factor (CF) and the enrichment factor (EF) confirmed that the sediments are contaminated with Cd by anthropogenic activities. The

pollution load index (PLI) values show >1.0 in all river sediments, indicating the river bed is slightly polluted with trace elements. Principal component analysis revealed that Al, Ba, Cu, Ni, Fe, Mn and Ti were primarily from the parent rock of the river basin and Cu, Cr, Cd, Pb and Zn were derived from both natural and anthropogenic sources. The heavy metal distribution study of Payaswini- Chandragiri river sediments is a valuable predictor of environmental changes and long-term observations of the geochemistry of Western Ghat river sediments.

ST -30

Ecotoxicological assessment of Green CuO Nanoparticles Using Hydra as Model Organism

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The main objective of the work was to determine the toxicity of green Copper oxide nanoparticles synthesized by a simple, cost-efficient, environmentally friendlyapproach using Azadirachta indica leaves extract. The Copper oxide nanoparticles were characterized by UV–vis spectrophotometry, XRD, FTIR, SEM, and TEM. The study revealed that the Hydra, when exposed to greenCuO NPs, exhibited dose-dependent and time-dependent toxicity. Impairment of feeding& regeneration was also observed. The key mechanism associated with the toxicity of green CuO NPs is mainly the enhanced ROS generation and oxidative stress that leads to DNA damage and apoptotic cell death. We propose the use of Hydra as a model organism for the risk assessment of nanomaterial contamination in aquatic environments from these results.

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ST-31

Effect of Mn doped Ni-Co mixed oxide catalysts on Urea Oxidation Electrocatalysis

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Urea as a fuel for energy generation and storage has attracted increased attention, particularly in the recent times, for it is stable, non-toxic, and abundantly available. Urea possesses 10.1 wt% hydrogen as well as plentiful sources that produce the same by direct or indirect means. A daily worldwide human production of urea is estimated to 240 MT. Nevertheless, the electrochemical oxidation of urea is generally sluggish and considered to be an inefficient process. However inexpensive Ni-based catalysts have shown comparable urea oxidation activity to that of precious metals, in an alkaline electrolyte, which is quite promising to be explored for employing them in Direct Urea Fuel Cell (DUFC) anode catalysts. In the present study, we investigated urea oxidation on a novel three-dimensional transition metal-based, mixed oxide catalyst, using Manganese (Mn), Cobalt (Co) and Nickel (Ni), utilising simple precipitation route at room temperature, subsequently followed by calcination at 400 ^{o}C. The synthesised oxide catalysts were NiO, Mn doped NiO, Co_3O_4, Mn doped Co_3O_4, $NiCo_2O_4$, Mn doped $NiCo_2O_4$ for a comparative urea oxidation study. pH of the testing solution was maintained at 13 using 1 M KOH and 0.33 M urea was fed as fuel for urea oxidation analysis. It was found that Mn doped $NiCo_2O_4$ catalyst exhibited excellent and highest urea oxidation activity of 45.88 $mAcm^{-2}$ (at a potential of 0.60 V, with an onset potential of 0.40 V vs. Hg/HgO), the value being twenty fold better than that of NiO and Co_3O_4 catalysts as well as three fold better than that of bare $NiCo_2O_4$ catalyst. Chronoamperometry curves of Mn doped $NiCo_2O_4$ catalyst showed stability over 2000 s in oxidizing urea. The exceptionally high mass activity of Mn doped $NiCo_2O_4$ catalyst is attributed to the least nano-crystallite size, better dispersion of Ni nuclei on to the spinel crystal matrix, enhanced Ni electrochemical active surface area, low band gap etc. observed in this study.

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Posters

P-1

NanomolarDetection and Photo-degradation of Organic dyes by PolyolMediated Silver Doped Zinc Oxide Nanomaterials.

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The success of surface enhanced Raman scattering (SERS) is highly dependent on the interaction between adsorbed molecules and the surface of plasmonic nanostructures. Doping can increase the defects of semiconductor which is favorable for the charge transfer (CT) mechanism from doped semiconductor to the molecules to be used as a probe in SERS study[1]. Furthermore, doping of noble metals can improve the photo catalytic activity of semiconductor material by trapping the photogenrated electron. The defects also increase the recombination time of electron-hole pair and hence catalytic activity of material[2]. Therefore, in present study, a green polyol method was utilized to synthesize silver doped zinc oxide (Ag-ZnO) nanoparticles (NPs). Structural, morphological, chemical and optical properties of synthesized ZnOand Ag-ZnO NPs were investigated by X-ray diffraction (XRD), field emission scanning electron microscopy (FE-SEM), Fourier transform infra-red (FT-IR), UV-Visible and SERS spectroscopy. To investigate the SERS performance of Ag-ZnO NPs, SERS study of Rhodamine 6G (R6G) was performed. The photo catalytic activity of the synthesized Ag-ZnO NPs was examined by performing the photo degradation of methylene blue under UV light irradiation.

The formation of ZnO and Ag-ZnONPs was confirmed by XRD study. The diffraction pattern of ZnO NPs showed peaks at 2θ 31.4, 34.0, 35.9, 47.2, 56.3, 62.5, 67.6 and 68.8 correspond to the reflection from (100), (002), (101), (102), (110), (103), (200) and (112) crystal planes of the hexagonal wurtziteZnO structure. The doping of Ag metal showed three additional peaks in diffractogram at 2θ 38, 44, 62 and 77 which corresponds to the (111), (200), (220) and (311) planes of metallic Ag with face-centered cubic (FCC) structure. For better understanding of size and morphology of NPs, FE-SEM analysis was done. Both bare ZnO and Ag-ZnO NPs were observed to be aggregated quasi spherical particles. The average size of ZnO and Ag-ZnO NPs were found to be 17 and 21 nm respectively. The size obtained from FE-SEM was good agreement with size obtained from

XRD results. Thus, doping of Ag in ZnO results increase in particle size. From FE-SEM images it was observed that there is aggregation of particles, but these may be due coating of PVP or polyol which is used during synthesis. EDS results clearly showed that ZnO sample consist of Zn and O while Ag-ZnO sample shows presence of Zn, O and Ag. Thus, EDS also confirms the Ag doping and which corroborates with XRD result. SERS spectra of R6G of different concentration (10^{-5} to 10^{-9} M) adsorbed on Ag-ZnO NPs were recorded using 532 nm laser with 1 second acquisition time. From concentration dependent SERS spectra of R6G the nanomolar sensing of R6G was achieved using Ag-ZnO NPs as a SERS substrate. The photo catalytic results indicate that Ag doped ZnO NPs showed relatively higher catalytic activity than bare ZnO NPs.

P-2

Preparation of a novel $Zn_3(PO_4)_2$ and its application in solar light degradation of crystal violet, malachite green and methylene blue

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Synthetic dyes are widely used in the textile, paper, printing, food, and other industries, and vast amounts are released into the environment together with industrial wastewater. However, undesirable and illegal release of dyes into the environment poses a significant threat to human health because organic dyes are teratogenic, carcinogenic, and mutagenic. Among many methods reported in the literature for cleaning of dye polluted water, adsorption and degradation are the most studied and applicable to real life. Here we synthesized $Zn_3(PO_4)_2$ via chemical route. In the first step we synthesize zinc phosphate via precipitation method then as prepared sample were heated at 550°C for 3 hrs. The structure, morphology and properties of the material was characterized by using different techniques including X-ray diffraction (XRD), Scanning electron microscopy (SEM) combined with Energy dispersive X-ray diffraction (EDX) and Fourier Transform Infrared Spectroscopy (FTIR). The batch adsorption experiment on the removal of dyes was performed with ZP, and the effect of various experimental parameters, such as adsorbent dosage contact time of nanocomposite at 25°C, were investigated. The nanomaterial shows enhance adsorptive degradation of dyes.

P-3

Performance of FO system for water recovery from paper industry secondary effluent

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Agriculture uses about 70 percent of the world's total freshwater. An alternative water supply is needed because of the limited freshwater supplies. Using a traditional fertilizer (urea) in the forward osmosis (FO) process [1,2] as a draw solution (DS) to extract good quality water from secondary effluents of the pulp and paper industry, removing the need for a regeneration process and thus requiring very little energy consumption for the operation of the FO system. It has the advantage that the DS does not require regeneration, so it can be used directly for irrigation purposes without any additional treatment. The purpose of the current study was to determine the actual application of FO to irrigate the crops based on their fertilizer requirements.This study examined the efficiency under varying DS concentrations (1 and 2 M urea) of a FO process for water recovery from the secondary effluent as the feed solutions (FS).In this process, cellulose triacetate (CTA) FO membrane was used repeatedly with flow rate of 60 L/h; with the corresponding effects on the specific energy consumption (SEC). The results showed that DS concentration from 1 to 2 M contributed to nearly 1.2 times increases in flux and nearly 30% decrease in SEC for secondary effluent as FS. The system flow rate of 60 L/h had a minor effect on water flux, but significantly SEC was 0.52 ± 0.05 kWh/m^3. This research has had important consequences for the FO system's proper assessment of energy use for water recovery from secondary effluent using a common fertilizer such as urea that could potentially be used for fertigation.

P-4

Synthesis of Titanium Phosphate-PolyPyrrole composite for application in degradation of methylene blue dye

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Methylene blue (MB) also known as methylthioninium chloride is cationic dye was first prepared in 1876, by Heinrich Caro. This is used in the medicine for treatment of methemoglobin levels, cyanide poisoning and urinary tract infections. This used at large scale in the textile, leather, and pulp and paper industry as dye. The unreacted methylene blue dye reaches drinking water reservoir via effluents of industrial waste. On drinking water containing MB dye causes common side effects such as headache, vomiting, confusion, shortness of breath, and high blood pressure.

The various treatment methods for the removal of dyes are adsorption, coagulation, chemical oxidation (using chlorine and ozone), membrane filtration, ion-exchange chemical reduction, biological treatment and degradation. Among these techniques most of these have some limitation such as formation of large volume sludge. The degradation of dyes using semiconductor materials and solar light form the gaseous product and results in the reduce formation of sludge. We synthesised titanium phosphate – polypyrrole composite for degradation of methylene blue dye under solar light. Different techniques were used for characterisation of samples include Powder X-ray diffraction pattern, FESEM, TEM, BET, TGA/DTA, and XPS. The degradation experiments under solar light showed enhanced degradation capacity of the composite compare to bare titanium phosphate and polypyrrole.

P-5

Monitoring of the Contaminants of the Emerging Concern in the Meenachil River, Kerala

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The presence of Contaminants of Emerging Concern (CECs) in the environmental matrices is a matter of high concern. In the present study, identification of CECs in surface water samples of Meenachil River, Kerala has been carried out by using high resolution mass spectrometer. The samples from 20 locations were extracted by solid phase extraction followed by LC-Q-ToF/MS and LC-MS/MS analysis. The method developed in the study was used to determine 13 CECs belonging to different pollutant families in water at parts per billion. Seven common CECs (metropolol, mefenamic acid, lidocaine, butylparaben, benzophenone, dibutyl phthalate and surfactants) were quantified. The highest concentration was observed for surfactants. Non target analysis revealed the occurrence of five liner alkylbenzene sulfonate (LAS) and eight other category of CECs. Some of the prominent quantified CECs are presented in Table 1.

Table 1. Identified and quantified CECs in Meenachil River by Using LC-MS/MS and LC-Q-ToF/MS Analysis

Sl no	Compound	Elemental Composition	Precursor ion (m/z)	Polarity
1	Benzophenone	$C_{13}H_{10}O$	183	$[M+H]^+$
2	Diisobutyl phthalate	$C_{16}H_{22}O_4$	279	$[M+H]^+$
3	Lignocaine	$C_{14}H_{22}N_2O$	235	$[M+H]^+$
4	Mefenamic acid	$C_{15}H_{15}NO_2$	242	$[M+H]^+$
5	Metoprolol	$C_{15}H_{25}NO_3$	268	$[M+H]^+$
6	2-Decyl benzene sulfonic acid	$C_{18}H_{30}O_3S$	325	$[M-H]^-$
7	Butylparaben	$C_{11}H_{14}O_3$	195	$[M+H]^+$

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P-6

Seasonal variation of major ions in Meenachil river, Kerala, India

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A systematic study for analyzing various ionic composition and physico-chemical water quality parameters in Meeanchil river was conducted during pre-monsoon, monsoon and post-monsoon seasons in the year 2019. A total of 20 surface water samples were collected from upstream to downstream during the three seasons and were analyzed for inorganic anions and cations by ion chromatography. The physico-chemical parameters identified are temperature, pH, conductivity, TDS, salinity, total hardness, and ions of Na, Ca, K, Mg, NH_4, Cl, SO_4, NO_3 and PO_4. Sodium and calcium dominate among cations and chloride and sulphate dominate among anions. The cationic concentration gradation observed is Na>K>Ca>Mg>NH_4 in pre-monsoon season (average value; 16.4 ppm, 9.5 ppm, 7.6 ppm, 2.5 ppm and 1.4 ppm, respectively) and Na>Ca>K>Mg>NH_4 in monsoon (average value: 2.8 ppm, 2.4 ppm, 0.82 ppm, 0.74 ppm and 0.08 ppm, respectively) and post-monsoon season (average value: 3.9 ppm, 3.0 ppm, 1.4 ppm, 1.1 ppm and 0.73 ppm, respectively). The anionic concentration gradation is Cl>SO_4>PO_4>NO_3 in pre-monsoon (average value: 11.2 ppm, 3.0 ppm, 1.08 ppm and 0.25 ppm, respectively) and Cl>NO_3>SO_4>PO_4 in monsoon season (average value: 4.1 ppm, 2.6 ppm, 1.7 ppm and 0.71 ppm respectively), and Cl>PO_4>SO_4>NO_3 in postmonsoon season (average value; 6.4 ppm, 2.2 ppm, 2.1 ppm and 0.51 ppm, respectively). The phosphorus concentration was analyzed with UV-visible absorption spectrophotometer. The average temperature, pH, conductivity, total dissolved solids, salinity and total hardness were found to be within the permissible limits in all three seasons. All the cations, chloride and sulphate concentrations were high during pre-monsoon season followed by post-monsoon and monsoon, except in the case of nitrate and phosphate.

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P-7

AntibacterialActivity of Cu-Ni Bimetallic nanoparticles and Poly(Styrene-DVB) Encapsulated CuNiBimetallic Nanomaterials Against *Escherichia coli* Bacteria.

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The implementation of nanotechnology in the field of wastewater treatment has recently received much research attention due to their distinct characteristic and unique properties. Currently, bimetallic nanoparticles (BNPs), composed of two different metal elements, have drawn great interest in drinking water treatment among various types of nanoparticles.BNPshave a greater surface area as compared to those of monometallic nanoparticles and in many cases, the specific properties of BNPsare enhanced because of the synergistic effects of the two distinct metals. In the present study, we investigated antibacterial activity of CuNiBNPsand Poly(Styrene-DVB) encapsulated CuNiBNPsagainst the widely used standard human pathogen *Escherichia coli* from aqueous solutions.The structural and chemical analysis of synthesized nanoparticle was determined using Scanning Electron microscopy (SEM), Transmission Electron Microscopy (TEM), Energy Dispersive X-ray Spectra (EDS), powder X-ray diffraction (PXRD) and surface area studies. Antibacterial action was studied using Colony Forming Unit (CFU). Batch study was conducted on the basis of parameters such as nanoparticle dosage, contact time and bacterial load and well diffusion method was used for testing the antibacterial effect of synthesised nanoparticles.Water samples collected from different sites were used to isolateE.coli culture and the contaminated aqueous solutions were artificially prepared by diluting the E.coli stock solution with sterilized water.According to results, the percentage removal of E.coli was increased with the contact time for both NPs with initial CFU of 340/ml. The maximum removal efficiency was observed at a contact time of 30 and 60 min respectively for the bimetallic and encapsulated NPs. The result revealed that the maximum percentage removal increase with increase in nanoparticle dosage. The optimum dosage of NP was found to be 0.05g/250 ml and 0.7 g/250 ml of bimetallic and encapsulated NPs respectively with the maximum efficiency of 100%. It was observed that the antibacterial efficiency of both NPs were decreased when the concentration of E.coli was increased. The study illustrated that, CuNiBNPs have higher antibacterial activity than poly(Styrene-DVB) encapsulated CuNiBNPs. This may be due to the partial loss of their activity proportional to the decrease of their active surface area due to the immobilization of NPs.

Exposure to very low levels of Pb2+ leads to chronic health problems, and the source for Pb2+ could be from water, soil and industrial exposure. Great efforts have been devoted to develop various kinds of Pb2+ sensors, among these fluorescent and colorimetric sensors are of great interest. Considering the significance of Pb2+ detection, a cost-effective point-of-use sensor platform is the need of the hour. Moreover, the sensor platform should obey WHOs ASSURED criteria (affordable, sensitive, specific, user-friendly, rapid and robust, equipment-free and deliverable to end users), and also it should imply the simple Do It Yourself (DIY) strategy. By keeping this in mind, herein we developed thiol protected gold nanocluster (Au18) based paper analytical device (PAD) for sensitive detection of Pb2+ through simple colorimetric technique by exploiting the photoluminescent properties of Au18. The selective detection of Pb2+ could observe with the color changes by naked eye, and under UV exposure of PAD. The asdeveloped point-of-use paper device could detect selectively ppm levels of Pb2+ and suffered no interference from other metal ions.

P-8

Arsenic (As) Bioremoval potential of Arseniclastic microorganisms through Biotransformation

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The presence of arsenic (As) in aquatic environments (groundwater) across pockets of the Gangetic basin including parts of the Bengal Delta Plain in India is attributed to a complex interplay between biogeochemical processes leading to the release of geogenic aquifer As. The bioaccumulative nature of this heavy metal is known to further put the lives of millions of people at risk of development of detrimental health problems owing to its spread caused by massive utilization of As laden water for agricultural (irrigation) and drinking purposes. In light of concern regarding drawbacks of conventional chemical application methods, As- biosorption, bioaccumulation, or biotransformation are considered eco-friendly alternatives. Microbe driven alteration of As species *ex-situ* or *in-situ* (sediment/plant-sediment systems) is being extensively studied. Similarly, as sorption to metal oxides/hydroxides/sulfides or biogenic iron oxides and sulfides has been also reported in the past. Microbial ability to drive as volatilization, sorption to/co-precipitation with biogenic minerals, or speciation, in general, holds the potential for utilization in the development of low-cost As removal strategies targetting segregation of As from varying environmental samples. Hence, these techniques require to be further investigated not only for direct application but also for utilization in combination with chemical methods to further enhance the process (time required, specificity) of as immobilization/reduced uptake by plants/bioremoval from water or sediment systems.

P-9

Detection of microplastics from gastrointestinal tract of commercial fishes collected from Cochin

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The therapeutic properties of plants can be determined by exploring metabolites. *Myristicabeddomei* King ssp.ustulata W.J. de Wilde is an ethanomedicinal plant belonging to Myristicaceae family and it is seen in Southern Western Ghats of Kerala, India. The present study aims to determine the antibacterial activity of three parts (pericarp, mace and seed) of M. Beddomei fruit. It was sequentially extracted with hexane, ethyl acetate and methanol. Then TLC separation was done with the active hexane fraction of seed and mace. The tested microbial strains include gram positive bacteria such as Staphylococcus aureusand Bacillus subtilis. The metabolite profiling of hexane and ethyl acetate fraction of seed and mace and second TLC fraction of seed and mace were done by GC MS and LC-Q-ToF-MS. In antibacterial screening, hexane and ethyl acetate fraction of mace and seed were highly active to the tested microbes. In TLC fraction of hexane extract of seed and mace, fraction 2 is highly active to the microbe. 4,4'-((p-phenylene)diisopropylidene)diphenol, methyl 11-octadecenoate , Methyl stearate, phen-1,5-diol-2-[9-phennonanoyl], Methyl 14-methylpentadecanoate,Methylisomyristate,Methyldihydrohydnocarpate, squalene, 2-methyl-5-(hexyn-1-yl) pyridine were the compounds resulted in the GC MS analysis. LC-Q-ToF-MS results shown that 1-(2,6-Dihydroxyphenyl)-9-(4hydroxyphenyl)-1-nonanone, 4-methoxy-2,6-bis(2-methyl-2-propanyl) phenyl propionate are present in TLC second fraction. The parts of fruits have active compounds for potential antibacterial activity and it is a promising candidate for further development as natural antimicrobial agent.

P-10

Prevalence of antibiotic resistance in *Escherichia coli* isolates from water samples taken from Cochin estuary

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The objective of the present study was to investigate the prevalence, phylogenetic grouping, antibiotic resistance of *E. coli* isolated from water samples of six different stations of Cochin estuary, India. *E. coli* strains were isolated from water samples, were collected monthly from six different stations along Cochin estuary for a period of five month from November 2018 - March 2019. Isolated strains were identified by using biochemical tests and molecular identification by targeting cyclic di-GMP regulator gene (*cdgR*). The phylogenetic group was determined for all the *E. coli* isolates by the new phylogenetic group assignment PCR based method. Antibiotic resistance patterns of all *E. coli* isolates were determined by disc diffusion method. In this study, Surface water temperature, salinity and pH fluctuated widely between various stations of the Cochin estuary and 85 *E. coli* strains isolated from water samples. A high percentage of isolates belonged to phylogenetic group A, followed by group E (12.9%), group B1 (11.7%), group D and F (10.5% each), group C (9.4%), unknown (8.2%) and group B2 (5.8% each).All isolates from water samples of Cochin estuary showed resistance to all the antibiotics tested except doripenem and ertapenem. Highest prevalence of antibiotic resistance was observed among isolates for cefotaxime (88.2%), followed by ampicillin(82.3%), colistin (80%), ceftazidime (62.3%), trimethoprim (36.4%), co-trimoxazole (29.4%), nalidixic acid (22.3%). Furthermore, between 20% and 10% of *E. coli* isolates were resistant to tetracycline (18.8%), ciprofloxacin (17.6%), piperacillin (16.4%), cefepime (11.7%) and streptomycin (10.5%). There was significant difference in the prevalence of antibiotic resistance among six stations. Significant differences were observed in the prevalence of antibiotic resistance between different stations ($p < 0.05$). These results suggest water is also serve as a source of antibiotic resistant *E. coli.*

P-11

Phyco-synthesized iron nanoparticle using *Planktochlorella nurekis* and its potential for Acetaminophen remediation

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Considerable development in the field of nanotechnology offers various applications especially in the area of wastewater treatment. The synthesis of metal nanoparticles like copper, iron, silver, palladium and goldusing algae has received much attention due to their simplicity and cost effectiveness. In the present study, the iron nanoparticles were synthesized using decotion of locally isolated microalga *Planktochlorellanurekis.*The phyco-synthesized iron nanoparticles (FeNP-PN) were characterized by UV-Vis spectroscopy, HR-TEM/EDAX, AFM, FTIR and zeta potential.The as-synthesized FeNP-PNwere used as adsorbent for the remediation of acetaminophen from aqueous solutions. It is also tested for the removal of acetaminophen from river water and pure water samples with a spiked concentration of 5ppm.The results of UV-Vis spectroscopy, HR-TEM/ EDAX, AFM, FTIR and zeta potential analysis revealed the formation of FeNP-PN. The HR-TEM images clearly confirm the presence of FeNP-PN with size ranged from 13-29 nm with spherical shape. The FTIR spectroscopy of both microalgal extract and FeNP-PN revealed the involvement of bioactive compounds like carbohydrates and proteins in the bioreduction and capping. The FeNP-PN could have successfully removed the acetaminophen from aqueous solution. The optimum adsorption conditions were determined as initial pH 3.0, temperature with 30°C, and adsorbent concentration of 105mg/L. Langmuir isotherm model was the better fitted model with experimental equilibrium data due to the high regression coefficients (R2>0.994).The adsorption kinetic data were fitted to pseudo-second-order with high regression coefficient (R2>0.998) than the pseudo-first-order kinetic model. The FeNP-PN could remove 98.6% and 91.3% of acetaminophen from both pure water and river water samples respectively. The present study proved the efficacy of FeNP-PN in the removal ofacetaminophen from river water samplesand can be considered as a viable option for the removal of acetaminophen like contaminants from natural water systems.

P-12

Treatment of industrial effluents and municipal wastewater using Aerobic Membrane Bioreactor

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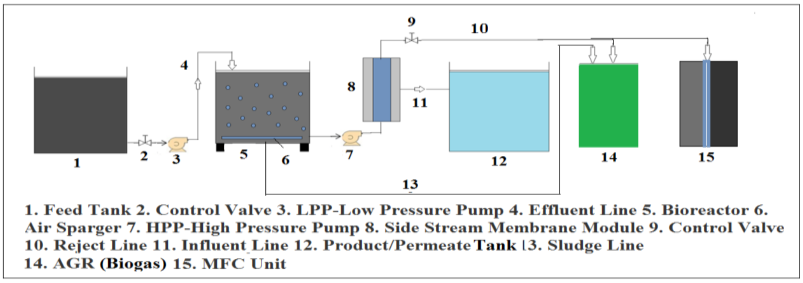
Rapid industrialization and population growth increase the worldwide demand for water resources. The amount of wastewater produced and the overall pollution load seems to be the greatest challenge that needs to be met. Effluents are critical components of the water cycle and a leading cause of degradation of aquatic ecosystems and waterborne diseases due to freshwater contamination, which have far-reaching implications on the well being of communities and peoples' livelihoods. Membrane bioreactor is an integrated process that combines both the biochemical degradation process and the membrane filtration technique. Experiments were carried out to treat effluents using MBR in an aerobic mode from several sources, mostly from municipal sewage, kitchen and dairy industries. Repeated trials at various ratios of these wastewaters have been optimized. Parameters such as total dissolved solids (TDS), electrical conductivity, turbidity, chemical oxygen demand (COD), color and odor etc., were analyzed. Urban Township and civil communities can be benefited with MBR technology as it can treat both kitchen and municipal effluents together in one system. However, the best part of this system talks about zero liquid discharge (ZLD) at a minimal cost without any sludge generation. CSIR-IICT developed indigenous membrane bioreactor pilot plant of capacity 500 Lit/hr for the treatment of IICT canteen wastewater and sewage from HMWSSB, Amberpet, and Hyderabad, India. Sludge and reject water streams are connected to the AGR unit (biogas plant) of a capacity of 250m^3/day. Reject water was fed to microbial fuel cells for power generation to make the overall process cost-effective and beneficial for providing freshwater for reuse, with the generation of energy and prevention of environmental pollution.



Schematic flow diagram of integrated MBR system + AGR/MFC unit

P-13

Coconut shell-based activated carbon for cationic dye removal

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The shells of Cocos nucifera serves as economical alternative for wastewater treatment and waste remediation. The coconut-based agricultural wastes have gained wide attention as productive adsorbent due to low-cost, significant adsorption capacity and removal of diverse pollutants from the industrial effluents. Based on this scenario, the current research was performed on the a). Production of adsorbent carbon from coconut shells, b). Exploring the role of nitrogen flow in the $ZnCl_2$ activation and characterizing the activated carbon in terms of structural morphologies, surface functionalities and textural features and c) evaluating the potential application of activated carbon in the removal of malachite green dyefrom aqueous solution. The coconut shells were carbonized in a slow pyrolytic unit available at the Department of Renewable Energy and Engineering, Tamil Nadu Agricultural University, Coimbatore. Carbonization resulted in the production of adsorbent carbon with a yield of 30 percent. The shells were cleaned, washed, dried and subjected to carbonization at 450°C for 3 hours to produce coconut shell derived adsorbent carbon.The carbonized sample was impregnated with zinc chloride at 1:1 ratio. After the impregnation, the sample was exposed to carbonization in tubular furnace under nitrogen atmosphere. The physico-chemical, structural and surface parameters were found to be enhanced after activation.Later, the activated carbon was stored for further studies.The $ZnCl_2$ activated carbon acquired a higher specific surface area (544.66 $m^2\ g^{-1}$) and zeta potential (-32.6 mV) with a significant malachite green

dye adsorption capacity (39.683 mg g^{-1}). The adsorption experiment was evaluated with varying contact time (20–220 min) and initial dye concentration (20–80 mg L^{-1}). Freundlich isotherm model (R^2>0.978) was best fit for the experimental data followed by the intraparticle diffusion model (R^2>0.88) as most appropriate model for the malachite green dye removal. Additionally, the energy and thermogravimetric analysis portrayed the suitability of the carbon material to be used as an energy alternative to coal. The results of the study proved the effectiveness of utilising chemicals in activating the carbon produced from coconut shells. The carbonization has enhanced the properties of adsorbent to a certain extent which has been divulged by the results earlier.

P-14

Colorimetric detection of lead (Pb) by gold nanoclusture embedded disposable paper analytical device

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Exposure to very low levels of Pb^{2+} leads to chronic health problems, and the source for Pb^{2+} could be from water, soil and industrial exposure. Great efforts have been devoted to develop various kinds of Pb^{2+} sensors, among these fluorescent and colorimetric sensors are of great interest. Considering the significance of Pb2+ detection, a cost-effective point-of-use sensor platform is the need of the hour. Moreover, the sensor platform should obey WHOs ASSURED criteria (affordable, sensitive, specific, user-friendly, rapid and robust, equipment-free and deliverable to end users), and also it should imply the simple Do It Yourself (DIY) strategy. By keeping this in mind, herein we developed thiol protected gold nanocluster (Au18) based paper analytical device (PAD) for sensitive detection of Pb2+ through simple colorimetric technique by exploiting the photoluminescent properties of Au18. The selective detection of Pb2+ could observe with the color changes by naked eye, and under UV exposure of PAD. The asdeveloped point-of-use paper device could detect selectively ppm levels of Pb2+ and suffered no interference from other metal ions.

P-15

Enhancing the Performance and Recyclability of Polyaniline/TiO_2 hybrid nanocomposite by immobilizing with Zein/HEC Functionalized composites for removal of anionic dyes from water

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Synthesis of highly stable photocatalyst using polymer composite paste is important to enhance the life cycle of the catalyst in the dye treatment process. In this regard, polyaniline/TiO_2 (PANI/TiO_2) hybrid nanocomposite was effectively immobilized by zein/hydroxy ethyl cellulose (zein/HEC) gel as an adhesive agent. The blending of zein/HEC/PANI/TiO_2 photocatalyst involves *insitu* oxidative polymerization followed by simultaneous immobilizing with zein/HEC composite. The PANI/TiO_2 composite was successfully grafted with the adhesive through physicochemical interaction, as evidenced by FESEM, FTIR and XRD. The simultaneous thermal analysis (STA) results show that the photocatalyst has the best thermal stability relative to PANI and PANI/TiO_2 in the recommended range of dye degradation temperature. The effect of external factors like TiO_2 nanoparticle proportion, catalyst dosage, and pH of the solution was studied in response to dye degradation efficiency. The catalyst is efficient to degrade methyl orange in a wide range of pH. The kinetics of the catalysis reaction obeys first order kinetics. The maximum efficiency achieved was 97.9 and 84.3% in the presence and absence of light, respectively. The catalyst was easily recovered by decantation, and its catalytic efficacy was more than 94% after five cycles. Hence, it is a promising alternative for decolorizing anionic dyes from wastewater.

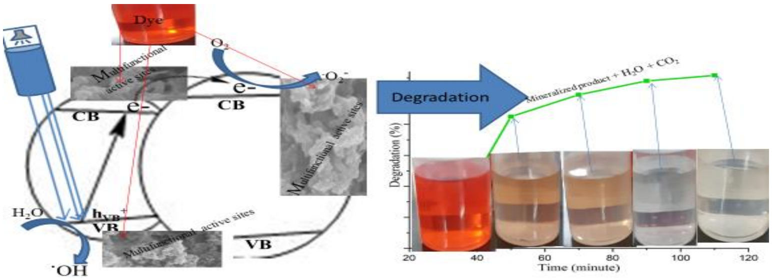

Figure.1

P-16

Removal efficiency of tetracycline from aqueous medium using biochar derived from Eichhornia Crassipes- an invasive wetland weed

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Pharmaceutically active compounds are important class of contaminants of emerging concern in aquatic environments due to their extensive usage and resulting environmental pollution. As such, the removal of these emerging contaminants especially like that of tetracycline (TC) has gained significant attention. Various bio- adsorbents derived from natural materials have been developed and tested for removing emerging pollutants from aqueous medium; however application of *Eichhornia crassipes*(EC)- a wet land/aquatic weed derived biochar in adsorption of TC has seldom been reported. The focus of this research was to synthesize Eichhornia crassipes biochar (HEBC) for the adsorptive removal of tetracycline (TC) from aqueous media. The sustainable conversion of the invasive weed biomass into biochar based adsorbent for TC could be a feasible and sustainable strategy for management of weed. The feedstock was collected from Kuttanadu wetland- a part of Vembanadu wetland system which is one of the world famous Ramsar site in Kerala, India and then pyrolyzed at 450⁰C for 1 hr. The removal efficiency of TC as a function of adsorbent dose, contact time, pH and concentration of the adsorbate, were determined through batch adsorption. The optimum TC adsorption was achieved at dosage of 0.5 g with removal efficiency 94.8% and pH at 7 with 93.5 % removal efficiency. The nature of eichhornia biochar in terms of chemical, thermal and surface properties revealed its specific characteristics as a better adsorbent for TC. The prepared char showed considerable reusability even at low initial concentrations. Moreover, the Life Cycle Assessment (LCA) of the resultant biochar suggested its potential usage as a better adsorbent of TC. The further utilization of spent char as soil amendments supports soil carbon sequestration and hence helps in climate change mitigation. The conversion of the biomass of this invasive species into biochar for adsorbing pollutants in water could be a feasible and sustainable strategy for management of the weed. Hence the present work envisages the wise utilization of aquatic weed derived

biochar for the effective removal of tetracycline from aqueous medium and has due importance.

P-17

Treatment of coir industry waste water using multi-layer membranes

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Coir industry waste water constitutes many important value added products. Understanding its constitution and individual recovery at low concentration is indeed a challenging analytical separation task. This work combines the unique properties of LbL and the properties of coating material (Chitosan,CHI) and polyacrylic acid (PAA) to prepare a membrane skin for the removal of contaminants from coir ret effluent .The advantages of LbL technique are that it is simple, environmental friendly and ultra-low coast. Ultra filtration technique was used for the study of dye rejection, ion permeation and selectivity of multilayer under pressure driven condition.The highest dye rejection was obtained at feed pH 3 and 5.5 bilayer combination and it is about 95.42%.Flux is about 53.64. Out of these different bilayers used, the good rejection is obtained from the 5.5 bilayer at all pH variations. COD, Conductivity and salinity were reduced by about 34%,33% and 88% respectively. The physico chemical properties of permeate showed that there is reduction in its properties after ultrafiltration through membranes. The preliminary analysis indicates the fabricated CHI/PAA multilayered membrane has potential in recovering some of the components as revealed by the mass analysis. The performance of the membrane for coir ret effluent is found to be satisfactory with respect to the removal of colour, COD and other compounds present in the effluent.

P-18

Analysis of the potential of soil based constructed wetland systems for grey water treatment

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The sustainability of constructed wetland (CW) system has been proven as a green technique for grey water treatment in terms of its efficiency and low cost maintenance. Even though, the capability of CWs for removing persistent pollutant likes surfactants (since they are most important and abundant chemicals found in grey water) is not much studied. From this point of view, a study has been carried out for the identification of surfactants present in grey water and the potential of soil based CW for surfactant removal. Other parameters like pH, conductivity, TDS and TOC were also evaluated. Thus, two soil based CWs were made (garden soil (GRS) and clay soil (CLS) planted with *Tradescantia spathecea.* Four samples for each set was fixed including control system (without plants or soil) to compare the performance of plant based systems. The samples include (i) a combination of plant, (ii) grey water and soil (two samples) (iii) grey water and soil (as control I, one sample) and (iv)grey water only without any plant or soil (as control II, one sample). As per experimental results, the two systems are well suited for the remediation of surfactants as well as for TOC removal. Garden soil based system performed much better in case of conductivity and TDS elimination sodium dodecyl sulfate**,** 14- hydroxyl tetradecane, 1-sulfonic acid, 4-decylbenzene sulfonic acid and 2-dodecylbenzene sulfonic acid are the surfactants identified in grey water using LC-Q-ToF-MS. More than 90% removal of these surfactants was observed in all four systems after treatment. The plants well survived in grey water till the completion of experiments.

P-19

Removal studies of selected emerging contaminants using natural coir fiber as adsorbent

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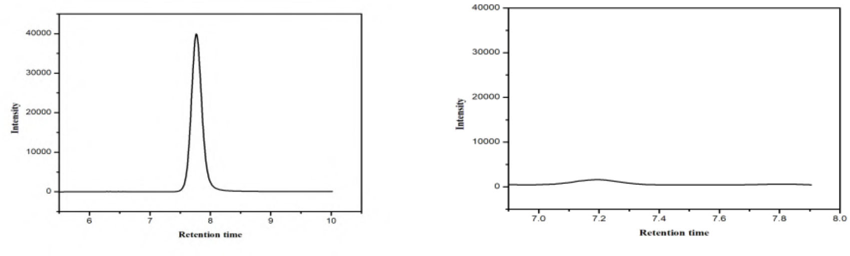
Dominant water treatment technologies are undergoing rejuvenation to accommodate the challenges raised by Emerging Contaminants (ECs). The development of low-cost adsorbents is one of the best option for the removal of various contaminants from water and wastewater. Here we have selected low- cost coir fiber as adsorbent used for the removal of three selected pharmaceuticals (Lidocaine, Propranolol and Isoniazid).The spiked solution is passed over pristine and coated coir packed column. The pristine coir is modified by Layer by Layer (LbL) technique using a combination of CHI/PAA polyions, which forms an effective multilayer. The High Performance Liquid Chromatography (HPLC) was used for the evaluation of concentration of pharmaceuticals in the feed and permeate solutions. The pristine coir fibre itself is a good adsorbent material for lidocaine and propranolol. After the modification of pristine coir by LBL technique results 82% removal of Isoniazid. It is noted that the removal efficiency of Isoniazid enhanced by LbL modified coir fiber. The HPLC chromatogram of one of the selected pharmaceutical, lidocaine befor and after treatment is presented in Fig (1).



(a) (b)

Figure.1. Chromatogram showing Lidocaine standard (a) and adsorption of Lidocaine in coir fiber(b).

Acknowledgements:

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P-20

Removal of Chromium (VI) from waste water using green synthesized iron nanoparticles with the seed extract of *Canavaliacathartica*

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In this work, iron nanoparticles (FeNP-CC) were prepared by using the aqueous seed extract of *Canavaliacathartica* (CC) plant.The importance of the present piece of work is to ascertain the potential of FeNP-CC for the removal of Cr (VI) ions from contaminated water. The as-prepared

FeNP-CC was stabilised in aqueous solution through phytochemicals extracted from the seeds of CC. The functional groups present in the bio-ligands acts as reducing and stabilising agents in the formation of nanoparticles. FeNP-CC was characterized using UV-vis spectroscopy, FTIR, HR-TEM and XRD.The as-synthesized iron nanoparticles demonstrated high ferric reducing ability in FRAP assay with an EC50 of 3.56 ± 0.28 µg/ml, which could be attributed to the high phenolic content of CC extract.Greater reducing power of FeNP-CC was also confirmed from total antioxidant capacity (TAC) assay where it was found that reducing power of 1g of FeNP-CC, is almost equivalent to 1.03g of trolox.FeNP-CC was successfully applied for the removal of Cr (VI) ions from laboratory waste water. The reaction conditions for Cr (VI) removal were optimized. From the results, removal of Cr (VI) followed pseudo-second order kinetics and showed a perfect fit (R^2= 0.99) with Freundlich isotherm model.

P-21

Removal of endrin from aqueous solution using biochar derived from goat dung: Effect of pyrolysis temperature

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Biochar (BC) is a carbon-rich product generated from the incomplete combustion of biomass through pyrolysis.For the present study, BC produced from goat dung (GDBC) through slow pyrolysis at 300 and 500 °C(GDBC300 and GDBC 500) were characterized by FT-IR, SEM, BET and pore size distribution. The effects of GDBC300 and GDBC500 on the removal efficiency of endrin from water were examined through laboratory experiments according to OECD guideline. Adsorption kinetics and equilibrium studies were performed using the batch adsorption method. Stock solution of endrin (~ 20mg/L) were prepared by dissolving the endrin with acetone and diluted into specific concentrations with a background solution containing 0.01M $CaCl_2$ solution. The kinetic studies of the adsorption of endrin from water was carried out using adsorbent-water (1g/L) in 50-mL test tubes for 48 h at 30°C. The containers were equilibrated on an incubator shaker at 30°C and agitated at 120 -150 rpm. Samples were withdrawn from the shaker at predetermined time intervals (0.5, 1, 2, 4, 6, 12, 24 and 48 h). Blanks, without biocharswere maintained as control. After equilibration, the suspension was centrifuged at 15,000rpm for 20min, an aliquot of the supernatant was taken and filtered through 0.2μm Nylon 6, 6 membrane filters and pesticide residues in the supernatant were quantified using gas chromatography mass spectrometry (GC-MS). For the GDBC500 and GDBC300 endrin adsorption capacity was 147μg/g and 76.32μg/g respectively at the initial adsorbate solution concentration of 200ppb. The removal efficiency of GDBC500 and GDBC300 for endrin was 73.56% and 38.14% respectively. Thebiochar produced at 500 °C showed greater sorption capacity due to its higher surface area and greater micropore volume. The sorption amounts (q_e) of endrin on the biochars increased with increasing pyrolysis temperature. The lower adsorption capacities of the biochars produced at 300°C in the study were attributed to the presence of fewer micropores and lower surface area. The addition of biochars with greater macroporous structures increased the adsorption capacity since micro and macropores are the main sites for binding and entrapment of endrin molecules. This study confirmed that GDBC500 biochar is an efficient adsorbent for the removal of the pesticide endrin from aqueous solution.

P-22

Studies on the role of Cu (II) ion on Protein Conformation and Misfolding

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Protein misfolding and aggregation are considered as the causes for a number of neurodegenerative disorders. Ageing, genetic and environmental factors are responsible for protein misfolding and aggregation. A number of invitro studies conducted has suggested the role of transition metal in accelerating protein aggregation. Of which divalent metal cation Cu (II) has a remarkable role in protein aggregation associated with neurodegenerative diseases. Besides an essential trace element Cu is toxic if present in excess or in free form inside the cells.Herein we initially investigated the interaction studies of Cu (II) ion with two vital proteins, bovine serum albumin (BSA) and human serum albumin (HSA) using fluorescence spectroscopy.The results from fluorescence spectroscopy indicates that Cu (II) ion haseffectively quenched the intrinsic fluorescence of both serum albumins through a static quenching mediated mechanism. Confirmation for this is further obtained from the results of time correlated single photon counting measurements and UV-Vis spectroscopy. The quenching rate constant K_q calculated for both serum albumins (BSA -1.601 x 10^{12} $Mol^{-1}s^{-1}$, HSA-0.984 x 10^{12} $Mol^{-1}s^{-1}$) is found to be two order of magnitude greater than the maximum scatter collision quenching constant for various quenchers with biopolymer 2×10^{10} Mol^{-1} s^{-1}. The secondary structural changes for both serum albumins in the presence of Cu (II) ion was analysed with the help of synchronous fluorescence and Fourier transform Infrared (FTIR) spectroscopy. The morphological changes for both serum albumins upon interaction with Cu (II) ion was also examined with the help of Atomic force microscopy imaging technique. Molecular docking was further employed to examine the binding sites and the nature of the interacting forces that exist between serum albumins and Cu (II) ion.

P-23

Spectroscopic and Molecular Docking Studies on the Interaction of Glyphosate and its derivatives to Serum albumins

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Glyphosate N-(phosphonomethyl) Glycine is a systemic, broad-spectrum organophosphorus herbicide frequently present in all environmental matrices. International Agency for research on Cancer (IARC) claimed Glyphosate as a probable carcinogen to humans and categorised it as a Group 2A carcinogen. But European food Safety Authority (EFSA) and European Chemical Agency (ECHA) reported that there is no supporting evidence for claiming glyphosate as a carcinogen. However its widespread use resulted in environmental contamination, therefore its detection in environmental samples and the study of its possible impact on human health is important. In the present study glyphosate herbicide, its derivative Aminomethylphosphonic acid (AMPA) and one of

its commercially available product Round Up was used for the interaction studies with serum albumins. The interaction studies were characterised with the help of fluorescence spectroscopy, Time correlated single photon counting measurements, synchronous fluorescence, UV-Vis Spectroscopy and Molecular modelling methods. All the techniques illustrated that glyphosate, AMPA and Round Up quenched the intrinsic fluorescence of serum albumins by static quenching mechanism. Further Glyphosate and Round Up interacted with serum albumins at pH 4.5 while that of AMPA at physiological pH 7.4 respectively.

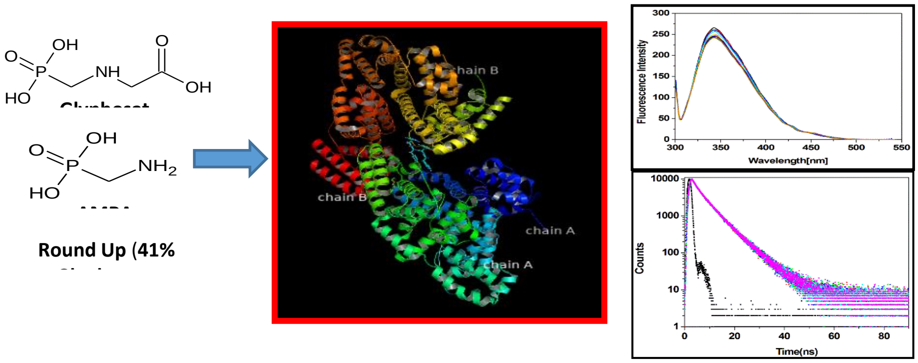

Figure.1.

P-24

Screening of Contaminants of Emerging Concern (CECs) in rainwater samples using HRMS

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Contaminants of emerging concern (CECs) are those compounds that are not properly monitored or regulated in the environment. They belong to various classes like pharmaceuticals, personal care products, flame retardants, artificial sweeteners, dyes, etc. The widespread occurrence of CECs has been reported in air, water, and sediments. However, only a limited number of studies exist that indicate the occurrence of CECs in rainwater. We have carried out a study based on the screening of CECs in rainwater to fill this gap. The samples were collected from a tropical site located in the Southwestern part of India. Ten rainfall events were collected during June – July 2020 for the study. The samples were homogenized and concentrated using Oasis HLB cartridge before the analysis. The analysis of the samples was carried out using UPLC – QTOF-MS. The chromatographic separation was achieved with the C18 column under gradient elution conditions using water with 0.1% formic acid and acetonitrile. The results indicated the presence of six contaminants belonging to different classes like dyes, pharmaceuticals, and surfactants as given in the table. Theis the first report on the presence of CECs in rainfall from this region.

Table.1. List of compounds identified from HRMS analysis of rainfall samples:

	Compounds	Chemical Formulae	Ionization mode	ppm error	m/z value measured	m/z value theoretical	Suspected sources
1	1-Octylpyrrolidone	$C_{12}H_{23}NO$	$[M+H]^+$	2.522	198.1857	198.1852	Surfactants
2	Miglustat	$C_{10}H_{21}NO_4$	$[M+H]^+$	3.633	220.1551	220.1543	Pharmaceuticals
3	Ditolylguanidine	$C_{15}H_{17}N_3$	$[M+H]^+$	2.498	240.1501	240.1495	Pharmaceuticals
4	Brefeldrin A	$C_{16}H_{24}O_4$	$[M+H]^+$	1.066	281.1750	281.1747	Pharmaceuticals
5	Oil blue 35	$C_{22}H_{26}N_2O_2$	$[M+H]^+$	1.423	351.2072	351.2067	Dyes
6	Sudan Blue	$C_{18}H_{15}N_2O_2$	$[M+H]^+$	1.355	295.1445	295.1441	Dyes

Acknowledgment:

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P-25

Adsorptive Removal of Diclofenac using Amino Functionalized Metal organic framework

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Metal Organic Frameworks (MOFs) are fascinating class of crystalline porous materials. High specific surface area, presence of functional groups and tunable poresize makes them an excellent material for water purification. Diclofenac sodium (DCF) is a common non-steroidal anti-inflammatory agent and is falls into the category of biologically active pharmaceutical and personal care products (PPCPs). Adsorptive removal of DCF from aqueous solution was studied using amino functionalized Aluminium based MOF. The MOF was synthesized by solvothermal method at 129^{0}C and characterized using FTIR spectroscopy. The adsorption studies were carried out using DCF (10ppm) at a solution pH in the range of 3 to 9 (using HCl and NaOH). Concentration of DCF was evaluated using high performance liquid chromatography (HPLC). Effect of MOF weight on percentage removal of DCF was studied by adding 2 - 10 mg of MOF in DCF solution (pH 5). NH_2-MOF showed above 90% adsorption capacity in all the studied pH. Adsorption at pH 4, 5 and 6 showed above 95% removal and the removal efficiency improved with increase in the weight of MOF from 42 to 98%. In the FTIR spectrum of NH_2-MOF the peak intensity at 1570 cm^{-1} was significantly decreased and one peak at 1110 cm^{-1} was completely disappeared after DCF adsorption. A new peak appears in the range of 950-1050 cm^{-1}.

Acknowledgement:

Amrutha Asokan is thankful to DST for providing the research fellowship

P-26

Selective extraction of mercury and its photometric determination with dithionein the organic phase

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A methodology has been proposed for highly selective and highly sensitive extraction photometric determination of mercury with dithione. Mercury (II) from a highly acidic environment in the presence of iodide ions and dimethylformamide (DMF) has been found to be quickly and selectively extracted by chloroform and benzene. When chloroform or benzene solution of dithioneand buffer solution with pH 2.5-14 is added to the extract and the aqueous-organic phases are shaken during 5-10 seconds, a painted complex compound is formed. The apparent molar repayment rate at a maximum light absorption of 610 nm is $7.1 \cdot 10^4$. The determination of mercury (II) is not prevented by 10,000 to 60,000 foreign ions within an error range of 2-5%.

The developed method has been applied to the analysis of industrial wastewater. The analysis time is 2-3 minutes, relative to the standard deviation of 0.02. The correctness and reproducibility of the method has been verified by the methods of additives in waste water. The method can be used to determine micro-containing mercury in air, biological materials, ores, rocks and other chemically complex materials without prior separation of accompanying elements.

The paper investigates conditions of selective extraction of a colorless halogenic complex of mercury (II) by inert organic solvents and its complexation with dithionedirectly in an organic phase, with the purpose of development of a highly selective, simple and accelerated method of extraction-photometric definition of mercury without preliminary separation of accompanying elements.Mercury and its compounds can be used in chemical technology, metallurgy, medicine, instrumentation, the electrical industry, agriculture, dyestuff production, mining and other fields of modern technology.

There has been increased attention recently to the problem of micromercuarism - the manifestation of exposure to low mercury concentrations. According to normative #1324-47, the maximum permissible concentration of mercury in the air of industrial premises is 0.01mg/m^3. However, recent research has identified 0.002-0.003 mg/m^3 as the new maximum permissible concentration of mercury in the air of the working area. Due to volatility and toxicity of mercury, certain safety measures must be observed when working with it.

As a result of the research, a new highly selective, accelerated and simple extraction-photometric method for determining mercury directly in the organic phase has been developed.

Therefore, the developed method of extraction-photometric determination of mercury is recommended for the analysis of mercury in industrial wastewater, ores, rocks, concentrates, industrial waste and other chemically complex materials.

P-27

Selective extraction of iron (III) and its spectrophotometric determination directly in the organic phase

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The developed method of extraction of iron (W) and the spectroscopic determination of iron directly in the organic phase differ from the existing selectivity, sensitivity, simplicity, rapidity and is recommended for the analysis of production solutions, waste water, ores, concentrates and other chemically complex materials without separation of accompanying elements directly in the organic phase.

Many chemical compounds and toxic metals are known to dissolve in droplets of moisture as pollutants into soil and water as a result of the operation of enterprises, plants and factories with atmospheric precipitation. Contamination environments heavy toxic metals and their compounds form a significant group of ecotoxicants, which largely determine the anthropogenic impact on the ecological structure of our environment and on mankind itself. Considering the ever-increasing production and use of heavy toxic metals, high toxicity and the ability to accumulate in the human body, it can have harmful effects even at low concentrations. These chemical pollutants have been identified as a priority. These ecotoxicants also include iron, copper, cadmium, nickel and others. Therefore, the relevance of the work presented is obvious and up-to-date. The search for selective ecoanalytical methods for identifying ecotoxicants in chemically complex materials is an urgent task.

Experience has shown that iron (III) from a highly acidic environment in the presence of rhodanide ions and dimethylformamide (DMF) is well extracted by benzene. A study of the extraction of iron (III) from benzene as a function of hydrogen, rhodanide ions and DMF concentrations has shown that the optimum conditions for the extraction of iron (III) are the best: 2.0-3.5 M for H_2SO_4, 0.3-2.0 M for rhodanide ions and 10-25 vol.% (for volume) of DMF. The duration of shaking phases is 3-5 seconds. With equal volumes of aqueous and organic phases, extraction of iron

(III) at single extraction is 99.9% and does not change to a 40:1 ratio of phase volumes.

The research has resulted in a new method of selective and sensitive extraction-spectrophotometric determination of iron directly in the organic phase. The extraction mechanism was identified and the structure of the complexes in the extract was determined, and certain conclusions were drawn on increasing the selectivity and sensitivity of the method for determining elements and the most analytically valuable reagents.

Therefore, the developed method of extraction-spectrophotometric determination of iron is distinguished by its high selectivity, sensitivity, ease of execution and rapidity and is recommended for the analysis of production solutions, wastewater, ores, concentrates and other chemically complex materials without separating the accompanying elements directly in the organic phase.

P-28

Occurrence of pharmaceutical compoundsand ecotoxicological impact of its discharge From selected wastewater treatment plants.

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Non-steroidal anti-inflammatory drugs (NSAIDs) (aspirin, ibuprofen, naproxen, ketoprofen, and diclofenac) were assessed in three selected wastewater treatment plants (WWTPs) and the receiving river in southwestern India The NSAIDs concentrations in the influents of the WWTPs ranged from 125-184 µg/L for aspirin, 5-22 µg/L for ibuprofen, 11-217µg/L for naproxen, 3-41 µg/L for ketoprofen and 12-68 µg/L for diclofenac, respectively. Effluent concentrations ranged from 0.4-0.7 µg/L for aspirin, 0.1-2 µg/L for ibuprofen, 3-14 µg/L for naproxen, 0.6-0.8µg/L for ketoprofen and 2-26µg/L for diclofenac. The NSAIDs in the WWTPs were found in the order of aspirin > naproxen > diclofenac >

ketoprofen > ibuprofen. In the Gurupura river, aspirin (0.02 μg/L), ibuprofen (0.17 μg/L), naproxen (8.8 μg/L), ketoprofen (1.5 μg/L) and diclofenac (1.6 μg/L) were quantified. Hazard quotient (HQ) in the effluents of WWTPs and river water was measured for different aquatic species. The results showed a medium risk of ibuprofen and naproxenfor the polyp Hydra attenuata. The persistent discharge of NSAIDs into the river will lead to the adverse effects to the resident organisms.

P-29

Assessment of metal contamination in the sediments of Sita –Swarna Estuary, southwest coast of India

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The present study aims to determine the pollution status of sediments in the Sita-Swarna estuary using different geochemical approaches like geoaccumulation index and enrichment factor. The elements were normalized to a reference element aluminium, to compensate for grain size and mineralogical effects. The core collected was subsampled at 2cm interval and depth-wise distribution of sand, silt, clay, organic carbon, major elements (Al, Fe, and Mn) and trace elements (As, Zn, Cd, Cu, Cr, Ni, Co, and Pb) were investigated.The sediment samples were subjected to the total digestion technique and were analyzed by using inductively coupled plasma optical emission spectroscopy (ICP-OES). Certified estuarine reference standard, BCR 667 was digested and run along with the samples. The accuracy of the samples and the reference standards were found to be less than 6 % and sample repeatability was within 5%. Pearson correlation and factor analysis performed for the data set showed a very good association of the metals with the finer fractions and oxyhydroxides of Fe and Mn.All the metals showed good interrelationship among each highlighting the common source of origin. The study revealed highest EF value for Cd (18) followed by Zn (3.7), Pb (2.9), As (2.2), Co (2.1), Cr (1.1), Ni (0.6), Fe (0.6), Mn (0.2), and Cu (0.2). Furthermore, it is similar to the geo accumulation index which also indicates higher values for Cd (2.5), thereby showing moderate to high pollution.Greater values of Zn can be attributed to surface runoff and input of organic wastes which is associated with municipal sewage and solid waste. Also,the high concentration of Cd is mainly because of the

anthropogenic sources in the catchment. It can be inferred from the analysis that the catchment demonstrated extreme enrichment for Cd that needs to be tackled immediately to avoid the fragile coastal climate.

P-30

Diclofenac removal by sludge derived hydrochar

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Sludge is a semi-solid slurry discharged from primary and secondary clarifiers in the effluent treatment plant of industries. It is a heterogeneous biomass material containing very merger solid (10%) and higher moisture content (90%) (Oumabady et al., 2020). Handling and disposal of effluent treatment plant sludge is challenging task for every industry, since it possess many regulatory issues and high management cost besides environmental degradation. Hydrothermal carbonization (HTC) or wet torrefaction serves to overcome the energy-intensive drying process for the management of organic feedstock with higher moisture content. The surface modified carbon products generated from HTC known as hydrochar which widens the array of their applications *i.e.* energy application, energy storage, adsorbents and soil application. The adsorption capacity of hydrochar can be increased by activation using chemical agent like KOH(Spataru et al., 2016).The global production of paper accounts for about 413 million tons in 2017 (FAOSTAT, 2018) of which India accounts for 3.18% of paper, paperboard and newsprint production per annum. These paper products are recycled after utilization through paper board mill industries thereby producing recycled paper and packaging materials. The effluent treatment plants (ETP) of these industries generates solid waste known as paper board mill sludge which are managed by landfill formations and incineration.On the other hand, the emerging contaminants which are entering the aquatic environment can be removed through the application of hydrochar as a low cost adsorbent. Diclofenac, an anti-inflammatory non-steroidal drug with ubiquitous source leads to significant impacts on aquatic species as it remains biologically active and it enters in food chain.Current study demonstrates the KOH activation of hydrochar and evaluating its potential towards the removal of anti-inflammatory drug Diclofenac in aqueous solution. The activated hydrochar was characterized for structural morphologies, surface functionalities and textural features.The activation resulted in the production of carbon nanospheres ranging between 20nm to 60nm. Additionally, the KOH promoted the removal of impurities from cracks and pores of activated hydrochars thus making it as a cleaner surface. Kinetics and sorption isotherms have been determined considering the effect of initial Diclofenac concentration and contact time. The adsorption kinetics exhibited second-order reaction for all adsorbents indicating higher coefficient of determination ($R^2 > 0.99$). The post-activated hydrochar recorded a highest removal of 37.23mg g^{-1} at Diclofenac concentration of 40mg L^{-1} after 15 hours. The formation of microspheres, pores and oxygenated functional groups due to intensive carbonization during KOH activation helped in the enhancement of hydrochar adsorption potential for diclofenac.

P-31

Progress in safe drinking water accessibility in kerala

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Water is a finite resource without which there is no life on Earth. Water accessibility is a basic human right, but increasing water consumption patterns threatens the sustainability of this resource. Attaining universal and equitable access to safe and affordable drinking water for all by 2030 has been listed as the sixth SDG of UN. However, providing safe, adequate and reliable water supply remains as a challenge in many parts of the world as well as in India.

Kerala Water Authority (KWA) and Kerala Rural Water and Sanitation Agency (KRWSA) are the main agencies in Kerala responsible for drinking water supply. Kerala being a water-rich state, its level of safe drinking water (Tap water) accessibility through the Public Distribution System (PDS) remains low when compared with other Indian states, as per the secondary data available for the period 1981-2011. Hence, the present study investigates the extent of progress made in providing safe drinking water accessibility in the state of Kerala in relation to all India and

selected Indian states during 1981-2011; also outlines the status of safe and affordable drinking water accessibility in 2019.

Analysis of the secondary data from Census of India (2011) and Economic Review (2020) leads to the following findings:

- The progress made in providing safe drinking water accessibility at all India level and Kerala has shown an increase of 47.30 and 21.30 % points respectively during 1981-2011.
- However while comparing the growth perception, Kerala state has surpassed all India level with 174.59%, while it was 123.82% for all India.
- During the last decade of the study period 2001-11, water accessibility coverage in Kerala had improved by 9% points which made the state's progress a remarkable achievement.
- A change in life style became visible among the people of Kerala after 2000; most of them have switched from using traditional sources of water to piped water. It is quite evident from 2001-11 data, tap water accessibility had increased while dependency on well water had come down in all the districts of Kerala. Out of the 14 districts, 10 have exhibited their improvement above the national level. The progress made in water accessibility in these districts has placed Kerala above the all India level of progress.
- As per recent (2019) data, in Kerala, 56.38 % of the total population has access to drinking water. Ernakulam has a better range of water supply network covering 84.14 % of its population, while Kasargod was noted with the least water supply coverage (28.16 %).

In summary, the progress made in water supply sector of Kerala has played a role in improving its status of Governance among the rest of states in India. According to Public Affairs Index 2020, Kerala has been recognised as best governed state in India based on quality of governance in terms of equity index, growth index and sustainability index. Thus, Kerala is marching towards achieving the sixth goal of UN's SDG.

P-32

Treatment of Slaughterhouse Wastewater and Electricity Generation using Microbial Fuel Cell Techniques

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The ability of dual-chambered Microbial Fuel Cell (MFC), fed with slaughterhouse wastewater and anaerobic mixed-consortium as initial source of bacteria to generate electricity simultaneously coupled with remediation of pollutants are the focus of the study. Materials and Methods: The MFCs were fabricated with a plastic of poly methyl methacrylate (PMMA) sheet as a single unit for anode and cathode chambers having 2600 mL of total volume capacity. To compare the performance of electrodes having different surface area, perforated graphite rod and graphite sheet were used as electrodes in Fuel cell I and Fuel cell II respectively. Microporous PVC battery separator used as salt bridge to separate anode and cathode chambers, and fuel cells were operated at room temperature with pH of 6.65 for 33 days of operation in batch mode. Results and Discussion: Wastewater from Slaughterhouse/Meat Processing Plant (MPP) will leads to the polluting effect to surrounding areas due to the high levels of moderately solubilized residues of organics and pathogens present in wastewater together with detergents used for cleaning purposes, consequently having high chemical oxygen demand (COD). After continuous monitoring over a period of 33 days, the fuel cell II produced maximum voltage of .89 mV that derived a maximum current density of 335.25 of mA/m^2 and power density of 291.66 mW/m^2 with remarkable changes in removal efficiency of COD, nitrate, phosphate and sulphate. MFC treatment assisted the removal efficiency of COD up to 64%, Nitrate 33 %, Phosphate 89%, and Sulphate 20%. Applications: This study shows that the treatment of raw slaughterhouse wastewater is effective with MFC technique. It also recommends possibilities of more electricity production using stack of additional MFCs in series, along with it serves plenteously of benefits like alternative energy from renewable sources, reuse of wastewater, simple construction, and cost effectiveness.

P-33

Valorising wine industry waste for the removal of Cr (VI) from polluted waters

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A low-cost biosorbent for hexavalent chromium removal from aqueous solutions using wine industry waste such as the Palomino Fino grape seed has been proposed. The winery waste is rich in lignocellulosic compounds with significant active functional groups [Rani et al., 2020], which provide potential sorption sites of great interest for the removal of heavy metal ions from polluted waters. Cr (VI) is one of the main pollutants in surface water and groundwater [Tripathi and Chaurasia, 2020] and the use of low-cost biomaterials to avoid this pollution is of great interest. The study was carried out in batch scale and a two-level factorial design with three factors and two repetitions of the central point was conducted for the optimization of the biosorption process. The biosorption capacity was evaluated by conducting experiments where the biomass was in contact with the metal solution, analysing afterwards the metallic concentration by atomic absorption spectroscopy.The highest percentage of Cr (VI) biosorption was achieved when using pH 5.5, 15 g/L of biosorbent and 8 h of contact time, being the pH of the solutions asignificant factoron the sorption process. Structural analysis of biosorbent before and after the sorption process was performed using Fourier transform infrared spectroscopy. Langmuir, Freundlich and Temkin adsorption isotherm equations were used in the equilibrium modelling and Freundlich model showed best fit (R^2= 0.994). The adsorption process followed pseudo first-order kinetics (R^2 = 0.974) and physisorption was found to be the rate-controlling step. Thermodynamic parameters were evaluated to find out the feasibility of the sorption process. The positive enthalpy values showed an endothermic nature of the process and the value of sticking probability confirmed the results of the kinetic study. The biosorption capacity was 91.7±0.6 %, showing a linear behaviour in the studied range for the initial Cr(VI) concentration (n=6, confidence level of 95%). As conclusion, this easily available residue offers very good properties as biosorbent for the removal of Cr(VI) from polluted waters.

P-34

Leachate from municipal solid waste: A potential threat to the environment

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The municipal solid waste (MSW) generation globally exceeds 2 billion tons per year, and the management of this massive volume of waste is a challenging issue. On average, the per capita municipal solid waste generation in developed countries is 522 to 759 kg per year, whereas, in developing countries, it is 110 to 526 kg per year (Karak et al., 2012). Studies suggest that more than 90% of MSW is managed unscientifically in developing countries. This improper management of MSW leads to several environmental and health problems. The high strength wastewater coming out of the MSW during its degradation called leachate poses a significant threat to the surrounding environment and human health (Arunbabu et al., 2017). The leachate is generated during different waste management stages, including storage, transportation, treatment and disposal. The high strength and variability in the leachate characteristics make its treatment as challenging and in most of the developing countries, the leachate is discharged untreated into the environment. Therefore, understanding the characteristics of leachate is a pre-requisite for its successful treatment and disposal. From the literature studied, there is a paucity of data available on leachate characteristics from MSW management facilities, especially in India. Therefore, in the present study, we attempted to characterize the leachate from the Brahmapuram MSW treatment plant in Kochi, Kerala, India. We also evaluated the pollution potential of leachate using the Leachate Pollution Index (LPI) (Kumar and Alappat, 2005). The leachate is characterized by high organic and nitrogen content. The leachate's LPI value was found to be high, which indicates its high potential for environmental contamination and demands proper treatment before discharging into the environment.

P-35

Water quality analysis of Kuttiady River with special reference to saline water intrusion

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The present study focus on the water quality analysis of Kuttiyadi River, Kerala, with special reference to saline water intrusion. Salinity intrusion has a serious effect on the water supply in the Kuttiyadi river basin area in the recent years. Kuttiyadi River is the only source of water for supply during summer in Vadakara Municipality and nearby villages, so the saline water intrusion affect the availability of fresh water for supply. The upstream sampling point which 22.5 km from the river mouth has salinity of 6.83 ‰ showed the rate of intensity of saline intrusion. Through Water quality analysis it is found that salt water intrusion in the river also leads to contamination ground water in the river sides. The results showed significant correlation with salinity and anions like Chloride, and Sulfate. Cations like Magnesium, Sodium, Calcium and Potassium are also significantly correlated with salinity of both surface water and ground water.

P-36

Temporal and spatial variations in the hydrochemistry of a tropical river, the Kali, southwestern India

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The relationship between the spatial and temporal variability of river hydrochemistry and the catchment processes of the large tropical river Kali in southwest India was studied to trace the catchment scale controls on riverine chemistry. Surface water sampling was conducted during monsoon (2018), post-monsoon (2018) and pre-monsoon (2019) seasons

to record the pattern of riverine chemistry in space and time. Cationic and anionic abundance of surface waters follow the order of $Na^+ > Ca^{2+} > Mg^{2+} > K^+$ and $HCO_3^- > Cl^- > SO_4^{2-} > NO_3^- > F^-$ respectively. Concentration of all the major ions are observed higher in Crocodile-Hunk region during three monitoring seasons. Various hydrochemical parameters determining the suitability of water for irrigation (e.g., % sodium, Sodium Adsorption Ratio, Permeability Index, and Residual Sodium Carbonate) reveals that Kali River water (except Crocodile-Hunk) is suitable for irrigation purposes. Both chemical weathering and anthropogenic activities influence the hydrochemistry of Kali River is controlled by monsoon- driven climatic seasonality and discharge. Long-term monitoring on hydrochemistry of mountainous rivers are crucial in context of climate change.

P-37

Microplastic particles (MPs) contamination in different brands of table salt in kerala, India

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Microplastics (MPs) are emerging pollutants of increasing environmental concern with a particle size less than 5 mm. The microplastics are released into the environment from primary sources (personal care products, synthetic textiles), as well as from secondary sources (fragmentation of large plastics). Microplastics are recognized as one of the major pollutants of the marine environment. The presence of microplastics in the marine sediments[1], beaches[2], lake sediment[3] as well as invertebrates in coastal waters[4] along the Indian coasts has been reported in the literature. However, reports on the MPs contamination in Indian sea salts are scarce. Hence the present study was carried out with the aim to evaluate the contamination of microplastics (MPs) in different brands of salts which are commercially available in Kerala. Besides that, the characteristics of MPs including: shape, size and type of polymer present the salts were also investigated. Eight brands of table salts were purchased from various supermarkets and local markets in Kerala, including four different brands of crystal salt and four different brands of powdered salt. The salts were dissolved in water and centrifuged to remove the sand particle. The samples were then filtered and the filter papers were investigated with stereo microscope and Raman spectroscopy. Microplastics were observed in all the samples studied with number of particles ranging from 145 to 340 particles/ kg. Most of the particles fall within the size range of 200-500 µm. Fibres are the predominant shape of MPs observed, followed by film and irregular fragments. Raman spectrum analysis revealed the presence of various types of polymers, including Polyethylene, Polybutadiene, Polyethylene terephthalate, Nylon, Tetrafluoro ethylene, High density poly ethylene, Polystyrene and Polypropylene. The polymer type, particles size and a number of particles shows considerable variation among different brands. The findings of this study shows that the commercially available salts in Kerala are highly contaminated with microplastic particles (MPs). The predominant polymers observed in the present study are the most commonly used polymers by human beings; hence the plastic wastes discarded can be the major source of MPs in salts. Hence care must be taken to reduce the plastic usage and more attention is needed while discarding the plastic waste.

P-38

Mapping water environment using Cloud based machine learning remote sensing Algorithm

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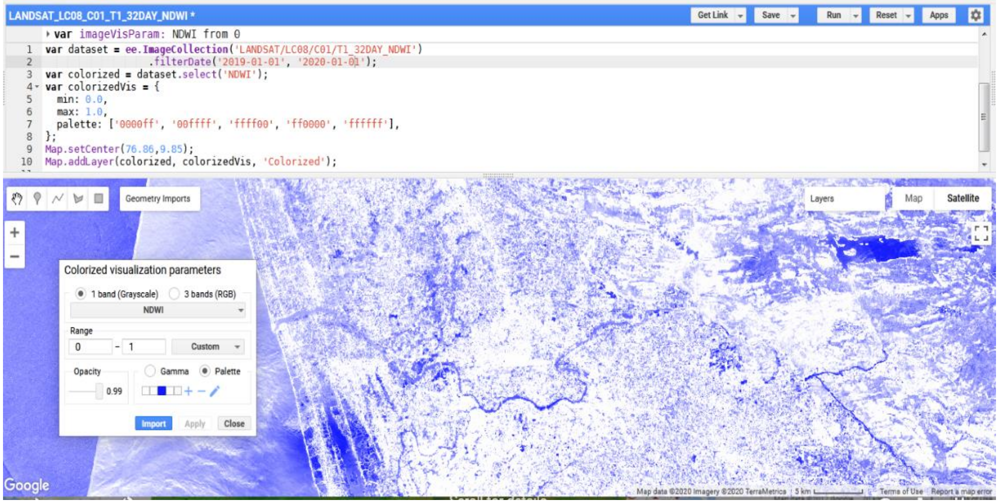
Extraction and mapping of water environments has gained attention for monitoring water pollution studies, flood extent zoning, wetland studies etc. The tremendous development of spatial agencies from recent past has increased the use of Earth Observation Satellite (EOS) systems.The spatial analysis has shifted its paradigm from proprietary software to open source and to cloud based computing through machine learning systems. The present study was conducted in cloud based machine learning platform to extract water environment of Ernakulum district. Geospatial analysis was run in Google Earth Engine (GEE) using JavaScripts Application Programming Interface (API). Sensor specific algorithm for Landsat 8 TIRS

OLI satellite image was used in this process. The method employed was Normalized Difference Water Index (NDWI) of McFeeters (1996)[1] spectral index. The results was attained from console as output. The study has attempted to extract and visualize water environments (Lake Ponds, Streams, canals, rivers, ponds, sea, estuary) and non water environments (impervious areas and vegited and semi wet vegetated area) through GEE cloud computing machine learning algorithm. The GEE has ability and stands unique for end users of various administrative departments for tackling disaster emergency and provide decision support systems of any place the computing time for decision making can be reduced through such machine learning approach.



```
var imageVisParam: NDWI from 0
var dataset = ee.ImageCollection('LANDSAT/LC08/C01/T1_32DAY_NDWI')
                  .filterDate('2019-01-01', '2020-01-01');
var colorized = dataset.select('NDWI');
var colorizedVis = {
  min: 0.0,
  max: 1.0,
  palette: ['0000ff', '00ffff', 'ffff00', 'ff0000', 'ffffff'],
};
Map.setCenter(76.86,9.85);
Map.addLayer(colorized, colorizedVis, 'Colorized');
```

Colorized visualization parameters

● 1 band (Grayscale) ○ 3 bands (RGB)

NDWI

Range 0 - 1 Custom

Opacity 0.99

○ Gamma ● Palette

Import Apply Close

Figure.1. Normalized Difference Water Index (NDWI) of ROI Method 1 (Note: Blue gradients were water environments and white color)

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List of Participants

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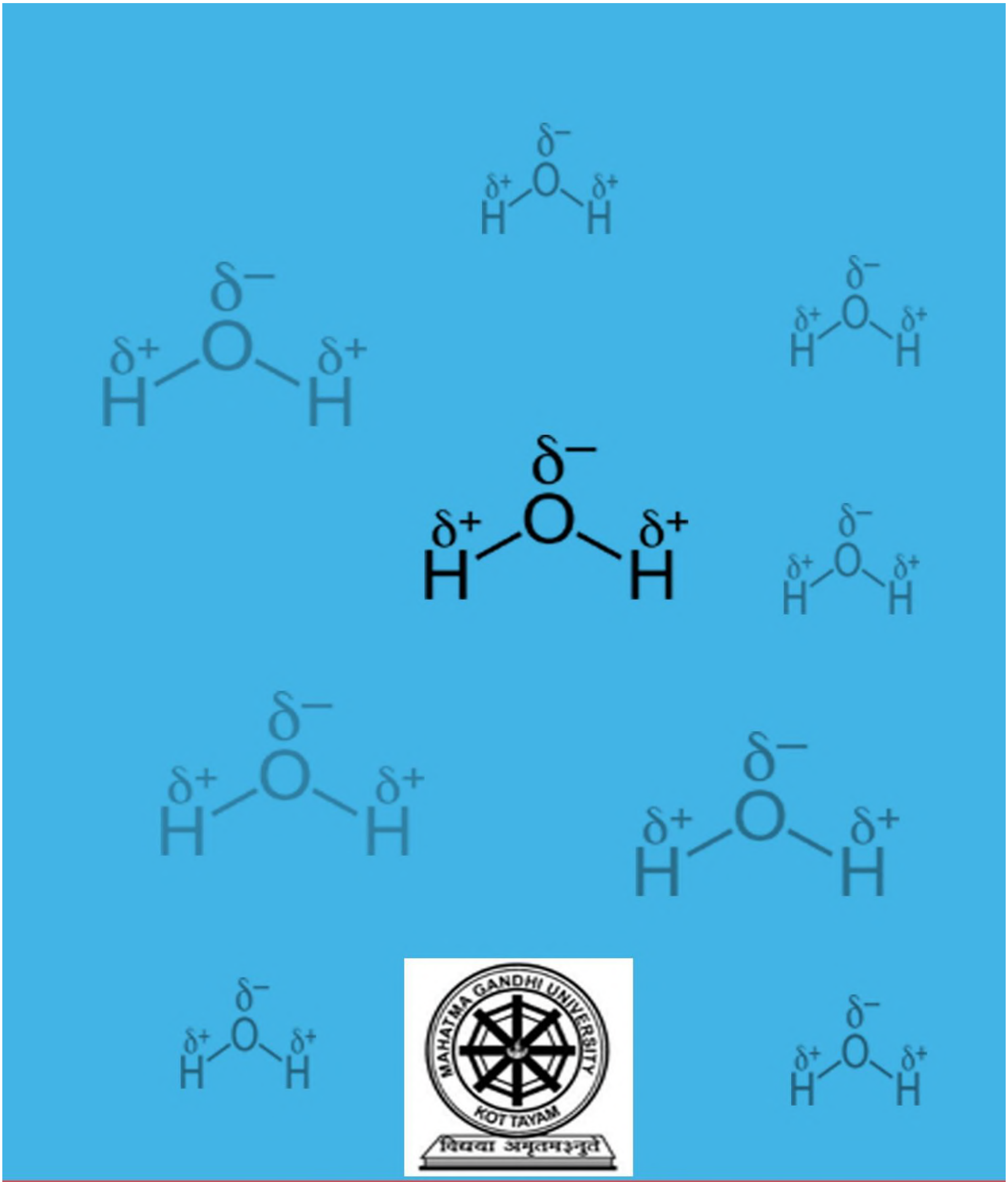

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