2nd International Conference on

"Advances in Water Treatment and Management"

(ICAWTM-23)

11-12 March 2023

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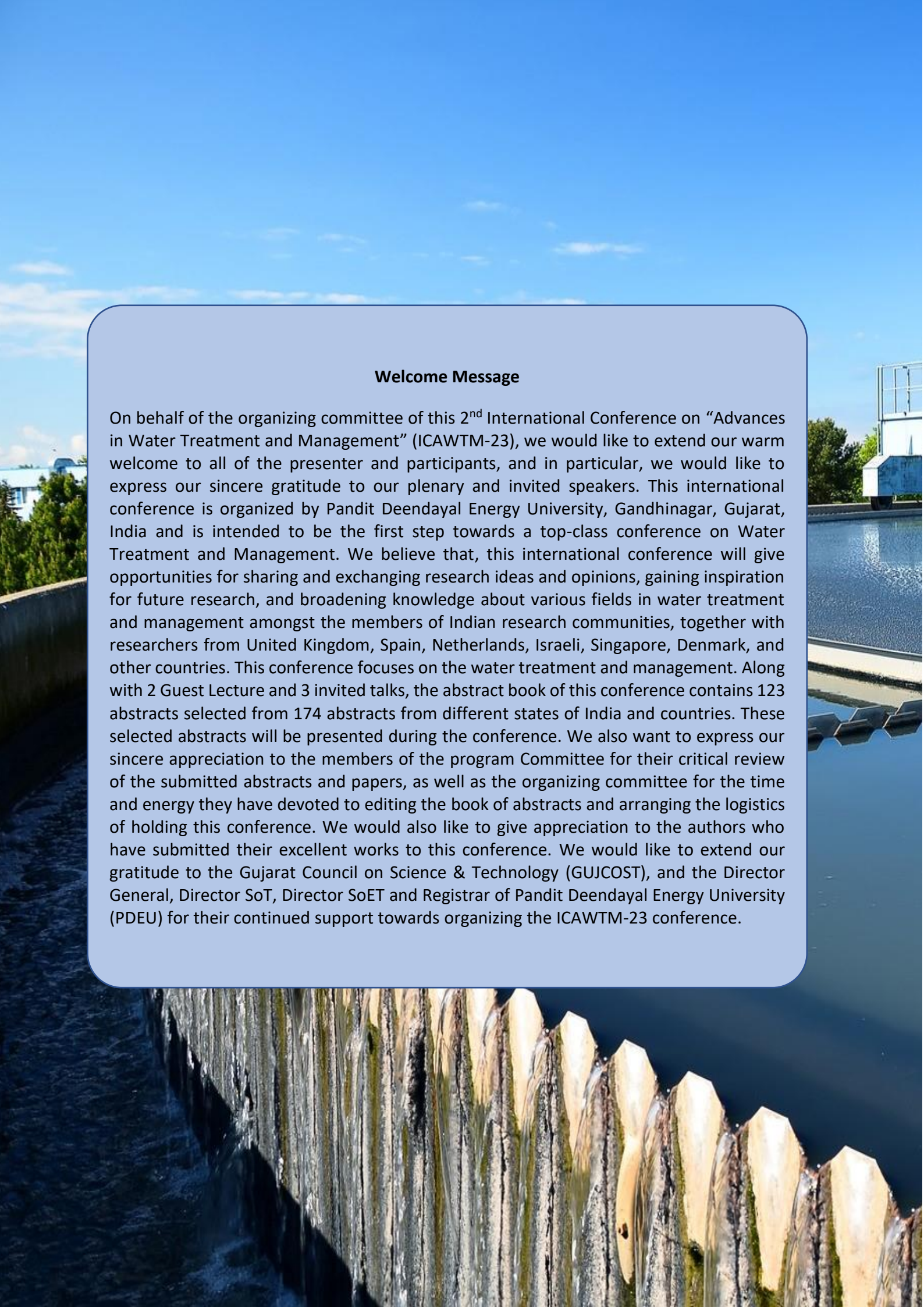

Welcome Message

On behalf of the organizing committee of this 2nd International Conference on "Advances in Water Treatment and Management" (ICAWTM-23), we would like to extend our warm welcome to all of the presenter and participants, and in particular, we would like to express our sincere gratitude to our plenary and invited speakers. This international conference is organized by Pandit Deendayal Energy University, Gandhinagar, Gujarat, India and is intended to be the first step towards a top-class conference on Water Treatment and Management. We believe that, this international conference will give opportunities for sharing and exchanging research ideas and opinions, gaining inspiration for future research, and broadening knowledge about various fields in water treatment and management amongst the members of Indian research communities, together with researchers from United Kingdom, Spain, Netherlands, Israeli, Singapore, Denmark, and other countries. This conference focuses on the water treatment and management. Along with 2 Guest Lecture and 3 invited talks, the abstract book of this conference contains 123 abstracts selected from 174 abstracts from different states of India and countries. These selected abstracts will be presented during the conference. We also want to express our sincere appreciation to the members of the program Committee for their critical review of the submitted abstracts and papers, as well as the organizing committee for the time and energy they have devoted to editing the book of abstracts and arranging the logistics of holding this conference. We would also like to give appreciation to the authors who have submitted their excellent works to this conference. We would like to extend our gratitude to the Gujarat Council on Science & Technology (GUJCOST), and the Director General, Director SoT, Director SoET and Registrar of Pandit Deendayal Energy University (PDEU) for their continued support towards organizing the ICAWTM-23 conference.

2nd International Conference

on

Advances in Water Treatment and Management (ICAWTM-23)

11-12 March 2023

Pandit Deendayal Energy University

Knowledge Corridor, Raisan Village
Gandhinagar, Gujarat-382 426, INDIA

Book of Abstracts

About the Conference

Water is a pressing issue in current times. The increase in the urban population, limiting natural resources and improper water management has increased the need for effective & efficient water treatment strategies. This conference is specially designed to bring together an interdisciplinary team of researchers to share their expertise and research experience on recent trends in water treatment and management. The idea is to bring together like-minded agencies and stakeholders including research organizations, universities, NGOs and SMEs from India and abroad to share their expertise in low-cost water treatment, wastewater treatment, recycle and reuse. Conference includes keynote lectures and invited talks by eminent resource persons from reputed universities and organizations, poster presentations, paper presentations, and interactive sessions. The faculties from different colleges, research scholars, students and scientists will be given opportunity to demonstrate their own works and get valuable suggestions from experts. The conference aims to create an integrated learning environment and encourage academicians, researchers and students to develop various competencies and enhance their self–efficacy in different techniques for affordable and feasible water treatment and management options.

Themes

Thrust Area

- Novel water treatment options for sustainable solutions to clean water scarcity
- Water desalination
- Wastewater treatment and management

Sub Themes to be addressed in this conference include, but not limited to the following

- Membrane and thermal desalination technologies
- Electrochemical systems in water treatment
- Renewable energy-based water treatment technologies and Low-cost solutions
- Novel hybrid systems and module design
- Novel materials for water treatment
- Artificial Intelligence and Machine Learning application in water
- Pre-treatment and post-treatment processes
- Membrane fouling, control and Resources recovery from brine
- Brine/ Concentrate management
- Water recycling and reuse
- Wastewater treatment using immobilized microorganism technology
- Sustainability and water management
- Cost effective methods for removal of heavy metals
- Phytoremediation and Bioremediation technologies for contamination of organic pollutants
- Constructed wetlands for dealing with emerging problem of polluted water
- Ex-situ/ In-situ phytoremediation for treatment of polluted water
- Energy and sustainability, economic evaluation, case studies
- Water policies, governance and planning
- Water, food, energy nexus towards circular economy
- Future trends in water security
- Energy needs for the water sector
- Green technologies for sustainable water resources and Biomimetics/Nature-based solutions
- Water and energy in context of industry 4.0
- Decarbonization and future energy systems
- Energy-saving technologies
- Sustainable development goals implementation

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Devang M. Thaker

Member Secretary
Gujarat Pollution Control Board
Gandhinagar

Dr. Yogesh Kumar

Deputy Director
MOEFCC IRO (Integrated Regional Office)
Gandhinagar

Invited Speakers

Prof. Philip Davies

University of Birmingham
UK

Dr. Dominic Standing

Ben Gurion University
Israel

Mr. Dharmendra Gor

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Program at Glance

Day-1

9:30 to 10:30	Inauguration of the Conference
10:30 to 11: 00	Visit to Centre of Excellence in Water Treatment and Management
11:00 to 11:30	Keynote Lecture by **Devang M. Thaker**, Member Secretary, Gujarat Pollution Control Board, Gandhinagar
11:30 to 12:00	Keynote Lecture by **Dr. Yogesh Kumar**, Deputy Director, MOEFCC IRO (Integrated Regional Office), Gandhinagar
14:00 to 15:00	Poster Presentation
15:00 to 15:30	Invited Talk-1
15:45 to 17:30	Paper Presentation WATER-001-WATER-034 (Track 1-4)

Day-2

9:30 to 10:00	Invited Talk-2
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A review study on biochar characteristics in removing pollutants from waste water

Devansh Shah [a], Madhav [a], Kashyap Tailor [a], Swapnil Dharaskar [a], Nagarjuna Reddy Paluvai [b], Suriapparao Dadi [a], Manish Kumar Sinha [a]*, Surendra Sasi Kumar Jampa [a, *]

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Abstract: The use of two or more material as feedstocks which is known as Co-pyrolysis has received a great increasing attention. This is because of its significant role in avoiding the weakness of all the products made from normal pyrolysis of individual feedstocks. The properties of biochar and enhancement of yield can become so easy through co-pyrolysis, like it improves pore structure, reduce ash content, increase heating value, and also enhance a very good adsorption performance towards a variety of pollutants. It has a great benefit added of decrease in quantity of waste and avoiding pollution issue. In this article we have focused on co-pyrolysis of different feedstock blends to biochar. The effects and influences of co-pyrolysis variables on yields and its characteristics of biochar has also been discussed in paper. It's applications as adsorbents on organic and inorganic pollutants has also been discussed briefly. The important future scopes and developments of co-pyrolysis into biochar is also included. In short, the paper includes extensively tasted pollutants, discussion on adsorption model, very effective use of feedstocks and synergic behaviour in co-pyrolysis to biochar adsorbent.

Keywords*: Biochar; Pollutants; Co-pyrolysis; Adsorption*

Rare Earth Element extraction from Geothermal brine using Hybrid Capacitive-deionisation process

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Abstract: Rare Earth Element (REE) in geothermal brine includes the pollutants such as dissolved Lanthanum, Cerium, Praseodymium, Neodymium, Promethium, Samarium, Europium, Gadolinium, Terbium, Dysprosium, Holmium, Erbium, Thulium, Ytterbium, lithium, and other ions, bacterial species. These REEs in geothermal brine is important for industry and harmful for agriculture and drinking purpose. Hence, identification, quantification, and extraction of these REEs are very important and economical for a geothermal plant. The present study systematically investigates the identification and quantification of the REE and other important ions in geothermal brine sources from Gujarat regions. For the extraction of REE from geothermal brine, geothermal brine treatment systems and their integration with automation control is designed in the present work. The proposed system filters geothermal brine and extracts REE through a hybrid filtration setup using capacitive deionization. Solar photovoltaic enabled Water Filtration using a hybrid Capacitive De-Ionization (CDI) treatment-based prototype to purify water and extracts REE. The proposed design allows the simultaneous removal of various dissolved organic and inorganic contaminants in geothermal brine.

Keywords*: Geothermal; Rare Earth Element; Water Treatment; Extraction; Treatment; Hybrid Method*

Effect of Chromophore Group on the Zero Valent Ion Decolorization Efficiency: Comparison of RR106 and RR120 Azo Dye Decolorization

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Abstract: The Chromophore is a group of certain atoms or electrons present in the dye structure. Additionally, auxochrome is another group of electrons or atoms in connection with chromophore responsible for strengthening the color. Hence, the effectiveness of any decolorization method solely depends on the molecular structure of the targeted dye. The zero-valent ions (Fe^0) are efficient electron donors and dye molecules are brilliant electron acceptors. Hence, this study compares the decolorization of single azo bond dye (RR106) and double azo bond dye (RR120) with lab-activated ZVI. The effect of the ZVI dose was investigated by varying the dose from 0.5, 1.0, 1.5, and 2.0 mg/L. RR106 showed 96% color removal with 2 mg/L of ZVI dose, while RR120 showed 69.3 % removal. 50, 100, and 150 mg/L dye concentrations were studied for both dyes. For all three dye concentrations, the removals were more than 93% for RR106 but it was relatively lesser and varied from 57.5 to 70.9 % for RR120. The usual degradation mechanism involves the conversion of Fe^0 to Fe^{+2} and H_2O_2 to Fe^{+3} in presence of oxygen. Hence, aeration plays a major role to increase treatment efficiency. For RR106 decolorization was increased from 46.7% to 94.7% when RPM was increased from 50 to 160. And for RR120 the decolorization was increased from 29.71 to 57.5% with an increase in RPM from 50 to 160. RR106 has only one azo bond with one acidic auxochrome (-OH) and 2 basic auxochromes ($-NH_2$) while RR120 has 2 azo bonds, 2 acidic auxochromes (-OH), and 4 basic auxochrome (-NHR). These larger numbers of chromophores and auxochromes are responsible for lesser decolorization of RR120 with the same dose of ZVI.

Keywords*: Chromophore Group; Azo Bond; RR106; RR120; Zero Valent Ion; ZVI*

Electrochemical Decolorization of RR120 Using Lab Prepared Mixed Metal Oxide Electrode: Comparison of NaCl and Na_2SO_4 as a Supporting Electrolyte

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Abstract: This study was performed with a lab-prepared mixed metal oxide electrode with 2.65 gm/cm^2 mixed metal oxide loading. A titanium plate was used as a base metal to fabricate the Ti/RuO_2-SnO_2-Sb_2O_5 electrode. The standard thermal decomposition (STD) method was used to fabricate the electrode. Electrochemical decolorization was carried out for 2 h at various current densities (1, 5, and 10 mA/cm^2). A pH of around 2 was maintained throughout the experimental study. Both the supporting electrolyte (NaCl and Na_2SO_4) were compared at a fixed dosage of 4 g/L. The effects of electrolytes were mainly examined in dye decolorization and energy consumption. The effects of various dye concentrations and current densities were also investigated for the electrolytes. This comparison study showed 99.77, 99.86, and 90.46%, dye decolorization after 2 h with NaCl electrolyte for 1, 5, and 10 mA/cm^2 CD for 50 mg/L dye solution. To achieve this much removal with NaCl electrolyte, around 0.03 x 10^{-4}, 0.4 x 10^{-4}, and 1.1 x 10^{-4} KWh/m^3 of energy was consumed. On the other hand, the Na_2SO_4 showed 78.87, 83.56, and 92.57%, dye decolorization for 1, 5, and 10 mA/cm^2 CD after 2 h for 50 mg/L dye solution. Similarly, Na_2SO_4 has demanded around 0.03 x 10^{-4}, 0.4 x 10^{-4}, and 1.4 x 10^{-4} kWh/m^3 energy. Both electrolytes were observed to be nearly identical as far as energy consumption is concerned. But, the decolorization efficiency of Na_2SO_4 was noted to be comparatively lesser. SO^{-2}, H_2O_2, and O_3 are the three main oxidants being produced with Na_2SO_4 electrolyte. HSO^- needs OH• to form SO^{-2}, thus OH• are being trapped by the intermediate reaction. On the other hand, when NaCl was used as a supporting electrolyte at an acidic pH, HOCl is generated, which enhances the decolorization.

Keywords*: Mixed Metal Oxide Electrode; Electrolyte; NaCl; Na_2SO_4*

Bioremediation of Environmental Pollutants using White rot Fungi

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Abstract: Environmental pollutants can have deleterious effects on human health and the environment. In order to mitigate these effects, various methods have been employed including chemical and physical degradation of the pollutants. However, these methods are often costly, ineffective, and/or toxic to humans and animals. Thus, researchers are exploring alternative strategies for remediation such as the use of fungi. WRF utilizing lignin as an energy source comprises fungi that break down xenobiotics and recalcitrant pollutants using peroxidases enzyme. White rot fungi degrade lignin and a bunch of other stuff with a lot of mechanisms. For lignin and environmental pollutants to be metabolized, both oxidative and reductive reactions are needed. The fungi make peroxidases that do both direct and indirect oxidation. Therefore, white rot fungi offer an excellent tool for bioremediation because they require very little energy input and work without the need for toxic chemicals or exposure to humans. One of the nutrients that promote the synthesis of enzymes, which influences pollution breakdown, is nitrogen. Different wood-rotting fungal strains should be examined for their capacity to break down xenobiotic substances using non-sterile soil samples. White rot fungi may be able to maximize pollutant degradation, which can support the creation of practical bioremediation techniques that are both effective and economical. Laboratory experiments have demonstrated the degradation of many hazardous chemicals and wastes. In addition to bacterial contamination, scaling up the process remains a technical challenge.

Keywords: *White Rot Fungi; Recalcitrant Pollutants; Peroxidases; Xenobiotics; Bioremediation; Lignin*

Photocatalytic degradation of levofloxacin by GO-TiO_2 under visible light

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Abstract: Carbon doped Titanium dioxide was prepared by doping graphene oxide through sol-gel method for the degradation of levofloxacin. The synthesised catalyst was characterised by XRD, FTIR, BET, DLS, CHNS and UV-vis. It was shown that doping increased the surface area and improved the visible light absorption. Furthermore, the results of the photocatalytic experiments show that the photodegradation rate of levofloxacin can be approached by pseudo first-order kinetics and it followed the Langmuir-Hinshelwood model. The doped catalyst with ~3% C degraded 74% levofloxacin within 3 hours under visible light (LED) and rate constant appeared to be 0.015 min^{-1}.

Keywords*: Photocatalysis; TiO_2; Levofloxacin; Wastewater; Sol-gel*

Recent advances in Chemical Oxygen Demand Detection Techniques: A Perspective

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Abstract: Water pollution is a significant problem globally, and measuring the amount of organic compounds in water is undoubtedly important for managing pollution levels. Chemical Oxygen Demand (COD) is a widely used parameter for assessing of the organic content in wastewater, which provides an indication of the level of treatment required. The measurement of COD is a critical aspect of wastewater management, and several detection techniques are available for this purpose. Being COD is an index for the appraisal of water quality; the proposed study aims to provide insights of an array of techniques for the detection and measurement of COD in wastewater which includes the Conventional, Standard detection methods along with their optimized methods and the new detection techniques with recent advancement in technologies to a great extent in Artificial Intelligence (AI) and Machine Learning (ML). The presented paper discusses the principles and advantages of various recent new COD detection techniques, including colorimetric, titrimetric, electrochemical, spectrophotometric, chemiluminescence, Thermal sensor, Flow injection analysis (FIA), Sequential injection analysis (SIA), and Microbial fuel cell (MFC) technologies. Nevertheless, the increasing awareness of environmental protection refers to the desideratum for an onsite, environmentally friendly, and rapid analytical method for the determination of COD along with simple, rapid, high precision, and cost-effective technique. The paper aims to provide a comprehensive understanding of COD detection techniques to help researchers in selecting the appropriate technique for their specific application along with future research directions which may focus on developing new and improved detection techniques that address the limitations of existing methods.

Keywords*: Chemical Oxygen Demand (COD); Wastewater; Detection; Standard Dichromate method*

Effect of Different Doses of Gamma-Ray Irradiation on Performance of Polysulfone Ultrafiltration Membrane

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Abstract: Despite various challenges that have the potential to reduce process efficiency, the development of membrane processes has accelerated across a variety of industries. The most significant obstacle to the widespread use of polymeric membranes is undoubtedly fouling, especially in pressure-driven membrane processes, which increases energy requirements and raises maintenance and operating costs. At different dose ranges, polymeric materials are susceptible to change when exposed to gamma radiation. Processing through gamma radiation can be an effective approach to deal with fouling issues. Therefore, this study is focused on the investigation of gamma radiation effects on the performance of the polysulfone (PSF) membrane synthesized by the direct blending method. The effectiveness of the membrane is evaluated by a comparative analysis of radiation cases before and after. At radiation dosages ranging from 0-70 kGy, the impact of gamma radiation on PSF membrane was examined using Field emission scanning electron microscope (FESEM), Fourier transform infrared-attenuated total reflection (FTIR-ATR) spectroscopy, Liquid–liquid displacement porosimetry (LLDP), pure water flux (PWF), water contact angle, bovine serum albumin (BSA) adsorption, solute rejection study, hydraulic permeability, and porosity. Furthermore, humic acid (HA) and BSA were used to study the rejection performance and antifouling properties of the irradiated and virgin membranes. The study emphasizes how significant changes in morphology and membrane separation properties with increasing radiation dosage lead to an improvement in membrane performance.

Keywords*: Polysulfone, Gamma Radiation, Fouling, Hydrophilicity, Radiation Dosage*

Adsorption of malachite green dye from aqueous solution on the bioadsorbent as low-cost adsorbent

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Abstract: There is a common industrial practice to release chemically harmful dyes to the environment in the form of discharge material, which gives a subject of global awareness. Many industries like food stuff, pulp and paper, textile, colour industries etc. releases colored discharge. The discharge of colour contaminated wastewater from the above industries may lead to the damage of the ecosystem. Due to their good solubility, they become common water pollutant. Removal of dyes from water now become very important because large number of dyes used in industries are highly toxic and cannot be removed by any simple method. Large number of methods have been developed to remove toxic colorings agent from wastewater include precipitation, electro kinetic coagulation, electro flotation, flocculation, irradiation, electrochemical destruction, membrane filtration, ion exchange and ozonation. Despite that, above processes are very costly and unable to use for small industries to treat large amount of industrial colored wastewater. The adsorption method gives an alternative for the removal of dye from contaminated water, especially when adsorbent is low cost and does not need pre-treatment step before its use. Various parameters like initial dye concentration, adsorbent dose, contact time, temperature, rpm and Ph will be studied in batch experiment. Basic dye Malachite green, elimination from the aqueous solution using bio adsorbent. Here batch experiments will be done to determine the effect of contact period, dose of adsorbent, pH, and initial concentration of dye. Isotherm models will be used to analyse the equilibrium data of adsorption of Malachite green dye on bioadsorbent. Pseudo first and second order models will be applied to study the obtained kinetic data at different initial dye concentration.

Keywords: *Malachite Green Dye; Bioadsorbent; Adsorption Isotherm Kinetics; Equilibrium*

Efficient removal of a food dye from wastewater onto coconut coir dust and its comparative illustration with other low-cost adsorbents

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Abstract: Coloured wastewater possesing toxicity in the form of various dyes were used in several industries including paper pulp, textile, food, paint etc. The treatment of these coloured toxicants through natural or agricultural waste is the demand of the current research. Biosorption is one of the best alternatives for dye removal from wastewater. Coconut coir dust (CCD) is a light weight material with great porosity and high air content, hence is choosen for the present study specimen. The present study describes the removal of toxic sunset yellow (SY) FCF from wastewater which is a commonly used coloring agent in food industry. The uptake capacity in batch and column mode is 82 mg/g and 160 mg/g respectively. The uptake capacity of SY follows the order as saal flower, eucalyptus leaf, mahua seed and coco dust with values of 26, 31, 43 and 82 mg/g respectively. Adsorption parameters like effluent pH, effluent dye concentration, dose, and contact time were optimised for estimation of adsorption capacity and rate constants. The output was better at high pH and lower concentration of dye. This study also emphasises on the comparative uptake capacities of the dye on other natural adsorbents. The uptake capacities of the dye has been tested using eucalyptus leaf powder, mahua seed powder, saal flower powder and compared with the coconut coir dust for better interpretation.

Keywords*: Biosorption; Sunset Yellow Dye; Coconut Coir Dust; Natural Adsorbents; Phytoremediation*

Fluoride Removal from Aqueous Solution Using Thermally Treated Dolomite Powder as Adsorbent

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Abstract: The objective of this paper was to evaluate the potential thermally activated dolomite powder (TADP) to remove fluoride ion from wastewater. Process variable are optimized for the effective fluoride removal and it is reported that dosage of adsorbent is 2.5mg, contact time is 60 min, particle size of adsorbent is 41.5µm, temperature of the solution is 35°C and pH is 7 for three initial concentrations (2ppm, 6ppm, 10ppm). Langmuir isotherm, Freundlich isotherm and Dubinin – Radushkevich (DR) model are applied to investigate the adsorption behavior. Both Langmuir and Freundlich have provided a best fit with R^2 0.9597 and 0.9542 respectively. It is observed through the study of thermodynamic parameters that the adsorption is exothermic and non-spontaneous. Adsorption kinetics is determined to adhere to the pseudo-second order model, with the coefficient of regression R^2 value of 0.982. The adsorbent SEM and XRD patterns were recorded to have a greater comprehension of adsorption process mechanism. Regeneration of TTDP adsorbent is done using a 1N NaOH solution.

Keywords*: Fluoride Removal; Adsorption Process; Treated Dolomite; Dynamic Model; Error Analysis; Regeneration*

Study of degradation of acid violet 7 dye using oxidising agents and ultrasonication

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Abstract: In the current study, Magnetic stirring homogenization of 150 mL solution when activated charcoal was used as an adsorbent was added to solution for degradation of acid dye Acid Violet-7 and ultrasonic bath with a working volume of 1 L were used to examine the sonochemical degradation of the acid Violet-7. It has been investigated how the decolorization is affected by treatment time, pH, adsorbent amount, initial concentration, and combination with oxidants such H_2O_2 and Fenton. It was proven that Acid Violet-7 dye may be efficiently removed using magnetic stirring homogenization and ultrasound when enhanced by additives by employing oxidants in combination with ultrasound to decolorize the dye. Almost 98% decolorization was recorded utilizing solely magnetic stirring homogenization under acidic circumstances (pH of 3), amount of adsorbent 0.6 g, initial dye concentration of 20 ppm at operating room temperature (25 ^oC). Also, the outcomes demonstrated that the decolorization for the sole ultrasound technique was preferred by reduced dye concentration, acidic surroundings, and room temperature (25 ^oC). Under the parameters of 20 ppm dye concentration, 150 W power, pH 3, and 40 kHz frequency, the maximum extent of decolorization for just the ultrasound-based procedure was 50.2%. Maximum effect for the combination techniques was shown for the Fenton reagent, resulting in nearly 100% decolorization. In comparison to Fenton, combinations of ultrasound and H2O2 showed somewhat reduced efficacy. It has been made abundantly obvious that treating effluents containing Acid Violet-7 dye in conjunction with optimum Fenton reagent in presence of H2O2 loading is effective. The goal of the study was to identify the optimal operational parameters for acid azo dye degradation that might be in good agreement with studies on actual effluent treatment.

Keywords*: Acid Violet 7 Dye (AV-7); Advanced Oxidation Process (AOP); Activated Charcoal (AC); Polytetrafluoroethylene (PTFE); Photo Fenton (PF); Ultrasound (US); Total Organic Carbon (TOC); Potassium Persulfate (KPS)*

Decolorization of Reactive Red 120 Dye Simulated Wastewater using UV/H_2O_2 Photolysis Process: Effect of Process Variables and Optimization using Response Surface Methodology

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Abstract: The decolorization of synthetic azo Reactive Red 120 (RR120) dye wastewater was investigated via UV/H_2O_2 process in a laboratory-scale batch photo-reactor equipped with a low-pressure mercury lamp. A preliminary study was conducted to understand the effect of various process variables like oxidant (H_2O_2) dose (20–120 mM)), initial dye concentration (100–200 mg/L), treatment time (0–75 minutes), initial pH (1–11) on the decolorization of RR120. Response surface methodology (RSM) was employed to assess individual and interactive effects of critical process parameters on treatment performance in terms of color removal efficiency. Optimized process conditions for UV/ H_2O_2 treatment of RR120 suggested by Box-Behnken Design (BBD) of RSM are H_2O_2 = 60 mM, initial pH = 4.6, initial dye concentration = 170 mg/L, and reaction time = 75 minutes. Under these conditions, 90% color removal was achieved, which is very close to the prediction given by the fitted model. The treatment cost of the UV/ H_2O_2 process was ~6 Rs/L.

Keywords*: Reactive Red 120; Azo Dye; UV/* H_2O_2*; Response Surface Methodology*

Treatment of Acid yellow 36 dye synthetic wastewater using low-cost waste agricultural materials for deriving activated carbon

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Abstract: The addition of dye to natural water bodies as a result of the wastewater discharged into rivers from the textile, cosmetic, and paper industries causes serious environmental problems. Dye wastewaters are objectionable due to the high colouring effect, pH shift, salt addition, and aesthetic problems in the water bodies. They hamper the photosynthetic activities of aquatic plants and are generally carcinogenic to animals. Although there are many technologies available for the treatment of dye wastewater, activated carbon adsorption is the most effective, dependable, affordable, and straightforward method. The present article describes the derivation process of efficient activated carbon adsorbents from waste agricultural materials and their utilization in wastewater treatment. In this study, activated carbon was prepared by discarded rice husk and coconut husk for adsorptive removal of Acid yellow 36 dye. Characterization of prepared activated carbons was done for the pH, moisture content, percent ash and Fourier transform Infrared (FTIR) analysis. The adsorption process was monitored by varying the experimental parameters, namely, pH, Adsorbent dose and dye concentration. The rice husk activated carbon (RH) gave 92 % dye removal and coconut husk activated carbon (CH) gave 83 % dye removal at an adsorbent dose of 1 g, pH 8 and dye concentration 100 mg/l. RH required time duration of 180 min. to achieve maximum removal, whereas CH required 90 min. to achieve its maximum removal. Further, the adsorption was modelled by Langmuir and Fruendlich models and the data was fitted in Pseudo first order and second order kinetics. Overall, the results showed that waste agricultural materials proved successful in decolourization of acid yellow 36 dye and provides a promising sustainable solution for similar dye wastewater treatment.

Keywords: *Adsorption; Rice Husk Activated Carbon; Coconut Husk Activated Carbon*

Recent Advancements in Engineered Adsorbents for the Removal of Heavy Metals from Wastewater

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Abstract: Increased urbanisation leads to the production of wastewater containing heavy metals, which results in harming ecology and human health. Several methods like chemical precipitation, electrochemical, ion exchange, adsorption, membrane filtration, reverse osmosis, etc., are used to remove heavy metals from wastewater. Among the methods, adsorption is widely used due to its simple treatment procedure and easy operation. Recent advancements in engineered adsorbents can provide an efficient and innovative solution for adsorption. This review discusses the impact of the different engineered adsorbents and their physiochemical properties, such as surface area, morphological features, functional groups, adsorption capacity, inorganic and organic constituents, etc. are inferred. It also makes a detailed analysis of the adsorbent dosage, adsorbate concentration, temperature, pH, adsorption time, chemical and physical forces involved. To understand the fundamental mechanism behind adsorption, different isotherm and kinetic models employed in the removal of heavy metals are evaluated. Finally, it explores and highlights the limitations and potentials of engineered adsorbents in the removal of heavy metals.

Keywords: *Adsorption; Adsorbent; Kinetics; Thermodynamics; Mechanism*

Adsorption of corafix black dye using mechanically reclaimed sand as an adsorbent for the textile wastewater treatment

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Abstract: One of the major reasons for polluting the environment and surface water are industrial effluents. To overcome this problem, innovative processes are suggested for the treatment of industrial effluents containing dyes and heavy metals. We can see that the daily usage of dyes is increasing, posing a serious harm to our biosphere in particular. Waste water contains a number of dyes that are harmful to plants, animals, and human life. This article used three isotherm models: Langmuir, Freundlich, and Dubinin-Radushkevich correlate four sets of experimental adsorption isotherm data obtained through laboratory batch testing. Linearized and nonlinearized isotherm models were compared and discussed. To determine the best-fit isotherm model, we interpreted the data of R^2 and came to a conclusion that Frendlich and DR Isotherm fits the most.

Keywords*: Effluents; Adsorption; Dyes; Low Cost; Sand; pH Value; Concentration*

Application of MOFs in membrane modification for treatment of waste water: A review

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Abstract: Biodiversity and water pollution are serious issues that are essential to be tackled rapidly and have garnered extensive attention from the research community and industry in recent years. The ever-expanding scale of industry and agriculture has led to a gradually increasing amount of contaminants (such as heavy metal ions, oily wastewater, natural organic matter, synthetic colours, and antibiotics) in natural resources. The prospective utilisation of metal-organic frameworks (MOFs) in purifying contaminated water by separating pollutants is received a great deal of attention. The use of MOF for modifying membranes for contaminant separation is investigated in this paper. The crucial aspect is that by incorporating MOFs into the membrane, separation performance and anti-fouling capability can be significantly improved. This review took advantage of the possibility of using a check and in-depth discussion of the principles of the MOFs to modify membranes used in water contamination.

***Keywords**: Metal Organic Framework; Biochar; Adsorption; Water Treatment*

CETP Wastewater Treatment Using Polyaniline Nanocomposite

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Abstract: The stepping up of industrial activities, rapid population growth, and improved people's living standards have resulted in more wastewater generation. The wastewater without treatment cannot be discharged as it can harm the ecosystem and affect living organisms. The wastewater discharge from varying industries is treated in common effluent treatment plants (CETP) and the treatment challenges are also increased due to the different characteristics of effluent. The composite nature of wastewater received in CETP need suitable treatment before it discharges. Nanotechnology is an emerging technology in the field of wastewater treatment. In this research work, polyaniline (PANI) nanocomposite was used to remove organic contaminants. Polyaniline is a conducting polymer and it has high adsorption capacity, low synthesis cost, and a large surface area. This study deals with the application of polyaniline nanocomposite synthesized chemically for degradation in CETP wastewater. In this study, wastewater was collected from one of the CETPs of Gujarat and was treated using Polyaniline nanocomposites. It was found that polyaniline is an effective adsorbent in the removal of Organic load. The result showed that PANI removed around 72% Total Organic Carbon (TOC), 83% Colour Removal, and 68% Turbidity removal at optimum conditions. Adsorption experiments were done in batch mode.

***Keywords**: Polyaniline; Adsorption; CETP; TOC Removal, Colour Removal*

Utilizing agricultural waste derived nanoparticles for wastewater treatment: A synergistic step toward circularity and sustainability

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Abstract: Rapid population growth and urbanization, accompanied by haphazard industrial activities, incessantly contaminate water with landfill wastes, heavy metals and toxic chemicals, leading to a significant deterioration in its quality and availability. The scenario has attracted global scientific community towards the development and establishment of cost-effective, sustainable and energy efficient water treatment strategies. Over the last few years, nanotechnology has convincingly addressed a plethora of environmental issues and subsequently, nanoparticles have been prudently engineered and successfully used in wastewater treatment. With constant advancement, novel methodologies of nanoparticle synthesis are being designed out of which plant-mediated "Green synthesis" route has gained considerable attention as a fast, scalable, non-toxic, and low-cost procedure. The present review aims to highlight the potential of agricultural wastes as useful ingredients for implementation of "Green" route for the fabrication of nanoparticles. It further elucidates the process and mechanism of utilizing waste- derived NPs for efficacious removal of various pollutants, dyes and organic substances from wastewater. Lastly, it concludes by discussing the limitations and challenges associated with the practical applications of the presented approach, along with the ongoing research and prospective solutions to overcome them. On an overall basis, the review intends to pose this approach as a magnificent amalgamation which simultaneously tackles the problem of waste disposal as well as water remediation and can thus emerge as an appealing technique to accomplish circularity and sustainability.

***Keywords**: Agricultural Waste; Nanoparticles; Wastewater Treatment; Green Synthesis*

A Study of Theoretical Mechanism on Wastewater components of Paper Industry with OH radical and Atmosphere

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Abstract: Waste water from paper and pulp industries contains large amount of toxic compounds like degrading products of lignin, cellulose, hemicellulose and wood extractives such as manomeric phenols, enol ethers, acetaldehyde, mercaptides, chlorinated phenols etc., among these the most dangerous of these compounds are chlorophenols such as guaicols, catechols and their transformation products anisoles and verathroles. The reactions of anisoles and verathroles with OH radical & atmospheric toxic gases like NOX, SO_X and CO_2 have been studied by using computational method and the products of these reactions are Secondary organic aerosols (SOA). DFT is used to calculate gibbs's free energy and by finding gibb's free energy it can be concluded that which compound is more reactive with which toxic gas and which reaction is possible. SOAs are toxic to atmosphere as well as human health so it is needful to decrease the reactivity of these reactions or to take measures to control/stop the release of these contaminants before they react with OH radical & atmospheric toxic gases.

Keywords*: Paper and Pulp Industry; Toxic Compounds and Gases; OH Radical; Gibb's Free Energy; Reactivity*

Emergence of Antibiotic Resistant Bacteria in Wastewater

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Abstract: Emergence of Antibiotic resistance as a global threat is a cause of alarm wherein the number of infections caused by resistant microorganisms are widely reported. As per WHO's GLASS report 2021, developing countries may experience the impact of antimicrobial resistance because of the high prevalence of bacterial infections. Wastewater Based Epidemiology (WBE) provides an opportunity for monitoring antibiotic resistant bacteria on a community level. This study focusses on the isolation of antibiotic resistant bacteria from sewage samples and developing a pattern for the antibiotic resistance in the environment. Over a period of 6 months, the number of Cefixime resistant bacteria were found to be the highest, followed by Erythromycin resistance, while the number of Gentamycin resistant bacteria was found to be minimum. Antibiotic Resistance Index (ARI) reveals that there is an extreme occurrence of ARB in 30% of the total selected sampling locations. Improvement in sewage treatment methods can aid in considerable reduction in release of resistance genes into the environment. Anaerobic-Aerobic sequences, disinfection and nanomaterials are the possible methods that can reduce ARGs in final effluent. This study explores the possibilities of planning and strategizing policies for monitoring and control of ARB in wastewater.

Keywords*: Antibiotic Resistant Bacteria; Antibiotic Resistance Index; Wastewater Based Epidemiology; Sewage Treatment; Wastewater Control Policy*

Common Effluent Wastewater Treatment by using Advanced Oxidation Process

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Abstract: In the past few years, Common effluent treatment plants facing issues of non-compliance and been penalized by National Green Tribunal for deviating discharge norms in Maharashtra & Gujarat states. There have been many researches on the use of different types of Advanced oxidation processes in pretreatment and post treatment for the degradation of Common effluent treatment wastewater streams to meet the discharge norms. Fenton treatment have few limitations like large consumption of dosing chemicals, acidic pH, high cost, generation of iron sludge its handling with disposal issues. Therefore, recently, more researches have been focused on improving the performance of conventional AOPs with catalysts such as metal oxides, zeolite, Titanium dioxide and activated carbon. This review provides an updated information on the degradation of various effluent streams and future challenges of AOPs.

Keywords: *AOPs-Advanced Oxidation Process; Common Effluent treatment; National Green Tribunal; Catalyst; Discharge norms*

Experimental Study of Treatment of Kitchen Waste Water Using Rice Husk Ash

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Abstract: Kitchen wastewater is nutrient and carbon-rich, and if properly collected and treated, it may provide new water, fertilizer, and energy. The important contaminants in domestic wastewater from the kitchen include organic load from food processing, utensil cleaning in the kitchen, soap, and detergents, these are oil and grease, proteins, carbohydrates, and other dissolved and suspended substances. These particles can also be removed effectively and the treated water used for agriculture or gardening. Kitchen wastewater treatment involves determination of BOD, COD, pH, TSS. Numerous techniques are employed globally to handle kitchen waste. The removal of various pollutants from wastewater and wastewaters is now being explored using rice husk, a material that is both ubiquitous and relatively inexpensive. The present work deals with the practicability of applying continuous process for removal of (BOD), (COD), (TSS), and pH using Rice husk ash as adsorbent. In present study continuous process is adopted to check the viability of rice husk as adsorbent. The effects of operating parameters such as (BOD), (COD), (TSS) removal were studied. From the experiment the optimum conditions were determined as 15cm depth of Rice husk ash (RHA) layer and 10min.At the optimum conditions, removal efficiencies for Chemical Oxygen Demand (94%), Biochemical Oxygen Demand (90%), Total Suspended Solids (91%) and pH (7.1) were observed. It is observed that Rice Husk (RH) can be used as effective adsorbent for treatment of kitchen wastewater.

Keywords*: Low-cost Adsorbent; Rice Husk; BOD; COD*

Electrochemical Coagulation of Wastewater Using Aerial Roots of Banyan Tree as Adsorbent

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Abstract: In this research work, an electrocoagulation process is carried out using copper, aluminum, and carbon electrodes by adding a different dose of the aqueous solution to the aerial roots of the banyan tree to enhance the process. The amino acids present in the aqueous solution of the aerial roots of the banyan tree are used as adsorbent surfaces instead of metal ions to reduce electrodes' corrosion and improve their sludge generation capacity. During the experimentation, a few parameters affecting electrocoagulation were made constant such as inter-electrode distance, pH, voltage, current density, and time required for electrolysis to compare the result for both the cases with and without the addition of an aqueous solution of the aerial roots of the banyan tree. The addition of aerial roots of the banyan tree in its aqueous form contains amino acids and Sterols having over fifty carbon chains for the adsorption process which gives better results than the electrocoagulation which is carried using metal ions of electrodes instead of providing any coagulant, and by addition of aerial roots of banyan tree as a coagulant showed that the sludge generation capacity per minute has increased by 5 to 10 milligrams per liters per minute.

Keywords*: Adsorption; Aerial roots; Banyan Tree; Coagulation; Electrodes; Electro-coagulation*

Hydrodynamic Cavitation as a promising AOP for Dairy Wastewater Treatment

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Abstract: In this present work, implementation of hydrodynamic cavitation (HC) alone and combination with chemical oxidants has been explored in the remediation of waste water generated at dairy industry. The consignment of non-biodegradable waste generated from different industries has grown up and is put in danger to the aquatic animals and hence it needs to be eliminated before discharging into the water bodies. The cavitation setup was developed by using orifice plate as a cavitation device which consist of 6 holes having 1.5mm in diameter. The experiment was carried out with a 10–12-liter waste water sample for 1 hour duration. Depletion of chemical oxygen demand (COD) due to the parameters involved in the HC such cavitation number (CV), inlet pressure, flow rate and chemical oxidants were studied. Effect of pH and advanced oxidation process (AOP) were also studied at various pH values (i.e., pH3, pH5, pH7) which results into depletion of COD was highest in case of acidic pH. Alone hydrodynamic cavitation reduced 61.53% and 53% COD at pH 3 and pH 5 respectively. This paper provides an insights of wastewater treatment using hydrodynamic cavitation which represents a low cost and reliable solution considering its simple reactor design, amenity of operation, high energy efficiency, and ease of socialization for treatment of waste water in dairy industry.

Keywords*: Wastewater Treatment; Hydrodynamic cavitation (HC); Chemical Oxygen Demand (COD); Cavitation Number (CV); pH*

Emerging water desalination technologies: Current status, challenges, and future trends

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Abstract: New technologies offer many new opportunities to diversify the desalination industry. Currently, this industry is dominated by thermal desalination and reverse osmosis. In this review, we focus on other emerging technologies which are forward osmosis, membrane distillation, and electrochemical distillation processes and they offer technological maturity and scale-up potential. The literature indicates that new desalination technologies have greatly benefited from advances in nanomaterials. However, membrane- based approaches alone do not enable the commercialization of forward osmosis or membrane distillation. For forward osmosis, proper selection of solutes and inexpensive recovery of the drawing solution in terms of low energy consumption is critical for large-scale commercialization. In membrane distillation, the use of low-grade heat and hybrid systems utilizing renewable energy sources should drive growth. This study explores advancement in process monitoring and control, especially in membrane distillation, through innovative in situ methods. These in situ methods can further reduce operating costs associated with manual sampling and frequent membrane replacement. Future work should be directed to system design optimization and economic evaluation of upscaling.

Keywords*: Emerging Technologies; Forward Osmosis; Electrochemical Desalination; Membrane Distillation; Hybrid Desalination*

Geothermal Desalination: A comparative analysis between RO, MSF, VCD, and MED

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Abstract: Water quality is critical, especially when it is used for domestic and direct applications. Geothermal Water with high salinity of 6000 ppm is unacceptable for residential usage. To reduce the salinity level, a desalination system is an innovative solution. It also eliminates hardness, total dissolve solubility, and other contaminants from water. This study compares and contrasts between several desalination methods as alternatives to traditional reverse osmosis using current state-of-the-art desalination procedures and existing conventional technologies. The comparative analysis assesses thermal and membrane processes in terms of their possible use. Membrane separation procedures like as reverse osmosis (RO) and multi- effect desalination (MED) are commercially available, as are thermal processes such as multi stage flash (MSF) and vapour compression distillation (VCD). The study examines the benefits and drawbacks of each technology in terms of energy efficiency, cost, and environmental effect. Each technology's energy efficiency is assessed using the energy recovery coefficient and specific energy consumption. The results are discussed in terms of the advantages and disadvantages of each technology as well as the implications different methods have on geothermal water desalination system.

Keywords*: Geothermal; Desalination; Membrane; Multi-Effect Desalination; Vapour Compression distillation*

Energy and Exergy Analysis of Solar Still with Phase Change Material (PCM) under the Climatic Conditions of India

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Abstract: The present study focuses on the exergetic and energetic performance investigation of the solar still with phase change material. The energy performance represents a quantitative view of the energy utilized in the solar desalination process, whereas the exergy performance shows a qualitative view of the maximum possible useful energy generated from the solar still under the ambient condition. The exergy analysis helps to identify the exergy destruction and losses in the solar still for the further improvements. The theoretical model was solved numerically using the numerical methods. The results shows similarity with the experimental data for the temperature and freshwater productivity of the solar still. The energy efficiency and exergy efficiency of the solar still with stearic acid was 56.22% and 2.96%. From the thermodynamic analysis, it was observed that the basin liner exergy destruction was maximum amongst all the components of the solar still.

Keywords: *Solar Still with PCM; Exergy Destruction; Irreversibility; Exergy Analysis; Energy Analysis*

Breaking of Butyric Acid-Water Azeotrope: Experimental Analysis on Air Gap Membrane Distillation

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Abstract: Air gap membrane distillation is a thermally driven membrane separation process. In this technique, only vapour phase is passed through a hydrophobic membrane. The vapour pressure difference is the driving force for this process. The vapour pressure difference is created due to the temperature gradient across the hydrophobic microporous membrane. In the present work, the applicability of the air gap membrane distillation (AGMD) technique has been experimentally researched for the breaking of the butyric acid-water azeotrope (18.4 wt% butyric acid). Several methods such as azeotropic distillation, extractive distillation, capillary distillation, adsorptive distillation, pervaporation, and diffusion distillation for the breaking of azeotrope. The limitations related to these methods are high energy requirements, limited options of entrainers, and recovery of the key component. To overcome this, AGMD process is a substitute for the conventional method for the breaking of azeotropes. The diffusivity of different components in the air plays an important role in breaking azeotropes. AGMD element with 0.22 µm of pore size, 175 µm of thickness of polytetrafluoroethylene (PTFE) flat sheet membrane was employed to execute several experimentations for breaking of butyric acid/Water azeotrope. The effect of operating parameters namely feed flow rate (2 – 6 L/min), bulk feed temperature (40 – 80 ^{0}C), air gap width (3 – 11 mm), cooling water flow rate (1 – 5 L/min), and cooling water temperature (8 – 20 ^{0}C) on total permeate flux, butyric acid selectivity, and the concentration of butyric acid in permeate and retentate were investigated experimentally. The experimental outcome shows that total permeate flux increases from 0.84 to 1.01 kg/m^{2}h and selectivity of butyric acid increases from 0.42 to 0.73 on increasing feed flow rate from 2 to 6 L/min at 3 mm air gap thickness. Also, on increasing the feed flow rate from 2 to 6 L/min at 3 mm air gap thickness, the concentration of butyric acid (wt%) in permeate increases from 8.04 to 14.17 whereas the concentration of butyric acid (wt%) in retentate decreases from 20.01 to 19.96. The butyric acid concentration in the permeate and the retentate was analysed by acid-base titration. The experimental results indicate that butyric acid- Water azeotrope breaks in both permeate and retentate. Therefore, it is concluded that a strong possibility of using the AGMD technique for the breaking of the azeotrope.

Keywords: *Air Gap Membrane Distillation; Butyric Acid/Water Azeotrope; PTFE Membrane; Operating Parameters; Titration Method*

Toluene-Water removal from synthetic water using Air Gap Membrane Distillation

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Abstract: Numerous techniques such as liquid-liquid extraction, adsorption, liquid emulsion membrane and Membrane Distillation (MD) are in existence in the removal of volatile organic compounds from waste water. It has been observed that in last few decades MD is gaining importance for the production of fresh water and removal of various volatile organic compounds from waste water. Few researchers had worked in the removal of volatile organic compound using Vacuum Membrane Distillation (VMD). However, due to less difference in vapor pressure, throughput and effective separation was not obtained in VMD. Therefore, another configuration of MD known as Air Gap Membrane Distillation (AGMD) is considered in this work for the removal of Toluene from waste water. In this study, Poly-tetra-fluoro-ethylene (PTFE) microporous hydrophobic membrane of pore size 0.22 µm and thickness 175 µm was used in AGMD module. The effect of various operating parameters such as feed bulk inlet temperature (40°C- 60°C), air gap width (3-11 mm), feed flow rate (1- 5 lpm), feed concentration (200- 1000 ppm) and cooling water temperature (12°C- 20°C) on permeate flux and selectivity were studied. It was observed that the permeate flux increases exponentially from 2.88 kg/m^{2}h to 4.65 kg/m^{2}h on increasing the feed bulk temperature from 40°C to 60°C at 3 mm air gap width. However, it increases linearly on increasing the feed bulk temperature at 11 mm air gap. The separation factor in terms of selectivity of toluene is increased from 40 to 60.8 on increasing the feed bulk temperature from 40°C to 60°C at 3 mm air gap width. Moreover, selectivity of toluene is found to be greater than 1 indicated easier and effective separation of Toluene using AGMD. The membrane fouling phenomena was also studied in this work and understood using SEM morphology. The permeate and retentate concentration was measured using UV-Visible Spectrophotometer.

Keywords: *Membrane Distillation; Microporous Hydrophobic Membrane; Operating Parameters; Separation Factor; Fouling Phenomena*

Membrane Desalination of Waste Water for the Contaminant Removal and Reduction of Fouling

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Abstract: One of the potential innovative techniques for desalinating water is the membrane distillation process. The study used for distinct types of polypropylene membranes with various capillary and pore sizes as well as wall thicknesses. The effluents created during the regeneration of ion exchangers as well as waste water that included protein and NaCl were used as feed. In numerous instances, substantial membrane fouling was seen when these solutions were concentrated using the membrane distillation technique. The heating of the feed and rising solute concentrations were the main causes of fouling. A method that passes water through a macro porous membrane while rejecting other non-volatile components present in the influent water by using variations in vapour pressure. Improved energy efficiency and lower water production costs in MD systems, however, continue to be significant technical challenges. In this study, we investigate how increasing water flux and decreasing unit energy consumption can be achieved by optimising the MD membrane's heat and mass transport properties.

Keywords: *Capillary and Pore Size; Distillation Techniques; Fouling, Energy Efficiency, Water Flux*

Investigation on Desalination system with help of IoT and cloud-based system

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Abstract: Growing water demand and a degrading environment have necessitated new technology and methods for optimizing resource use and desalinating seawater into drinking water. In this day and age, the Internet of Things allows us to optimize a series of previously complicated processes that require enormous resources. This study describes a practical water desalination model and proposes an intelligent environment to regulate water treatment facilities. The suggested system will gather data and analyze it to determine the approach that will result in the most effective water desalination. Here the desalination system is integrated with the cloud as well as IoT for the improvement of its operation and better data collection. At a salt content of 10 g/l, the current desalination system used 8.31 KWh/m^3 of energy to generate 1.5 l/hour during the experimental days and its potential for widespread use.

Keywords*: IoT; Desalination; Water Treatment; Hourly Output*

Analysis of the Desalination system by Machine learning algorithm

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Abstract: Desalination is a process to convert the saline water into the potable water. It is very important process for the study because the use of the water is increasing day by day in various applications. In current research work analysis of desalination system is conducted with the help of Machine learning algorithm. The data collected through experimental investigation was employed for a predictive model development employing Bayesian optimized Gaussian Process regression (BoA-GPR). The tests were conducted using air velocity (v), air temperature (T), and relative humidity (RH) as control factors while the amount of condensate (Cond.) generated as dependent response variable. There is a good match between the training and test results.

Keywords*: BoA-GPR; Desalination; Condensation; Output*

Performance enhancement of single slope solar still integrated with nanoparticles/Nano fluids & Phase Change Material – A detail review

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Abstract: The universal crisis of drinking water accessibility is increasing day by day, whereas the freshwater necessity is enormously growing. Most of the human diseases are due to contaminated or non-purified water. Nowadays, each and every country is facing a problem of huge water scarceness because of pollution created by manmade activities. Adequate quality and reliability of drinking water source is the fundamental need of all persons on this earth. Fresh water which was obtained from the rivers and lakes are becoming infrequent because of industrialization and population explosion. Water purification using solar energy has become more & more popular because it is cost effective & eco-friendly. Solar still water distillation could be a solution to overcome this universal problem. A range of solar still designs has been developed worldwide. Many investigators outlined mathematical terms, performed experiments and validated various solar stills by varying the design and operating parameters. Since last few decades, more research work is going on to improve the solar still performance and try to provide a sustainable water purification system. There is a strong need to improve the single slope solar still performance and increase the productivity of still. The various factors affecting the productivity of solar still are: Climatic Parameters, Operational Parameters, Design Parameters & numerous modifications implemented in solar still. Among all these parameters, main focus on implemented solar still with nanomaterial/nano paints & Phase change materials (PCM) are most common technique. There is no more work is carried out in coastline area of Gujarat on single slope solar still as compared to other region. So the aim of this review paper is focused on performance of solar water distillation using Phase Change Materials & nanomaterial in active as well as passive single slope solar still.

Keywords*: Single slope Solar Still; Nanomaterial; Nano Fluids; Phase Change Material (PCM)*

Sustainable Treatment Techniques for the Augmentation of a Common Effluent Treatment Plant

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Abstract: The common effluent treatment plants are crucial for managing industrial wastewater. Factors like the expansion of existing industries, increasing number of industrial units, changing wastewater characteristics, and increasing hydraulic load can affect the existing CETP treatment facilities. To maintain the discharge standards set by the regulators, CETPs have to be upgraded or augmented by implementing the recent treatment schemes. This study aims to evaluate an existing treatment facility established to treat wastewater from the dye and dye intermediates industry. The CETP has shown less reliability level in terms of COD and BOD parameters. Hence it is necessary for the CETP to upgrade its existing treatment facility by incorporating the latest treatment techniques. The design of various possible treatment techniques which could be suitable for the CETP has been investigated in this paper. The proposed treatment scheme and upgradation framework can be beneficial for the CETP in the long term. Also, it will help to maintain the effluent characteristic within the discharge standards most of the time.

Keywords*: Reliability Analysis; CETP; Treatment Techniques; Augmentation; Industrial Wastewater*

Kinetic and Thermodynamic Studies on the Removal of Phenol from Stimulated Refinery Effluent

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Abstract: Phenol is a major organic pollutant in wastewater from petrochemical, polymer and pharmaceutical industries and refineries. The toxic and poisonous properties of phenol necessitate its removal from wastewater whereby this area of study is gaining prominence. Different technologies are available to remove phenol from wastewater. However, they are expensive. Among them, adsorption is found to be effective in terms of phenol removal and cost. The biggest challenge is to find a cost-effective adsorbent to be used in this process. Therefore, this study attempts to find an adsorbent that is economical. In the present study, the adsorbent was prepared from cotton bracts which were characterized by thermo gravimetric analysis, scanning electron microscopy and Fourier transform infra-red spectroscopy. It was converted into activated carbon, and the feasibility of using it was investigated and optimized. A pH of 8.9 was found to the optimum for the maximum removal of phenol. The equilibrium adsorption data of phenol removal showed good correlation with Langmuir isotherm. Additionally, the adsorption kinetic data showed pseudo second order kinetic model. The maximum uptake capacity of phenol onto cotton bracts and thermally activated cotton bracts were found to be 5.53 mg g^{-1} and 10.35 mg g^{-1}, respectively at 303 K. The negative value of □G□< 0 confirms that the process is spontaneous.

Keywords*: Cotton Bracts; Thermal Activation; Adsorption; Optimization; Isotherms*

Possible barriers in execution of STP at the affordable housing in Ahmedabad City: An Empirical Study on finding the gap related to the execution of STP

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Abstract: Comprehensive industrial development; and its' positive impact on the employment, has captivated the attention of the people living at the urban and semi urban areas in Ahmedabad city. Urbanization is growing by leaps and bounds during last decade. Between 2007 and 2017 the urbanization has grown by 132% and reached up to 6 sq km per decade (Paul John;2020). Under the ambitious project, "Housing for all"; government has liberalize the conditions for the affordable housing for the non-government players. Real estate projects are getting themselves registered with RERA Gujarat good in numbers year on year. Construction related guideline has covered several things but one of the things which have not been completely addressed is how to deal with drainage water? Especially; the areas with no drainage related infrastructure e.g., AUDA area. Residential apartment is offering 24-hour water facility as one of their amenities in order to captivate the potential buyers. On an average, the affordable residential apartment with less than 150 units are having underground water tank having 50tousand liters of the water capacity. Besides this, every block or tower is having 15 to 20 thousand liters of the overhead water tank to ensure water supply without interruption. Government has instructed the developers to install the Sewage Treatment Plant (STP) with their residential scheme. Point here is how many developers are following the STP related policy? The objective of STP is to recycle the grey water and reuse it. Further, after the possession, how many STPs are into the functional condition? What are the possible barriers that are acting as the hindrances in execution of STP? The objective of this research paper is to define the possible barriers in ensuring and executing the STP at the affordable housing in Ahmedabad City. Secondary data has been collected by referring the government policy, related articles and papers. Authors have selected different affordable housing projects and meet their site manager/ chair person. Also, they have done short meeting with the project engineer/developer to know the issues related to execute the STP. In depth personal interview is the method to collect the primary data. The common findings are like, people at the affordable housing are not aware with the STP objective at the scheme and those who are aware; they do not know the functionality of it. Besides this, the trust level related to recycling of the water is highly missing. Some developers, also, have just symbolized the STP at their scheme and it is like model of plant and not functional unit. This is mere an attempt to find the hindrances related to the execution of STP at the affordable housing unit.

Kinetic and Thermodynamic Studies of Cr (VI) Bio-sorption for Tannery Effluent Treatment

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Abstract: This research aimed to examine the adsorption capabilities of Shrimp Shell Activated Carbon as bio-sorbents for the removal of chromium ions from tannery effluent. The FT-IR analysis of the adsorbents revealed a change in the functional groups of the structure of both adsorbents before and after adsorption, which may be related to the adsorption processes occurring on the surface of the adsorbent. Experiments involving adsorption were conducted as batch investigations with varying contact periods, pH, adsorbent dose, initial metal ion concentration, and temperature. Maximum Cr (VI) removal efficiency was observed at 140 min contact time, 22 g/L adsorbent dosage, and pH 3. The percentage of Cr (VI) removal rose as adsorbent dose (from 5 to 20 g/L) and contact time increased (from 60 to 160 min). The Freundlich isotherm model fit the equilibrium data better than the Langmuir model. The kinetics of chromium adsorption was accurately modelled by a pseudo-second-order kinetic model, and the calculated equilibrium sorption capacity of the model was in good agreement with the sorption capacity determined by experiment. The thermodynamic characteristics indicated the feasibility of the adsorption technique. Positive entropy values show an increase in unpredictability at solid-liquid interfaces during adsorption. The efficiency of the adsorbents in removing chromium from waste water was also investigated and found to be effective.

Keywords*: Shrimp Shell Activated Carbon; Tannery Effluent; Biosorption; Kinetic and Thermodynamic Study*

Regression based analysis of a Fe catalyzed ozone-based process for degradation of pharmaceutical

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Abstract: The water treatment through the ozonation process is gaining a lot of attention after the advancement of new startups and modern technologies for ozone generators. The available literature on the use of ozone for water and wastewater treatment is humungous. Most of the work reported in the literature on pure ozone and catalytic ozone-based processes is examined to study the degradation of the dyes, intermediates, some organic products such as phenols, and related products. These days there is numerous work which is getting published on pharmaceutical wastewater due to its increasing threat to aquatic life. The ozone-based processes are also getting explored as one of the key methods for the treatment of pharmaceutical wastewater. All of these works have explained the role of various parameters such as pH, ozone flow rate, ozone generation rate, catalyst dose, the concentration of the pollutants, and the presence of other ions, which can influence the rate of degradation and % COD removal. However, most of these studies lack in providing a clear mathematical expression for the optimum conditions to achieve the desired % degradation. In this work, a Fe-based catalyst has been used to degrade a model pollutant through the ozonation process. The process parameters chosen for the work were pH, Fe dose, temperature, and ozone dose. These parameters studied in the work have been optimized targeting maximum % degradation. A response surface methodology analysis was adopted to do the regression of the model parameters and %degradation was used as the single response. It was observed that the significant parameters obtained in the regression analysis were pH, and Fe dose. Since the ozone dose was very high as compared to the molar concentration of the model pharmaceutical, the effects were not very prominent.

Keywords*: Iron Catalyst; Ozone; Pharmaceutical Compound; Regression Model; Wastewater*

Polysulfone membrane modified with ZIF-8/PEGMA for the removal of organic matter from the wastewater

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Abstract: The scientific advancement is needed to investigate the trade-off between selectivity and permeability, contamination, and the durability limits of different polymeric membranes. Excellent thermal stability, anti-biofouling, and permeability performance were discovered by ZIF-8 modified membranes to resolve these challenges and enhance the characteristics. In this study, we have synthesized a Polysulfone (PSF) membrane modified with ZIF-8/ PEGMA using the precipitation polymerization method. By combining PEGMA copolymer, a considerable improvement in the PSF membrane's hydrophilicity and ability to resist fouling was seen. The density, permeability, and morphology of the membrane were improved by systematically increasing the co-polymer dose from 0 wt% to 2 wt%. The PSF@ZIF8/PEGMA is characterized by FTIR-ATR to identify and verify the functional group, to understand the morphology Scanning Electron Microscope (FE-SEM) is used, contact angle analysis to determine the hydrophilicity of the membrane, Thermogravimetric Analysis (TGA), and X-ray diffraction (XRD). The value for pure water flux and HA rejection of membrane containing 1.5% ZIF-8/PEGMA showed an excellent result i.e., 686.2 L/m^{2}h and 98% respectively with enhanced fouling properties. Moreover, PSF@PEG/ZIF-8 may have potential use in the separation of organic materials from wastewater.

Keywords*: Polysulfone; Fouling; Wastewater Treatment; MOF; PEGMA*

Review on the synthesis of the Mg Doped thin film by Spin Coating and their application in dye degradation

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Abstract: Nanoparticles are used for dye degradation because they have a large surface area-to-volume ratio, which allows them to adsorb and degrade dyes more efficiently than larger particles. Additionally, the small size of nanoparticles allows them to penetrate into the pores of the dye molecules, facilitating the degradation process. The use of nanoparticles also reduces the amount of reagents required for the process, making it more cost-effective and environmentally friendly. Advantage of spin coating is that it is a simple, low-cost and scalable method for preparing thin films. It can be used to prepare uniform and homogeneous films with thicknesses ranging from a few nanometers to several micrometers. Additionally, spin coating allows for good control over the film thickness, composition and morphology, which can be adjusted by changing the spinning speed and the solution concentration. In summary, Mg-doped thin films have been shown to have photo catalytic properties, which mean they can aid in the degradation of dyes under UV light. This is due to the presence of Mg ions in the film, which act as electron acceptors and enhance the separation of electron-hole pairs, leading to an increase in the amount of reactive oxygen species that can degrade the dyes. This technology has potential applications in areas such as water purification, air purification and treatment of industrial wastewater. Mg doping of thin films prepared by spin coating can enhance the electrical conductivity and it's a cost effective and simple way to fabricate thin films with good homogeneity and thickness control.

***Keywords**: Spin Coating; Mg Doped Thin Films; Photo Catalytic Activity; UV Light; Electron Hole; Nanoparticles*

A review on chemical approaches for wastewater treatments

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Abstract: Wastewater treatment is a vital process that ensures the protection of our surface and groundwater resources. There are a variety of treatment techniques available, based on physical, chemical, and biological approaches. Chemical treatment is one of the key methods used in wastewater treatment, and it has proven to be effective in removing pollutants such as heavy metals, organics, and nutrients. However, the cost of chemical treatment methods can be a significant factor in the selection and implementation of treatment processes on large scale. This review paper aims to provide an overview of various chemical methods for wastewater treatment and their associated costs. The methods discussed will include coagulation, flocculation, precipitation, oxidation, and adsorption. The advantages and limitations of each method will be discussed, as well as the most recent developments and future research directions in the field. Additionally, the paper will also cover the selection of appropriate chemical methods based on the characteristics of the wastewater, and the economic and environmental considerations. Overall, it aims to provide a comprehensive overview of the current state of chemical methods for wastewater treatment, with a focus on cost analysis, and the potentials for future in the field.

***Keywords:** Wastewater Treatment; Chemical Treatment; Coagulation; Flocculation; Oxidation; Adsorption*

Potential of Moringa Oliefera for waste water treatment

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Abstract: The prevalence of natural processes for solving the problem of wastewater has increased because these processes do not harm the environment and offer many other benefits such as lower cost, reduced by-product production and improved biodegradability. It has been observed historically that Moringa Oliefera is used as natural coagulant for effluent treatment and being used even today. This paper addressing the potential of Moringa Oliefera as a natural coagulant. It reviews mainly the processing steps and mechanism of coagulation using Moringa Oliefera to treat waste water. Further, it identifies the research gap and recommends the future directions in the field of waste water treatment using natural coagulant.

***Keywords**: Moringa Oliefera; Wastewater Treatment; Natural Coagulant*

Synthesis and Application of modified biopolymer for Wastewater Treatment

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Abstract: Treatment of chemical industry wastewater is challenge for the world to save environment. There are many processes developed for treatment of industrial wastewater. Very simple to highly complex methods are invented by different researchers. These methods can be compared on various aspects such as their performance on wastewater, ease of operation, cost, etc. Coagulation and flocculation is one of the most widely used technique for treatment of wastewater. Wide variety of chemicals used as coagulant and flocculent and used in different combinations. Very few natural chemicals are used for this role. Natural chemicals are biodegradable, environment friendly and not harmful to environment compared to synthetic chemicals/ polymers. Chitosan is one such natural polymer, reported its usefulness in treatment as flocculent. In this paper, The COD is studied and reported the performance of modified chitosan as a flocculent along with different conventional coagulants. Chitosan has been modified, to improve its performance. Variety of combinations of coagulants and flocculants is used for the treatment of wastewater.

Keywords*: Biodegradable Wastewater Treatment; Cationic Chitosan; Coagulation; Flocculation; Modified Chitosan; Natural Flocculent*

Use of hybrid techniques in biodiesel for wastewater treatment application

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Abstract: Biodiesel is produced from vegetable oils, such as edible and non-edible through esterification and/or transesterification processes. Post-treatment of these generates 150 liters and 120 liters of wastewater, respectively per hundred liters of biodiesel production. Wastewater contains high amounts of organic compounds, oils and greases (O&G), therefore, has a high chemical oxygen demand (COD). Biodiesel wastewater is thus considered a highly toxic effluent, which is an emerging issue of environmental concern. The literature describes wastewater treatment by coagulation, electrocoagulation, biological, adsorption, and microbial fuel cell, which consist of a combination of two or more processes. The commonly used processes for biodiesel wastewater treatment are advanced oxidation processes (AOP) such as Fenton, photo-Fenton, solar photo-Fenton, and solar-photolysis. Hybrid methods based on hydrodynamic cavitation (HC) have demonstrated good synergism compared to the individual treatment approach. The main parameters associated with HC are (i) structural characteristics of the reactor: cavitation-induced bubble shape and size, flow chamber, etc. (ii) characteristics of liquid medium: viscosity, density, etc. (iii) characteristics of technological process: time, temperature, pressure, concentration etc. According to recent studies, it has been predicted that HC can manage process economics in terms of money and space if proper optimization is done for biodiesel wastewater and can be effectively coupled with any other AOPs for enhancing the efficiency of treatment with less polluting as no byproducts are formed. Overall, industrially viable, environmentally friendly, and highly energy-efficient wastewater treatment can be achieved using a combined treatment approach based on HC under optimized conditions. The characteristic of biodiesel wastewater analyzed are TDS, COD, and pH as these are the major constituents.

Keywords: *Biodiesel Wastewater Treatment; Advance Oxidation Processes; Hydrodynamic Cavitation; Hybrid Methods*

Novel nanocellulose composites for the degradation of azithromycin in wastewater

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Abstract: Azithromycin (AZM), a novel macrolide, is used in treating several diseases. However, upon contamination of water, AZM can cause toxic effects to live organisms in the water and can also become a source to grow drug-resistant bacteria, a global threat in recent times. In recent days, the use of AZM has increased significantly, i.e., 640 million DDD was sold in India during the covid-19 period. In India, the average antibiotic concentration in pharmaceutical effluents was found to be more than 353.9 mg/L, with AZM accounting for the majority of this. Among the various treatment methods, oxidative degradation with photocatalytic materials is the most efficient method for degrading pharmaceutical compounds in wastewater. Novel nano cellulose-titanium dioxide composites were synthesized and used for the oxidative degradation of azithromycin in wastewater. The developed composite could degrade the azithromycin in wastewater with 95% efficiency.

Keywords: *Nanocellulose; Composites; Azithromycin; Wastewater*

Novel Hydrodynamic Cavitation Reactor for Sewage Water Treatment

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Abstract: Wastewater treatment is a critical process that is essential for ensuring the safe and responsible management of water resources. Traditional wastewater treatment methods are energy intensive and produces large amount of sludge which needs proper handling. The present paper focuses on the development of novel hydrodynamic cavitation-based reactor to treat the sewage water. A square shaped nozzle type of reactor is proposed, and its performance is investigated through careful experiments for sewage water collected from the local source. For the given flow rate, optimum injection pressure is identified such that cavitation bubble is formed inside the nozzle. Experiments are carried out for this pressure and performance parameters are estimated using modified Winkler method. The effect of cavitation on the sample temperature, dissolved oxygen, biological oxygen demand (BOD) and chemical oxygen demand (COD) are studied. The temperature and dissolved oxygen have been increased while BOD and COD have decreased significantly with time.

Keywords*: Hydrodynamic Cavitation; Wastewater Treatment; Biological Oxygen Demand; Chemical Oxygen Demand*

Advanced photocatalytic oxidation of organic water pollutant dyes by synergistic augmentation of electrochemical water splitting

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Abstract: The research work aims to investigate the potential of combining electrochemical water splitting and photocatalytic oxidation for the removal of organic pollutants from water. The optimization of electrochemical water splitting conditions has been carried out using various electrode materials, including titanium, titanium dioxide, and graphite, in the first stage. In the second stage, photocatalytic oxidation has been integrated with electrochemical water splitting to evaluate the synergistic effect on the removal of organic pollutants. The photocatalytic oxidation is based on the advanced oxidation of organic pollutants and is supported by the oxygen generated through the electrochemical water splitting. The photocatalytic oxidation process will use biodegradable buoyant photocatalytic particles that are bio-char particles loaded with gC_3N_4. The removal efficiency of selected organic pollutants, such as Methylene Blue and Rhodamine-B, has been studied through experiments for varying parameters such as pH, catalyst concentration, and light intensity. The data thus obtained has been analyzed to calculate the removal rate and rate constant, which is further compared with the results obtained from individual processes. The result of this study provides valuable insights into the potential of the combined process for the removal of organic pollutants from water and support the development of practical and sustainable water treatment technologies.

Keywords*: Photocatalytic Oxidation; Electrochemical Water Splitting; Advanced Oxidation Process*

Preparation of novel adsorptive membrane using spent spices waste-derived biochar to treat synthetic wastewater

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Abstract: The proposed research seeks to develop biochar-infused polymeric mixed matrix membranes from spent spice wastes. Post-extraction of essential oils and fatty acids from spices (the main ingredient in food items, cosmetics, and pharmaceuticals), the generated spent-spice waste is frequently discarded in landfills. The biochar-infused polymeric mixed matrix membranes derived from these spent spice wastes are tested to remove dyes from synthetic wastewater. The current study involves the preparation of biochar by pyrolyzing a mixture of five spent spices (ginger, clove, black pepper, fenugreek, and cardamom) at 350°C. This replicates the quality of actual spent spices waste. Proximate analysis of the biomass (mixture of spice waste) and biochar shows an increase in the fixed carbon content due to pyrolysis. The biochar is activated thermally and chemically and then infused in a polymeric mixed matrix membrane for adsorption. The morphology through FESEM images of biochar and membrane before and after activation exhibit an increase in porosity as well as the formation of honeycomb-like structures. For adsorption studies, a solution of synthetic wastewater containing three dyes (methylene blue (MB), congo red (CR), and tartrazine) is used. The adsorption of biochar is studied through two approaches: first, a batch adsorption study of biochar mixed with wastewater, and second, wastewater filtration through a spin-coated membrane. The percentage removal of dyes from wastewater is compared. The adsorption efficiency is found to be comparable for both modes.

Keywords: *Biochar-infused Polymeric Mixed Matrix Membranes; Spin-coating; Wastewater Treatment; Pharmaceutical Pollutants; Spent Spice Waste Utilization*

A review on the quality and yield improvement of tea through water treatment, management, and the control of other relevant parameters in the tea gardens

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Abstract: To achieve a high yield of good quality tea in the tea gardens, treatment and management of water along with controlling various auxiliary parameters are of utmost significance. India, specifically the northeastern part, is one of the top contributors to the growth and supply of tea across the world. A broad range of research work has been done in various parts of the globe to manage water and to find an optimum parameter to obtain a high tea yield. Various environmental, atmospheric and topological parameters such as drought, nutrient shortages, the concentration of toxic elements, water quality (pH, TDS, EC, pathogen), rainfall, atmospheric temperature, of sunshine hours, soil moisture, slope, shade management land topography, and slope effect on the water requirement for the crop. Also, the comparative studies on the effect of these parameters have been incorporated based on the geographic locations using GIS analysis. Apart from this, the wastewater produced from this tea factory can be treated using technology such as natural wetlands, constructed wetlands, and gravel bed hydroponics and this water can be reused for irrigation. This paper attempts to evaluate the impact of above mention various parameters reported by several researchers at different stages of the life cycle of tea cultivation, manufacturing, and transportation of tea for water resources management. To order to achieve above-mentioned goal various research paper from the year (2010 to 2022) has been collected and discussed in this review article.

Keywords*: Water Treatment; Water Management; Tea; GIS & Remote Sensing; pH, Rainfall*

A comprehensive study on integrated approach for water hyacinth management to conserve natural water resources in India

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Abstract: Rapid growth of free-floating invasive weed Water Hyacinth (WH) has caused environmental and social menace in most of the water bodies. Due to its large mat formation, it not only affects the underlying aquatic species by blocking sunlight and depleting oxygen, it also interferes with commercial activities like fishing and transportation. Public health is also affected as it gives shelter to disease causing mosquitoes. It is a bio-indicator of water body polluted with heavy metals. Removal and management of this weed is as important aspect to conserve natural water resources. Various manual, mechanical, chemical and biological methods have been tried and tested to eradicate this plant. However, each method has its own limitations and the reoccurrence of this weed in short time calls for an innovative approach to find sustainable solutions. Recent studies focus on utilization of this weed for commercial purposes rather than eradicating it. The high cellulose and hemi-cellulose content present in the plant makes it an excellent source for renewable fuel production. It also finds application in industries that prepare animal food, compost and bio-fertilizers due to high nutrients present in it. Many states in India are utilizing WH plant for producing eco-friendly and creative products thus helping in local employment generation. This study evaluates advantages and drawbacks of weed removal methods, potential of WH plant in phytoremediation and biofuel production, case studies of success stories of alternate uses of WH plant and possible action plans for economically and ecologically sustaining the plant management to conserve water resources in India.

Keywords*: Water Hyacinth; Water Pollution; Weed Management; Biofuel Production; Agro-products; Action Plan; Case Studies; Environmental Sustainability*

Analyzing Regional Heterogeneity of Monsoon in Western Regions of India for Water Management

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Abstract: To attain sustainability of water in human life is very essential. Annual variations in rainfall directly affect availability of water and occurrence of local hydrometeorological extreme events such as droughts and flood. These events take place frequently due to climate change and various geographic conditions in monsoon dependent country like India. Investigation of regional heterogeneity of monsoon with climatic conditions in western regions of India through satellite-based observations is necessary to formulate effective strategies and management during climate change scenario causing environmental and economical losses. This work aims to compare two different geographic locations to understand precipitation pattern, which is essential for the water management into drought prone-area of Rajasthan and flood prone-region of Gujarat over past years. Comprehensive analysis of monsoon characteristics such as precipitation through satellite retrieved long term data (2001-2020) shows a different trend due to variation in geographic condition of both the regions. In present study, high rate of precipitation (~ 20-24 mm/day) for a few months during monsoon has been noted for flood prone region in Gujarat, influencing flood scenario and there is a need for better policies to control flood. Deficit amount of rainfall during monsoon (~ 1-5 mm/day) has been observed for Thar Desert in Rajasthan causing scarcity of water and effective water management strategies are essential. Observation of microphysical properties of clouds such as cloud liquid water helped to analyze the trend of precipitation as behavior of cloud systems are complex. These variations in precipitation reveal need for better water management policies and their implications at regional level, as they are much dependent of climatic conditions. Planning for Water management may be addressed and improvised effectively through long-term assessment of cloud conditions over the region. Further consideration of various meteorological and cloud parameters and their changes may help for better prediction of weather and complement new policies along with amendments in existing policies related to mitigation strategies for disasters, fresh water supply water resource management and food security.

Keywords*: Regional Heterogeneity; Monsoon; Precipitation; Drought; Flood; Water Management*

Role of Environmental Social Governance (ESG) in the water industry

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Abstract: Environmental Social Governance implementation is important in all sectors as it gives validation to the sustainable practices that are mandatory nowadays. Advancing all three aspects of ESG is a problem for even the most progressive utilities and providers of water treatment. Water as per ESG is not only limited to a single metric of volume but also includes water quality, scarcity, accessibility, sanitation and hygiene. The current ESG reporting frameworks undermine water as a major risk and opportunity and that too at a time when water is increasingly being recognized as a materialistic risk to industries and businesses. If there is a focus on climate change, but water is excluded both as an opportunity and business risk then the issues related to the environment and society tied to water will not be solved. The purpose of this paper is to determine the role of ESG in achieving sustainability in the water sector overcoming the bottlenecks like under-valuation, lack of equitable access, over-allocation and heavy pollution of water globally. According to the World Economic Forum, the water footprint has to be brought to the same level of importance as the climate change footprint as it is inter-connected with human health and wellness, energy supplies, food supplies, sustained biodiversity as well as the economic feasibility of any industry. ESG is essential for industries as various stakeholders like customers, investors, suppliers who add value to the business consider it as an essential factor while investing in any industry. Including a water treatment project in a company for the treatment and reuse has environmental benefits like reduction in power consumption, less use of water from local supply. Various social benefits involve leaving more water for stakeholders and also building trust with communities and governance benefits include improvement in business performance, enabling open reporting of water performance metrics and reducing issues related to withdrawal of water or discharge limits. Overall, this helps in enhancing their ESG goals and improving their ESG metrics.

Keywords*: Environmental Social Governance; Sustainability; Risk and opportunity; Water Treatment Projects; Stakeholders*

Flood Risk Management using HecRAS model for the planning of Artificial Levees as a Structural measure: A Case Study of Upper Sabarmati River Basin, Gujarat, India

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Abstract: Flood is one of the most devastating natural phenomena causing huge loss of life, damage to properties and infrastructures. It also affects socio-economic conditions of region and country all over the world. There are a number of models available for assessing impact of downstream flood in a river basin based on different hydrological parameters. In this study, we have used a simple HecRAS model for planning the artificial levees at the downstream of Dharoi Dam on Sabarmati River, Gujarat, India as a structural measure for controlling the flood. Initially, part of the river basin extending from the Dharoi Dam to Dharol Bridge (58 km) has been selected for the hydrological model study. Digital Elevation Model (DEM) was used for the topographic study of the area. The 1D (HecRAS) steady flow analyses was performed using 2006 monthly discharge data to identify the flood risk cross-sections of the river basin in the downstream region considering natural topography. The Artificial levee structural members were added to these cross-sections in the model and the steady flow analysis was performed again with levees at critical locations on both the sides of the river banks. Based on the flood inundation map created by the model study and developed cross-sections, six locations were identified for planning the levees to prevent spreading of the flood in low lying areas adjacent to river banks. The results indicated that after the addition of levees at these vulnerable locations, flood water remained confined to river channel and thus helped in planning of the structural measure for mitigating the flood in the study area. This simple HecRAS-1D model can be applied in other areas also and results can be compared with other models under different geo- environmental conditions for its wider use.

Keywords*: Flood Risk Management; Downstream Regions; Cross-Sections; Levees; Flood Inundation; Mitigation*

A Study on the Presence of Endocrine Disrupting Chemicals (EDC) in Water, Health Impacts and its Treatability

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Abstract: In recent years, the increasing population and industrialization have released different contaminants in the surface water. Endocrine Disrupting Chemicals (EDCs) are defined as any exogenous chemical or a mixture of chemicals that impact human biological systems. EDCs can cause harm to wildlife and to human health too. Their impact on human health is most concerning as the chemicals cause interference with the endocrine system in the human body which is responsible for growth and development and response to injury. The presence of these chemicals in drinking water can cause disruption to different human systems of development, reproduction, neurological, and cardiovascular. These chemicals can be released in the surface water from different natural and anthropogenic substances like pharmaceuticals, pesticides, components of plastics etc. These substances can be found in various products like plastic bottles, metal cans, detergents, food additives, cosmetics and pesticides. The paper focuses on identifying different industrial and non-industrial sources of EDCs. The various mechanisms by which EDCs cause disruption to human systems, their health impacts and treatability study will also be discussed.

Keywords*: Endocrine Disrupting Chemicals; Hormone; Human health impacts; Water*

Effect of corrosion rate on material's chemical composition

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Abstract: This study investigated the change in chemical composition of the galvanized iron due to exposure to supply water in the water distribution network. A galvanized iron sample was installed in the distribution network pipeline for 315 days. Water samples were tested for their physicochemical characteristics. The corrosion rate of galvanized iron was also determined. XRD analysis of the by-products was carried out after exposure. The EDX analysis of the galvanized iron sample was carried out without and after exposure to supply water. As a result of the experiment, the sample material's composition changed from C 11.0% to 7.7%, O 14.0% to 25.3%, Fe 10.8% to 65.8%, and Zn 63.2% to 0.6% by weight. It was illustrated by the XRD graph that when Zn reacted with supply water, by-products of Zinc Sulfate Hydroxide, Zinc Oxide, Zinc Sulfate, or Zinc Chloride were produced. It was also noticed that Zn was reduced by 62.60%. SEM analysis indicates that Zinc coating has disappeared from the top layer. So, it can be concluded that after exposure to supply water in the distribution network, Zn reduced almost to zero.

Keywords: *Chemical Composition; Galvanized Iron; XRD Analysis; EDX Analysis; Corrosion Rate*

Identification of Sensitive Region by Short Term Shoreline Change Analysis over Gulf of Khambhat, Gujarat

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Abstract: Coastal zones, rivers, and riverine habitats, as well as deltas, all have tremendous significance in perspective of ecology, socioeconomic, and environmental standpoint. The present study is focused on Gulf of Cambay which also known as Gulf of Khambhat with the objective to identify most susceptible zones to erosion and accretion. The shoreline extraction has been carried out from multitemporal satellite datasets for three years 2016, 2017, and 2018 consecutively. The high-water line (HTL) is considered as shoreline. The visual interpretation of atmospherically corrected Landsat 8 OLI/TIRS C1 Level 1 satellite data has been used to demarcate the HTL based on various geomorphology and land use & land cover features. The study area, deciphered three regions (A: Mahadevpur region, B: Vishwamitri river estuary, C: Gogha region near Bhavnagar) is eroded and accreted drastically. The erosion observed over a period of three years were 8.41 km^2, 13. 41 km^2 and 2.6 km^2 whereas deposition 17.25 km^2, 15.58 km^2 and 5.93 km^2, over the region A, B & C respectively. The main reason for erosion were strong tidal currents accompanied by wave action. Situation of erosion is magnified by degradation of mangrove cover over mudflats whereas accretion is the result of the sediment load transportation & deposition from the rivers i.e., Mahi, Narmada, Sabarmati, Vishwamitri, Tapti rivers. The study is in line with Sustainable Development Goals (SDG) 14: "Conserve and sustainably use the oceans, seas and marine resources for sustainable development", Target 14.2 "sustainable manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience and take action for their restoration in order to achieve healthy and productive oceans" & 14.5 "conserve at least 10 percent of coastal and marine areas, consistent with national and international law and based on best available scientific information".

Keywords: *Shoreline Change; Erosion & Accretion; Gulf of Khambhat; Sustainable Development Goals*

Assessment of long-term Rainfall trend in Tapi river basin using the IMD gridded data

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Abstract: This paper aims to study rainfall variability in the Tapi river basin (TRB) and also in the Lower Tapi river basin (LTRB), Middle Tapi river basin (MTRB), and Upper Tapi river basin (UTRB) for different periods, i.e., 1901-2022, 1951-2022, 1975-2022 and 1991-2022. Temporal trend analysis is performed using the Modified Mann Kendall (MMK) test and linear regression (LR) test to investigate rainfall variability. The Innovative trend analysis (ITA) method is also used to find a trend in high, medium and low rainfall. The data used for this study is IMD gridded data, downloaded from the India-WRIS website on an annual scale from 1901 to 2022. The study shows that annual rainfall is increasing at a rate of 1.51, 2.06, 4.39 and 9.65 mm/year for the period of 1901-2022, 1951-2022, 1975-2022 and 1991-2022 in LTRB. Similarly, 0.89, 0.06, 0.84, and 3.45 mm/year in MTRB, 0.09, 0.14, -0.03 and 1.79 mm/year in UTRB and 0.55, 0.07, 0.33 and 1.31 mm/year in TRB for the similar period. Linear regression and the ITA method show identical results with the MMK test. The result of this study indicates that in a later span of a time period (1991-2022), there is a very high increase in the rate of rainfall in TRB and the highest in LTRB may be due to climate change and other anthropogenic activity.

Keywords*: Rainfall Trend; Modified Mann Kendall Test; ITA Method; Linear Regression; Tapi River Basin*

Geothermal water quality assessment for industrial, irrigation and domestic purpose: Case Study from Savarkundla and Lasundra, Gujarat, India

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Abstract: Gujarat is a state with huge scarcity of fresh and clean water. In such conditions any form or resource of water can act as a major contributor to the society. Gujarat is surrounded by sea water from three sides which recharges the other forms of water body in this region, one such important form of water resource is geothermal water. Savarkundla and Lasundra are one of the potential geothermal spots of Gujarat. Six water samples are assessed from these regions three from each of the study area. Physio- chemical parameters were assessed to understand the characteristics of these waters. Anionic and Cationic parameters like Na^+, K^+, Mg^{2+}, Cl^-, $HCO3^-$, CO_3^{-2}, SO_4^{-2}, pH, TDS and Conductivity is analysed to understand its suitability in industrial, irrigation and domestic sectors. Plots like Ternary diagram, Gibbs plot, Wilcox plot, Durov plot, Schoeller plot, Stiff plot and Piper plot describes the suitability of geothermal water in these regions for application in industrial, agricultural, and domestic sectors. The result of the analysis suggests that the geothermal water of Savarkundla can be used in all the three sectors whereas, the geothermal water of Lasundra must be pre-treated before it can be used for irrigation and drinking purposes.

Keywords*: Geothermal Energy; Irrigation; Industrial; Resource; Societal Benefit*

Decolorization of textile wastewater using electrocoagulation process

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Abstract: In the environmental pollution talk, wastewater treatment is one of the major issues currently. The current situation of population growth and industrial evaluation contributes more to wastewater generation. In particular modern world depends more on the textile industry, it also generates a significant amount of industrial wastewater. Textile industry effluent is a major concern among all dye-producing industries as it releases complex compounds in wastewater, which also occurs in large volumes. Furthermore, these effluents need an advanced treatment process to discharge into the receiving bodies as per discharge standards. This experimental study discusses the degradation of Reactive Red 195 and Reactive Yellow 145 by using the Electrocoagulation Process. These dyes are widely used in the textile industries and are highly toxic when released into the environment. The principle objective of this study is to investigate the decolourisation efficiency based on various parameters like current density, initial concentration, pH, reaction time, and salt concentration (NaCl). Iron electrodes were used in this electrocoagulation study. Decolourisation efficiency of up to 94% has been achieved at optimum conditions.

Keywords*: Electrocoagulation; Iron Electrodes; Decolourisation Efficiency; Textile Wastewater; Reactive Red 195; Reactive Yellow 145*

Pillared Clays for Treatment of Textile Wastewater

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Abstract: Dyes are used to produce attractively coloured products which are used in industries such as textiles, food, leather, paper and plastics. However, the unutilized dye compounds cause deleterious effects such as water pollution, prevention of light penetration into water, loss of aesthetic appeal even at low concentrations and harm both aquatic organisms and humans. These organic compounds are not easily decomposable in conventional water treatment and hence are required to be treated in a specific manner. Adsorption is a technique which is simple, sustainable, easy to operate and maintain. Clay is a naturally occurring porous material which may be functionalized into a versatile and effective adsorbent. The inherent swelling problem of clay upon contact with water may be overcome by the process of pillaring. Pillared clays are formed by intercalating them with exchangeable poly metal cations and subsequent calcination. These treatments improve the physicochemical properties of clay such as BET surface area, micropore volume and water stability. In current study bentonite clay has been used for pillaring using Cr polycations and calcined at 500ºC. The Cr pillared clay had higher interlayer spacing, surface area and pore volume. Two types of dyes viz., Acid Green and Basic Yellow dye were adsorbed using pillared clays. Kinetics and isothermal studies have been done for characterizing the adsorption of both the dyes onto Cr pillared clay. Process parameters such as pH, concentration of dyes, dosage of adsorbent and salt concentration have been modelled and optimised using response surface methodology using Design Expert software. Further, the real textile waste water was subjected to adsorption of Cr pillared clays and was found to be effective in reducing the COD of the wastewater by 75%.

Keywords*: Pillared Clays; Wastewater Treatment; Dyes; Adsorption; Sustainable*

Atmospheric Plasma Technology for Sustainable Wet Processing of Textiles

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Abstract: Nowadays, the preservation of the environment is one of the top priorities of scientists and researchers which drives them to innovate and develop eco-friendly methods and processes. The textile industry is considered one of the most water consumption industries due to the water they need for preparation and finishing operations. The plasma state is frequently referred to as the 4th state of matter in the sequence; solid, liquid, gas, and plasma, in which some or all of the electrons in the outer atomic orbital have become separated from the atoms resulting in the accumulation of electrons, ions and possibly of neutrals and photons, which are no longer bound to each other. For textile fields of application, fundamentally only 'cold plasma' and in particular the corona and glow discharge are of interest. Plasma treatment generally takes place in dry conditions; thus, the fibres are not swollen. The changes in properties induced by plasma treatment are therefore restricted to the surface only. This review aims to highlight the effects of plasma treatment technology on textiles and the potentiality of considering it as an alternative to conventional wet processing (desizing, bleaching, etc.). Types of plasma, techniques, applications, advantages, and disadvantages are mentioned. The water consumption and the environmental impact are discussed. Plasma modification of textiles saves large quantities of water, chemicals, and electrical energy, which is made possible since the plasma process does not produce large volumes of waste or toxic by-products.

Keywords: *Plasma Technology; Sustainable Wet Processing; Eco-friendly; Water Consumption; Environmental Impact*

Experimental Analysis for Removal of Pb & Cu from industrial Wastewater by using Low-Cost Adsorbent (Banana peel)

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Abstract: Heavy metals have become a serious pollutant in water because of its non-biodegradable and hazardous properties. In this research paper, banana peel powder is used as bio-adsorbent to remove heavy metals from contaminated/polluted industrial wastewater. Conventional methods are not very productive & are costly & require high energy consumption. The major problem related with banana peel as bio-adsorbent is that large quantity of banana peel wastes contributes to its significant disposal issue. According to the outline in India, a total calculation of about 30.9 tons of banana peel waste was produced. Therefore, it is essential to resolve the difficulty of banana peel disposal by converting it into bio-adsorbent. The goal of this research is to make use of banana peel bio- adsorbent and to evaluate heavy metals adsorption capacity of the banana peel bio-adsorbent. In that case, the banana peels are used in adsorption of heavy metals where it extracts out the Cu and Pb from the waste water from the industries. The research of this study will minimize the effect on the living things caused by the waste water released by the heavy industries. The results from the enhanced method revealed the applicability of the method to environmental water samples. This study therefore verifies that banana peel is a promising adsorbent for the removal of heavy metals from industrial effluent. The most major of pollutants is the effluents (dyes) which are disposed directly to the river from the textile industries. This effluent contains a variety heavy metals like chromium and copper. Some of the heavy metals which are available in even smaller amount will cause a greater pollution. Disposal of the industrial effluents into the water streams or precious water resource must be avoided. Although there are various treatment methods before disposal, which will not be productive in the removal of heavy metals. Adsorption is well- known as productive and economic method for low concentration heavy metal wastewater treatment. In the adsorption process variety adsorbents are available. In this study, banana peels were made used and activated carbon produced from banana peel as a low-cost adsorbent. A comparative study is prepared in order to make a comparison between the removal efficiency of lead by these adsorbents. The dosage of adsorbents was about 10 grams, 15 grams, 20 grams which will create a situation of removing heavy metals. The adsorption process is completed at the room temperature for about an hour for each adsorbent. The adsorption process is initiated with the initial concentration of 10 gram of each adsorbent and then gradually increased based on the removal percentage.

Keywords*: Adsorption; Banana Peel; Heavy Metals; Activated Carbon Filter*

Solar Photocatalytic Dye Degradation using Zinc Orthotitanate as a Photocatalyst

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Abstract: Zinc Orthotitanate is one of the candidate materials for the photocatalytic dye degradation method. In this work, Zinc Orthotitanate (Zn_2TiO_4) powder has been synthesized by solid-state reaction method. For preparation of Zinc Orthotitanate, precursors ZnO and TiO_2 were taken in molar ratio of 2:1 and was ground inside high energy planetary ball mill for 2 h. The ball milled powder was calcined at 900°C for 2 h at ambient air atmosphere. The obtained calcined powder was further characterized by X-ray diffraction analysis (XRD), Raman spectroscopy for its phase purity and with Dynamic light scattering (DLS) for its particle size. The X-ray diffraction pattern shows a dominant phase of Zinc Orthotitanate (Zn_2TiO_4). From DLS study, the mean particle size was determined to be 950 nm. The Raman peak corresponds to 245 cm^{-1}, 304 cm^{-1} (Eg), 474 cm^{-1} (F2g), 720 cm^{-1}(A1g) modes were assigned to cubic inverse spinel structure of Zn_2TiO_4. Water is the most precious thing for all the living being on the earth, but due to rapid industrialization these water bodies are polluted in such a way that it is not suitable for drinking and reusing it. So, photocatalysis is the most suitable technique for dye degradation. Photocatalytic dye degradation of Crystal Violet was done under solar light and complete degradation was obtained in 100 minutes of solar irradiation.

Keywords: *Photocatalysis; Dye Degradation; Zinc Orthotitanate; Solid State Reaction; Planetary Ball Mill*

Modelling sorption of arsenic by ceramic water filter fabricated from Soil of Rajasthan

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Abstract: Ceramic water filters (CWFs) are sustainable systems for providing clean and affordable drinking water to remote communities. This paper presents a machine learning-mediated process for predicting the arsenic treatment efficiency of a ceramic water filter from an aqueous solution. The machine learning approach is an environmentally conscientious and powerful instrument for increasing the sorption effectiveness of ceramic water filters, hence minimizing the risk of global water scarcity. Accordingly, experimental studies that aimed to eliminate arsenic from water were taken into account and subsequently, an optimized distributed gradient boosting model (XGBoost) is constructed to anticipate the adsorptive eviction of arsenic onto these CWF systems. The findings showed that the XGBoost model was highly accurate, with a root-mean-squared error (RMSE) of 5.34 and 7.49 and; a determination coefficient (R2) of 0.987 and 0.965; for the training and testing phases, respectively. With an accuracy of 98% in practice, the proposed optimized model can be recommended for practical engineering to predict and improve the heavy metal treatment efficacy of CWF systems.

Keywords: *Regression; XGboost; Machine Learning; Ceramic Water Filter; Arsenic Treatment*

Treatment of domestic and industrial wastewater through phytoremediation: A review

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Abstract: Water among the other basic entities is essential for the survival of human beings. Developing countries like India discharges a lot of domestic as well as industrial effluents into the water bodies without or partially treating it, which leads to human health issues and environmental degradation. Phytoremediation is well-accepted technique, but still not been widely used on a commercial scale. Many studies have been done in the past for the treatment of wastewater through phytoremediation for domestic wastewater. However, this study identifies species beneficial for the treatment of domestic as well as industrial wastewater for the removal of targeted pollutants like COD, phenol, Heavy metals Cd, Zn, Cu, Cr, nutrients like N, P, K, etc. The removal efficiency of various pollutants has been found out for various phytoremediation species. This paper also discusses various types of reactors, and wetland structures - useful for phytoremediation. This study also provides knowledge of the design and implementation of phytoremediation and the challenges faced in treating industrial wastewater for a cost-effective sustainable treatment technology.

Keywords: *Phytoremediation; Wastewater Treatment; Heavy Metal Removal; Cost Effective; Sustainable Treatment Technology*

Fluoride removal from groundwater using fish scales derived biochar

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Abstract: Fluoride levels in underground water have risen to significant levels in many parts of the world, which has caused a tremendous amount of damage to the environment. Fish wastes, on the other hand, are generally recognized as having significant environmental impacts. There is usually a high biological oxygen demand (BOD) associated with these wastes as well as a strong offensive odour. A large portion of fishery waste consists of scales, which are generally discarded as waste of little commercial value. Fish scale derived biochar as an adsorbent is used in this study to correlate its performance as a novel and relatively low-cost adsorbent for the removal of fluoride from aqueous solutions. Fluoride ions have a greater affinity for chitosan materials than other adsorbents. Fish scale waste, which is a readily available chitosan material with virtually no value, has been analysed so that it may be converted into a useful adsorbent. Batch adsorption and kinetic study is done to observe the efficiency of fluoride removal using fish scales derived biochar. The various properties like effect of pH, adsorbent dose, initial fluoride concentration, agitation speed, contact time, and temperature is studied. Washing, drying, and grinding of fish scales is performed in accordance with FTIR and SEM characterization for fluoride removal from groundwater. The results showed that fish scales derived biochar can be successfully used as an effective adsorbent for groundwater fluoride removal.

Keywords: *Fluoride; Biochar; Adsorption Isotherm; Groundwater; Characterization*

Extraction of Geothermal Water using Directed Energy Method of Millimeter Wave Technology

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Abstract: Drilling of geothermal water well is quite challenging then traditional water well drilling. Geothermal water well drilling deals with high temperature and pressure conditions. Conventional drilling methods are very mature, but still have difficulty drilling through very deep, very hard and hot rocks for geothermal water well drilling applications. Physical contact between the tool bit and the rock or surface to be drilled is the major constraint in conventional drilling methods. It is necessary to find cost-effective technologies to improve drilling performance in hard rock formations in order to support the growth of geothermal energy generation from deep deposits. Currently, the costs associated with drilling can make up to 70% of a deep geothermal project's overall investment. Millimetre Waves (MMW) is one of the technologies which overcome the limitations and reduce rock drilling to a fundamental interaction between energy and matter without the need for mechanical contact with the surface to be drilled. This review states a brief history of directed energy drilling, various types of deep drilling methods including plasma-pulse geo-drilling, thermal spallation drilling, flame jet drilling, electropulse boring, and laser drilling. Millimeter Wave Technology is discussed in detail with its method of operation, how it is useful in melting rocks at greater depths, the rate of penetration it provides, and its merits are discussed as compared with conventional drilling methods. Moreover, deep drilling using MMW from a geothermal perspective is discussed where penetrating hard rocks encountered at greater depths is a major challenge.

Keywords*: Millimeter Wave Technology; Deep Drilling; Geothermal; Directed Energy*

Integrated Assessment of Ground Water of Dudhwada Village of Padra Taluka with Special Reference to Industrial Pollution

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Abstract: This study carried out to examine the groundwater quality in Dudhwada, Piludra and Kharakdi are the major areas of Padra which has remained affected for a long time due to industrial waste. Groundwater samples have been collected from the various locations of the above-mentioned villages from the varied sources such as Hand pumps, bore well, wells and tube wells which were subjected to analyse the physicochemical parameters like pH, Electrical Conductivity, TDS, Na, K, Ca, Mg, fluoride, sulfate, phosphate, sulphide, chemical oxygen demand, DO. Cr, I, Mn, Ni, Co, Pb, Ca, Zn, Cd, and Cu Heavy Metals etc. The obtained results were to determine if all the studied parameters fall under the prescribed guidelines of Bureau of Indian Standards (BIS) and World Health Organization (WHO). Entire study conducted by GPCB has been compared with the present study and it was determined that Total Dissolved Solids (TDS), Total hardness, COD have shown a difference as compared to the past results while the concentration of Electrical Conductivity and alkalinity have shown an incline. Ground water is the major source of reliance for the people of Dudhwada, emergence of industries is somewhere responsible for the contamination due to its open release of chemical discharge in rivers and lakes. Dye and Pharmaceutical industries with their mass production have absolutely lost the control over the discharge of hazardous residue, leaving the water puddles, hand pumps highly contaminated.

Keywords*: Groundwater; Industrial Pollution; Water Quality*

Hydrodynamic Cavitation- A Promising Technology for Water Treatment

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Abstract: Water treatment is crucial nowadays due to the scarcity of potable water and rapidly increasing necessities of the global population. The present work focuses on Hydrodynamic Cavitation which is a promising application in wastewater treatment when used in combination with Advanced Oxidation Processes (AOPs). The first part of the work highlights a critical analysis of the literature on combined approaches based on hydrodynamic cavitation, followed by obtained experimental results. The prime objective of investigating the effects of Peroxide and Fenton reagent with HC on COD removal is presented. The optimisation of operating parameters of hydrodynamic cavitation such as the effects of changing pH of the sample and the concentration variations of oxidising agents was executed to determine the maximum degradation. Throughout the research, samples of river water were taken from the Mula-Mutha river located in Pune. One hour of hydrodynamic cavitation scaled down the COD of pH 3 river water by about 60%. Subsequently, utilising Sodium persulphate resulted in the highest degradation at 9 pH wherein the estimated optimal concentration of persulphate is 600 ppm. With a COD reduction of over 89%, 15 mM H_2O_2 is the recommended dosage when peroxide is employed as an oxidant. Significant enhancement in the rate of degradation has been observed with Fenton reagent for 60 minutes, where the H_2O_2 to $FeSO_4$ molar ratio of 10:1 and the pH of 3 considered to be optimal, achieved the COD removal of about 93%. Fenton procedure alone or H_2O_2 + HC is the most efficient for river water with extremely high COD since it attained the greatest COD reduction during the experimental work. Kinetics of hydrodynamic cavitation degradation obey pseudo-first-order law; hence, the estimated rate constant is $K = 7.21 \times 10^{-4}\ s^{-1}$. The motor utilised has a power rating of 1500W and the total cost of operation for the cavitating system is approximated to be Rs 18 per hour.

Keywords: *Water Treatment; Hydrodynamic Cavitation; COD; Hydrogen Peroxide; Fenton Reagent*

Implementation of SWASTIIK Technology for Providing Safe Drinking Water- Devising Newer Methodologies

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Abstract: SWASTIIK technology that combines traditional knowledgebase of Ayurveda with modern hydrodynamic cavitation technology has huge potential for implementation in real life, especially for substituting the existing chlorination method for drinking water treatment. The problems that need to be addressed include part or complete separation of the natural oils and devising newer reactor modifications for increased efficacy. The present work incorporates use of newer copper reactor configuration, employing vortex flow for generating cavitation for the disinfection of water. Elimination of model contaminant, *E. coli*, with initial concentration of ~10^5 CFU/mL of bacteria was used for the disinfection study. Copper vortex diode with the capacity of 1 m^3/h was employed as a cavitating device. The cavitation using copper vortex diode gave significantly higher disinfection, over 30%, compared that with conventional vortex diode, with aluminium as material of construction, under similar conditions. The results reveal that copper as a material of construction for the cavitating device plays an important role and further enhances the extent of disinfection, beyond conventional cavitation, and also in the reported SWASTIIK technology, which can be exploited for the application in real life operation for increased efficacy and for reduced cost. The newer methodology can have advantage of no harmful carcinogenic disinfection by- products as compared to that in conventional chlorination process and with comparable cost, it can be considered to be sustainable alternative to chlorination.

Keywords*: Bacteria; Cavitation; Disinfection; SWASTIIK; Water Treatment*

Impact of anthropogenic pollution on shallow groundwater

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Abstract: The study presents the risk to contamination in groundwater supply wells with due impact of anthropogenic pollution in Aligarh district of Uttar Pradesh province (India). The major source of contamination in the study area are some food preservation industries, slaughter house industries, agricultural chemical wastes and solid wastes in the drains. Polluted effluent of industries, runoff from agricultural fields to drains, and heavily polluted water of drains can potentially degrade the quality of groundwater water in the study area with 10000 people rely on for their domestic use. Groundwater samples have been collected from five different villages of Aligarh and different physicochemical parameters were monitored in all groundwater samples from pre-monsoon season (June) to post-monsoon season (October) in 2022 to identify the major differences in the quality of groundwater in the wells. All samples were analyzed for the basic physicochemical parameters like pH, total dissolved solid, total hardness, alkalinity, calcium, chloride, sulphates, and heavy metals like iron and chromium. In study area some of parameters were in safe range while some parameters were exceeding the desirable limit defined by IS10500:2009. Alkalinity, total dissolved solids, hardness and chloride of the groundwater samples were recorded more in post-monsoon season than it was in pre-monsoon season and some other parameters like pH and sulphates remains stable. Some parameters like pH, total dissolved solids, chlorides and sulphates remains in desirable limit whereas some other parameters like hardness, alkalinity crosses desirable limit but stays within permissible limit. Hence groundwater needs some treatment like lime soda process before use in domestic purposes. Heavy metals detection test have done for chromium and iron, but the heavy metals were not detected in the test. This study discusses in detail about the impact of anthropogenic activities on groundwater. The study has been divided into several chapters. Each chapter discusses in detail about the study. At the end result have been discussed, conclusion of the study have been derived and some solution and recommendation have been proposed.

***Keywords**: Anthropogenic Pollution; Groundwater; Pre-monsoon post-monsoon; Aligarh*

Applicability of nanomaterials in water and waste-water treatment: A state-of-the-art review and future perspectives

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Abstract: The need for clean water is growing as a result of the overall impact and concerns that water resource contamination has on the planet. Nanotechnology might improve the frameworks for the next generation of water delivery systems and provide efficient methods for treating, using, and recycling water. Due to their effectiveness against synthetic and natural pollutants, numerous nanoparticles are developing with advances in nanotechnology for water filtration and waste-water treatment technologies. Nanoparticles are increasingly used in waste-water treatment due to their unique properties, such as their small size, high surface area, and high reactivity. This paper discusses the potential uses of nanoparticles for waste-water treatment, including adsorption, photocatalysis, and biofouling control. Adsorption is the most widely used method, in which nanoparticles remove organic pollutants, heavy metals, and other contaminants from waste-water. Photocatalysis is another promising application, where the nanoparticles can be used to degrade organic pollutants under UV light. Disinfection, or Antimicrobial nanomaterials-based technology, is gaining attention as a viable approach to waste-water treatment. This paper reviews the existing literature on nanoparticle waste-water treatment applications and discusses the potential benefits and challenges associated with the technology.

***Keywords**: Nanoparticles; Wastewater Treatment; Metallic Nanoparticles; Adsorption; Photocatalysis*

Utilizing agricultural waste-derived activated carbon ash to treat industrial waste water

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Abstract: The present study relates to a fast microwave digestion process for producing active carbon ash from wheat straw. The sustainable and environmentally friendly raw material for this technique, wheat straw powder, is crushed and dried in a hot air oven. Following the drying process, the material is put into the microwave digestion system with a 1:10 ratio of 35% to 37% hydrochloric acid. Temperatures used for the microwave digestion optimization range from 110 °C to 130 °C for 10-15 minutes. After digestion, a charred product is produced, activation products are rinsed with distilled water until Cl^- ions are removed, and active carbon ash is produced following the drying process. In this innovative procedure, activated carbon is quickly created at 120 °C in just 10 minutes without producing airborne particles. The technique falls under the purview of agriculture technology. FTIR, XRD, SEM, and EDX are used to characterise the finished product. This resulted in activated carbon with good colour removal and methylene blue (MB) absorbency properties from industrial waste water. The advantages of this activated carbon made from agricultural waste include low cost, quick and easy operation, adaptability for large-scale manufacturing, and excellent market competitiveness.

***Keywords:** Agricultural Waste; Wheat Straw; Microwave Digestion; Activated Carbon; Water Treatment, Methylene Blue; Adsorption*

Effect of anaerobic degradation on different parameters of three different Ratios of textile dye wastewater to glucose using a batch reactor

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Abstract: Textile industries contribute about 4% to the nation's gross domestic product (GDP) and are also one of the major industries responsible for causing pollution to the water bodies. Textile industries make use of about 10,000 types of dyes, out of which 70% of them are azo dyes. The intense color of the dyes is one of the most notorious characteristics of untreated textile wastewater. There are various methods to treat textile wastewater, column adsorption being one of the most commonly used methods for removing dyes. Despite being an economical approach, it has several drawbacks in terms of regeneration, and reusability of the adsorbent. The use of biological techniques can get over these restrictions. Azo dyes are difficult to degrade aerobically, but anaerobic decomposition can reduce the azo dyes' -N=N- linkage and release aromatic amines. The breakage of this -N=N- makes the dye colorless. The primary goal of the study was to treat synthetic textile wastewater anaerobically in a batch reactor and evaluate the removal efficiency in terms of COD, BOD, VS, TSS, and other relevant parameters by changing the dye-to-glucose ratio. Changes in the dye-to-glucose ratio considerably altered the removal performance. Observed maximum COD removal efficiencies were 77.5%, 66.9%, and 54.2% for dye-to-glucose ratios of 20:80, 50:50, and 60:40, respectively. The observed percentages of color removal were 88%, 77%, and 54%, respectively. The cumulative biogas yield was used to elucidate the batch reactor kinetics using various well-known models, such as, Gompertz, Haldane, etc. Therefore, anaerobic biodegradation may be a helpful approach for treating textile dye wastewater in the future. To further investigate the relatively young field of dye biodegradation; however, many more experimental results are necessary.

Keywords*: Anaerobic Degradation; Batch Reactor; COD removal; % Color removal; Kinetics*

Reducing the Effluent Load by Coating Hygiene Textile with Microencapsulated AA, ACN Based SAP

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Abstract: A superabsorbent polymer (SAP) based on co-polymerization of acrylic acid, its salt and acrylonitrile was prepared by solution polymerization using benzoyl peroxide as an initiator. Experiments were performed at 80-90˚C for 1.5 hour with varying concentration of acrylic acid (AA), potassium persulfate (KPS), and acrylonitrile (ACN). The SAP was microencapsulated with a diameter less than 15 µm, and coated on sanitary napkin. After complete utilization of sanitary napkin, the discharge of the same in routine water sewage. The coated polymers adjust with the pH of menstrual discharge and neutralize the liquid. The discharged water sample was studied and compared with conventional sanitary napkin discharged in water. Studied suggest that experimented, i.e., microencapsulated SAP coating on hygiene textile decreases the effluent load compare to conventional one. The analysis clearly indicates about lower values of COD, BOD and TDS, and neutral pH of the wastewater, than studied with conventional hygiene textiles.

Keywords: *Superabsorbent Polymers; Effluent Load; Microencapsulation; Sanitary Napkin; Chemical Oxygen Demand; Biological Oxygen Demand*

Removal of Copper from Industrial Wastewater by Developed Composite Adsorbents

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Abstract: The importance of removal of heavy metals like Cu from industrial wastewater has received immense attention due to rapid industrialization and heavy metals potential to threat to environment, especially in the developing countries like India. The use of effective adsorbents and alternatives to traditional adsorbents like charcoal has recently attracted a lot of attention in studies on the removal of heavy metals from wastewater. For the treatment of industrial wastewater, agricultural waste to alternative after processing of material and therefore in this research, agricultural waste like soyabean husk, rice husk and wheat husk are procured from nearby area and after chemical and thermal treatment, adsorbents and composite adsorbents (CA) are prepared and used in column experiment to conduct the study on adsorption process, adsorption capacity and heavy metal removal efficiency. Composite adsorbents are 10% more effective than individual adsorbent to remove the heavy metals. CA-2 & CA-3 are more efficient than CA-1, CA-4, CA-5 and CA-6. CA-2 consist of 50% wheat husk, 33% rice husk and 17% soyabean husk and CA-3 consist of 50% wheat husk, 17% rice husk and 33% soyabean husk. Composite adsorbent gives maximum 82% removal for copper from industrial wastewater. Developed adsorbents prepared from these husks can be effectively used for adsorption due to low cost & high availability. The most recommended approach for removing harmful metals from industrial wastewater is the adsorption process since it is easy, affordable, and efficient.

Keywords*: Composite Adsorbents; Agricultural Waste; Column Experiment; Heavy Metals; Industrial Wastewater*

MAX-CdS hybrid Nanocomposite as an Effective Photocatalyst for the Degradation of Toxic Industrial Dyes

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Abstract: The textile, paper, cosmetic, chemical industries, and other fields are constantly flushing down their organic waste to the drains, polluting the water. As per reports, various nanoparticles have been used as adsorbents and photocatalysts and have shown remarkable results in this regard. The present study reports the synthesis of CdS and CdS-MAX-Phasehybrid nanocomposites using a thermal decomposition approach at 180 °C in 1 hour. The synthesized samples have been characterized for their, phase, morphology, and functional group analysis. The nanocomposites have been explored for photocatalytic degradation of methylene blue and it was found that the composites exhibit excellent response (98%) even with ¼ amount of CdS as compared to pure CdS and MAX- phase. The CdS-MAX-Phase can further study for degradation of organic dye and many more applications.

Keywords: *CdS-MAX Nanocomposites; Thermal Decomposition; Photocatalysis; Methylene Blue; degradation; Wastewater Treatment*

Treatment of Domestic and Industrial Wastewater with Constructed Wetland - A Review

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Abstract: Constructed wetland (CW) is an engineered version of a natural wastewater treatment. It can be applied in a sustainable way for domestic (DWW) and industrial wastewater (IWW) treatment with low capital, operational and maintenance cost. Pollutant removal efficiency of CW affected by substrate, plants, microbes, temperature, hydraulic loading rate, hydraulic retention time (HRT). Removal of nitrogen increased with intermittent aeration, back recirculation of little quantity of treated water, use of ion exchange substrate and microbes. Removal of organic compounds increased with batch loading of wastewater and substrate with sufficient porosity. Substrate with iron, aluminium, and calcium, increased the phosphorus absorption. Higher temperature favours the plant and microbes growth. Area requirement can be reduced with various design modifications. Wetland can be constructed at 1/3rd cost and can be maintain at $1/5^{th}$ cost than conventional wastewater treatment. Author compared more than 80 research studies to find the best possible solution for DWW and IWW treatment. Properly designed CW can treat DWW at 3-4 days HRT and removes up to 81-92% COD, and 70-89% BOD. Hybrid CW with longer HRT, perform better in treatment of IWW. Hybrid CW can removed 76-99% colour from textile wastewater, and 55-96% colour form pulp and paper mills wastewater.

Keywords*: Constructed Wetland; Domestic Wastewater; Industrial Wastewater; Pollutant Removal Efficiency; HRT; Low Cost*

A Comprehensive Review on Different Treatment Methods of Oilfield Produced Water

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Abstract: Oilfield produced water (OPW) is an inextricably linked component of crude oil recovery processes. It is the most significant type of waste generated during hydrocarbon recovery. OPW contains high concentrations of organic and inorganic salts, heavy metals and sand particles. Exploration and Production (E&P) operations also generate large volumes of brine water. Due to the complex and hazardous composition of OPW, it cannot be simply discarded into the environment. With respect to the global rise in industrial activities, production of crude oil has increased to a large extent. Subsequently, generation of OPW has increased. This makes it neccessary to manage OPW in a suistanable and eco-friendly manner. Currently, the focus is on treating OPW to make it suitable for reuse. Different physical, chemical and biological methods are used to treat it. This article discusses the reuse of OPW for various purposes in addition to studying the different treatment methods in detail. The regulation of various parameters such as total dissolved solids (TDS), total organic carbon (TOC), chemical oxygen demand (COD), oil-in-water in OPW are examined in the treatment methods being used in the industry.

Keywords: *Crude Oil; Hydrocarbon; Exploration and Production; Produced Water; Treatment methods*

Characteristics Analysis of Oil and Gas Industry Wastewater from Bakrol Field

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Abstract: During Exploration & Production operation, the waste water generated in huge quantity along with crude oil. Produced water is a complex mixture of dissolved and particulate inorganic and organic matters. It contains abundant inorganic chemicals like calcium, magnesium, sodium and chloride. In high concentrations, the other inorganic components, such as barium, strontium, boron, sulphate, carbonate and bicarbonate are also present. The dominant organic chemicals in most produced water are soluble low molecular weight organic acids and some aromatic hydrocarbons. Constituents of produced water vary a lot depending on a number of factors, including geographic locations, characteristics of formations (i.e., the depth of formation, porosity and permeability of formation rocks/sands, water content) and injected fracturing fluid. Since water is becoming a big issue in some arid areas and as regulations become more restrictive for disposal and reinjection, produced water reuse/recycle will be a solution to reduce the wastewater production and alleviate environmental effects. The main objective of this study is to statistically evaluate the produced water quality and to provide an assessment on the spatial distribution of specific groundwater quality parameters like pH, conductivity, alkalinity, turbidity, total organic carbon, total nitrogen, total dissolved solids (TDS).

Keywords: *Petroleum; Produced Water; Characterization; Composition; Water Injection*

Comparative performance of R600a and R290 adopted in two stage vapour compression refrigeration system based on Exergy analysis

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Abstract: In the present work, low GWP refrigerants such as R-600a, and R-290 are investigated for its performance with two stage vapour compression refrigeration system. The refrigerants are investigated for its 1st law and 2nd Law performance. Effect of operating parameter such as evaporator temperature and condenser temperature are evaluated on the different performance parameters of both the refrigerants. First and second law-based performance parameters such as COP, exergy efficiency, and total irreversibility of the system are evaluated for different operating temperature. The results show that R600a has a higher COP and energy efficiency than R290 refrigerants. Its overall Irreversibility rate is also lowered as compared to R290 refrigerants.

Machine Learning-based Predictive Models for Water Quality Index: An Analysis and Comparison

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Abstract: As per the UN Sustainable Development Goals, access to clean water is a fundamental human right and essential for the survival and well-being of communities worldwide. However, the reality is that millions of people still lack access to safe and clean water. The World Health Organization estimates that 3.575 million people die from water-related diseases in a year in with 2.2 million being children. The quality of water used in everyday life impacts human health excessively. This is where the importance of accurate and reliable water quality prediction comes into play. This research explores a series of supervised machine learning-based techniques to estimate the water quality index (WQI). The study focuses on analyzing the dataset consisting of different features contributing to the calculation of water quality. A thorough analysis of the dataset has been done and is used for the prediction of the Water Quality Index. Several Regression algorithms have been applied to predict Water Quality Index (WQI) with better accuracy.

Keywords: *WQI; Regression; Indian Water Quality Dataset; Supervised Learning; Machine Learning; Accuracy*

Groundwater Quality Evaluation Using Various Heavy Metal Indices-Based Method & Associated Health Risk Assessment

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Abstract: Groundwater is a vital source of drinking water for communities around the world. However, it is also vulnerable to contamination from various anthropogenic & geogenic sources. Heavy metals, in particular, can pose significant health risks if present in excess levels in groundwater due to its non-biodegradable nature, bioaccumulation and biomagnification through food chain. This study aimed to assess the groundwater quality and associated health risk for the Teliamura Municipal Council under Khowai District of Tripura. To assess the quality of water with respect to heavy metal, various indices-based methods namely, the heavy metal evaluation index (HEI), the contamination index (CI), and the heavy metal pollution index (HPI) were adopted in this study. Groundwater samples were collected and analysed for seven physicochemical parameters, including some heavy metals (As, Fe) and other toxic contaminants (NO_3^-, F^-). These parameters were mapped using geographic information system (GIS) platform to understand their spatial distributions. Furthermore, non-carcinogenic health risk was assessed for each of the sampling stations. The results obtained from HPI indicates overall good water quality. However, 45% of samples showed high pollution level as per the CI & HEI index in addition to heavy metals, the study area has a high concentration of nitrate, which increases the non-carcinogenic health risk. In order to determine the best remediation measures, it is also recommended to carry out further research to investigate the local scale contamination sources. Findings of this study will help decision makers to understand the overall water quality in terms of heavy metals as well as the associated health risk.

Keywords: *Groundwater; Heavy Metal; Health Risk Assessment; Geographic Information System (GIS)*

Potential impacts of landfill leachate on the quality of groundwater bodies

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Abstract: As the global population expands, so does the difficulty of dealing with municipal solid waste. The improper open dumping of trash is wreaking havoc across the country, and two immediate effects of this are the poisoning of groundwater and surface water. During landfill operations, leachates are created, most often as a result of precipitation infiltration through the trash tips. Because these liquid wastes pose serious pollution threats if they come into contact with the ground, soil, or surface rivers, precautions must be taken to avoid environmental disasters. This study analyses leachate and water quality including both groundwater and surface water with respect to the winter season. This is a preliminary study and further analysis of the leachate is to be done. The leachate samples were collected from the Jambuva landfill of Vadodara and groundwater and surface water were collected from the nearby areas. The major source of the landfill was Municipal Solid Waste but a few amounts of different wastes were also observed. Physicochemical characterization of the samples was done by the analysis of pollutant parameters DO, BOD, alkalinity, Hardness, Total Solids, and Chloride in the laboratory. Climatic parameters like pH and temperature were taken on the spot. The quality of water in most of the samples was not pleasant as the concentration level of pollutants was higher than the threshold. Therefore, Waste management strategies should be developed in response to urbanization and population growth in order to reduce pollution and protect public health.

Keywords*: Solid Waste Management; Leachate; Landfilling; Physicochemical Analysis*

Insights of Ground water quality assessment methods- A Review

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Abstract: Among all available sources of water, groundwater is most decentralized and dependable source of water for millions rural and urban families. Water demand has increased over the years and this has led to scarcity of water because of pollution. In this connection, the assessment of hydro-chemical properties of groundwater is one of the prime tasks in the present-day context. Groundwater is highly affected by existing geology, degree of chemical weathering, quality of recharge, some surface element sources, etc. This paper introduces different methods of assessment of groundwater quality like Multivariate Analysis, Linear Regression Analysis, Artificial Intelligence and Multi Criteria Decision Method and their subtypes also. Multivariate analysis methods is used to investigate relationship among the trace elements and factors controlling trace elements distribution in groundwater. The linear regression analysis is used for the water quality parameters and it measure higher and better levels of significance in their correlation coefficient. Artificial Intelligence can produce a GOI value by eliminating the sub-index calculations from which groundwater quality can be forecasted. Multiple criteria decision-making (MCDM) is a complex decision-making to find GQI which can assess the groundwater quality and manage it too. By comparing these methods, it shows all this method have their own importance like MFA and ANN works satisfactory for handling large data sets, MA works accurately for finding relationship between trace elements, Regression analysis Method measure higher and better levels of significance in their correlation coefficient and CANFIS can produce GQI easily and AHP can determine GQI easily and accurately. So, according to the need the appropriate method can be selected.

Keywords*: Groundwater Quality Assessment; MCDM; AI; WQI; Statistical Analysis*

Water Network Optimization with Wastewater Recycle and Treatment in Multipurpose Batch Plant Facility

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Abstract: Batch process industries consume large amounts of freshwater for washing and generate considerable amounts of wastewater. Every liter of wastewater released further pollutes the environment in general and groundwater in particular. Hence, it is necessary to minimize the consumption of fresh water and treat contaminated water before discharge. Present study deals with a network of waste water handling by recycling strategy, which would reduce the burden of fresh water consumption and optimal selection of end of the pipe treatment technique. Efficacy of the method is demonstrated with the help of commercial multipurpose batch plant. Analysis of results obtained from an industrial case study has shown 66% reduction in fresh water consumption. The results further have shown several options of treatment units for substantial reduction in treatment cost.

Keywords: *Multipurpose Batch Plant; Environment; Freshwater; Water Network; Recycling Strategy; Treatment Technique*

Fuzzy Rule Based Evaluation of Water Quality Index

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Abstract: Fuzzy logic is very useful for addressing real-world problems, which usually involve a degree of uncertainty. Fuzzy logic and inference system have widespread applications to various engineering problems. Fuzzy logic has been successfully employed to solve not just engineering problems in the fields of civil and mechanical engineering, but their applicability to the field of water resources and environmental engineering has generated interesting solution to difficult problems. We can simply say that fuzzy logic is the new view of science towards the universe. In fact, processes are analysed as they truly are, not the way we want them to be, but how can we use them? The two commonly used inference system are, i.e., Mamdani fuzzy model and Sugeno fuzzy model. One of the most effective ways to communicate information on environmental trends in general and water quality in particular to policy makers and public at large is with indices. Though agreed in principle, many countries are engaged in developing their own technique for the computation of water quality index. However, in view of uncertainties, the approach outlined in this paper using fuzzy logic-based formalism - a soft computing technique could be a better representation of a dynamic system, and thereby providing a new dimension of monitoring water quality. In the present study fuzzy rule-based models have been developed for the assessment of surface water quality index and the same has been compared with conventional water quality index. Both the quality indices have been compared on the basis of development of framework and derived results from earlier researches shows that fuzzy rule based computational model gives prominent results when compared to conventional water quality index.

Keywords*: WQI; Fuzzy Logic; Inference System; Membership Function*

The Sulfate Radical Generation and Optimization of Parameters Through a UV-based Technique

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Abstract: Advanced oxidation processes (AOP) are based on the use of various radicals for water treatment that has been studied in the past two decades. The radicals such as hydroxyl and superoxide radicals can degrade the complex and toxic micropollutants present in water. Mostly hydroxyl radicals are given prior attention in the AOPs which have an oxidative potential of 2.8 V. A new and powerful radical, Sulfate radicals is now gaining some attention of the researchers which is found to be superior that hydroxyl radicals in terms of the value of the oxidative potential can range from 2.8-3.1 V. The use of sulfate radicals is limited, and its potential is yet to be explored. Some of the available generation methods of sulfate radicals are Ultrasonication, photochemical oxidation, and plasma oxidation. These methods are energy intensive, and the concentration of radicals generated is not up to the expectation. The photochemical oxidation method is simpler than the other two methods and consumes less energy. Therefore, this work is intended to generate the sulfate radicals in a photochemical oxidation setup and generate a high amount of sulfate radicals. Some important parameters which control the generation of the radicals such as pH, temperature, and precursor dose have been investigated in this work. An orange azo dye was used as the model pollutant to observe the efficacy of the sulfate radicals. It was observed that the generation of the sulfate radicals in the photocatalytic reactor prefers the acidic pH, in the range of 2–4. The response surface methodology has been adopted to establish a regression analysis and optimize the parameters.

Keywords: *Photochemical Oxidation; Sulfate Radicals; Water Treatment; Regression Analysis; Optimization*

Air Quality Index management of a Medium-Sized Community space through Nature-based solutions in Gurugram, Haryana

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Abstract: A case study details the Air Quality Index (AQI) audit and improvement conducted for office space in Gurugram, Haryana (Urban Air Labs Pvt. Ltd.). The parametric was the concentration of Particulate Matter (PM) of 2.5 (µg/m³) outdoors and indoors in the comparison. Due to the negligible presence of volatile organic compounds and other gaseous pollutants, the AQI rating was proportional to the $PM_{2.5}$ concentration and directly affected the air-quality status representation of the office. The safer rating per the National Air Quality Index (NAQI) scale for AQI is 50 and for $PM_{2.5}$ is 30 (µg/m³). In general, the observed AQI and PM levels at the site were 161 ± 20 & 95 ± 10 (µg/m³) outdoors and 181 ± 20 & 115 ± 10 (µg/m³) indoors. Hence, the test location was equally polluted outdoors and indoors and needed attention for the health and safety of the employees. Urban Air Labs developed Nature-based solutions (NBS) (patent filed) such as Ubreathe Life & Ubreathe Mini on the science of Phytoremediation and biomimicry for inducting air quality control. Using the devices mentioned and a few preventive measures, the average of $PM_{2.5}$ levels was tracked down to 32 ± 10 (µg/m³) in a short course of time. The followed protocol lays a benchmark for future work on reducing AQI and PM in the workspace relevant to the discussion arena. The future scope includes improving the single pass efficiency of the NBS solutions and practical analysis of air-flow patterns in the office setting to select the different device configurations for enhanced effectiveness of AQI control.

***Keywords**: AQI; $PM_{2.5}$; Nature-based Solutions; Phytoremediation*

Identifying climate hotspots from spatio-temporal trends in exposure indicators for southern agro-climatic zone of Gujarat state, India

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Abstract: Present research identified climate hotspots based on spatio-temporal trends in annual time series of eight exposure indicators which are maximum (Tmax) and minimum (Tmin) temperature, total rainfall (Rain), hot days (HD), rainy days (RD), light rain days (LRD), no rain days (NORD) and one day extreme rainfall (Maxrain). The southern agro-climatic zone of Gujarat state, India is a heavy rainfall region with mountainous terrain in the east and a very long coast line in the west. The IMD (Indian Meteorological Department) gridded dataset for temperature and rainfall parameters of 1951-2020 time period have been used to identify significance and magnitude of trends utilizing Mann-Kendal (MK) test and Sen's slope methods, respectively. The outcomes obtained from such analysis at each grid point has been spatially distributed for the whole region in GIS environment using IDW interpolation. The results highlighted positive trends for Tmax in western parts and negative trends in eastern parts. For Tmin, significant positive trends were observed in western parts with trend magnitude in the range of 0.030 °C/year. The Rain indicator showed significant negative trends in the eastern parts but significant positive trends in the western parts with trend magnitudes in the range of -6.8 mm/year and 6.7 mm/year respectively. The climate hotspots were identified using PCA (Principal Component Analysis) considering trend significance (Z-value) and magnitudes (sen's slope) giving three components which explained about 85% variation. PC1 consisted of Tmax, Tmin, Rain and Maxrain indicators, PC2 included RD, LRD and NORD indicators whereas PC3 comprised HD indicator. The composite PC map obtained from factor scores identified climate hotspots in NW, SW and eastern parts.

***Keywords**: Climate Change; Hotspots; Temperature; Rainfall; Trends; PCA*

Machine Learning based water quality assessment for Canal and ground water in India

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Abstract: This paper focuses on the application of machine learning techniques for water quality assessment in canal and groundwater sources in India. Access to safe and potable water is a crucial aspect of human well-being, and a reliable and efficient means of water quality assessment is necessary to ensure the availability of clean water. However, traditional methods of water quality assessment such as chemical analysis and laboratory testing can be time-consuming and expensive, particularly in remote areas where resources may be limited. In this study, we aimed to address these challenges by using machine learning algorithms to analyze water quality data. The study collected water quality data from canals and groundwater sources in different regions of India, including parameters such as pH, conductivity, total dissolved solids, and heavy metal concentrations. The performance of the model was evaluated using cross-validation and compared with traditional water quality assessment methods. The results showed that the machine learning model was able to accurately predict water quality levels and identify contamination sources with a high degree of accuracy. In particular, the model demonstrated strong performance in detecting elevated levels of heavy metals, a significant concern in groundwater sources in India. The study highlights the potential for machine learning to provide a cost-effective and efficient solution for water quality assessment in India. The model could be easily scaled up and applied to larger water quality datasets, providing valuable insights into the state of water quality in canals and groundwater sources. Moreover, this could be used to identify areas that require further investigation and intervention, helping to prioritize resources and efforts to ensure safe and potable water for communities.

Keywords: *Machine Learning; Water Quality; Canals; Groundwater*

Surface Water Quality Assessment of Lakhisarai Stretch of Kiul River in Bihar

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Abstract: This research work assesses the adverse effect of urbanization near the catchment of the Kiul River along the Lakhisarai stretch. The physicochemical water quality assessment and heavy metal analysis is done along the stretch of Kiul River flowing through entire Lakhisarai region. The stretch is divided in two zones namely Rurban area (S1, S2, S6, S8) and Urban area (S3, S4, S5, S7) each consisting of four station points. The collected water samples are analyzed for both pre-monsoon (May 2022) and post-monsoon (September 2022) seasons. The indices for water quality (i.e. WQI) and Heavy metals (HMI) are calculated using standard formula. WQI analysis states that quality of water for Rurban region for (S1, S2) is of very poor quality and (S6, S8) is of poor category. For Urban region (S4), water is unfit for consumption and for S3, S5, and S7 water is of very poor category. Analytical findings states that Rurban region does not have major impact on water quality as that of urban region. However due to seasonal variation dilution took place and Rurban area had slight impact on water quality whereas urban area water quality got severely affected. Urban water assessment in comparison with the surface water quality standards, shows significant increase in Turbidity, B.O.D, C.O.D. and decrease in Dissolved oxygen (DO). The worst performance of urban areas water quality is due to direct discharge of effluent in water body, sand mining and poor catchment management.

Keywords*: Urbanization; WQI; Rurban; Urban Water Quality; Physiochemical Parameters*

A Conceptual model of the Tulsishyam Hotspring geothermal system, Gujarat, India

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Abstract: With rising energy demands per capita, renewable energy has risen to merit of its own. Among renewable energy, geothermal energy is one of the promising renewable sources and is recently given high consideration. In many regions of Gujarat, India, the permanent lack of surface water associated with drought conditions and lack of power is a major issue. Geothermal can play an important role in overcoming these issues. One such area of Gujarat is Tulsishyam which has surface occurrences of geothermal water. In this study, Gravity and Magnetic surveys were conducted, and an integrated subsurface model was prepared to understand the location of the geothermal sweet spot. The most suitable model for the location of geothermal springs in the study area is tried to explain in this study. For the Tulsishyam Hotspring geothermal system, the present study will help in the research, evaluation, and prospective development of this resource for direct usage and electricity production.

Keywords*: Geothermal; Tulsishyam; Gravity; Magnetic; Subsurface Model; Hotspring*

A Review on Challenges, Operating Condition, Configuration and Environmental Impact of EV's Battery Disposal on water bodies

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Abstract: Batteries due to their chemical composition react with matter present around them and release hazardous gases and also creates impact on water in water bodies. Using them in automobiles emits "zero pollution" but their production and disposal is environmentally deterioratory. Electric vehicle transportation is a key to solve the climate crisis. Mostly EVs manufacturer use Lithium-Ion Based battery which on disposal pollutes the ecosystem by releasing toxic waste including sever health impact when it comes in contact with water bodies. The management and handling of battery is a problem to think on since they become explosive if the storage is uncontrolled. Waste batteries will also cause water pollution and inhibit the growth and reproduction of aquatic organisms and other potential dangers. EV batteries can contaminate the water supplies and leach into the environment, resulting harm to human health and aquatic life. The conventional technology used for treatment of disposal is less environmentally friendly, so there is a need to focus on efficient techniques which could prevent environment degradation. Since urbanization and modernization will result in an increase in use of lithium-Ion, Recycling technologies of battery will be an area of interest. This paper focuses on methods of environmentally feasible and friendly ways of disposal of EV's battery to avoid hazards and to minimize water pollution. Also Recycling of battery to assess the amount and quality of recycled lithium that can be used in electric vehicles which in turn reduce water pollution.

Keywords: *EVs Battery; Recycling; Automotive Industries; Battery Disposal; Water Pollution*

Water Consciousness and Indian Cinema: A Textual and Critical Discourse Analysis of Select Hindi Language Movies

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Abstract: Water, water everywhere and not a drop to drink," and so wrote the English poet Samuel Taylor Coleridge in his unforgettable poem *The Rime of the Ancient Mariner* way back in 1798. While one cannot be sure if Coleridge was a clairvoyant, the prophetic line could very well turn into a dystopian reality soon if people are not sensitized about the misuse of water. In this regard, the role of popular media in general and cinema in particular is critically important. In a country like India, cinema has the potential to bring about awareness vis-à-vis the conservation and proper utilization of water. While it cannot be said that Indian cinema has been particularly concerned about water, there have been attempts here and there to further the discourse around water and bring about a paradigm change in people's everyday aquatic behaviour. The current paper would do a textual and Critical Discourse Analysis of five Hindi language movies and pinpoint the diegetic and thematic elements in the said movies that ventured into creating water consciousness among the audience. The five movies that have been selected by the researchers in the process are *Lagaan* (2002), *Well Done Abba* (2010), *Jal* (2013), *Kaun Kitney Paani Mein* (2015) and *Kadvi Hawa* (2017). While *Lagaan* and *Jal* make specific comments on water, the rest are themed on water itself. Both mainstream and parallel movies have been included in the study so that one can clearly understand both the popular and the nuanced discourses on water. Additionally, Hindi language movies have been selected as the language has well and truly been able to transcend cultural barriers in India. All the movies have been released at different times and hence the study would also show the historical evolution of the understanding on water conservation.

Keywords: *Water, Cinema, Hindi, Discourse, Conservation*

Analysis of Ground water quality in the coastal stretch of Bhavnagar, Gujarat

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Abstract: Groundwater is fresh water that soaks into the soil and is stored in the tiny spaces (pores) between rocks and particles of soil. Groundwater accounts for nearly 95 percent of the nation's fresh water resources. Ground water quantity and quality are equally important factors in the context of modern water management. Quality of water is mainly affected by pollution from different sources. In the coastal stretch, the major cause for groundwater pollution is seawater intrusion. In the present study an attempt has been made to evaluate the water quality in the coastal stretch of Bhavnagar, Gujarat. Groundwater samples were collected from selected locations and analyzed for major physio-chemical parameters. For the hydro chemical analysis Piper diagram was created for major hydro chemical parameters such as Ca, Mg, Na, K, CO_3, HCO_3, Cl, SO_4 and TDS using GW Chart software. The Water Quality Index (WQI) has been carried out for analysis of groundwater quality in the study area. This study indicates that seawater intrusion have heavily affected the groundwater quality of coastal stretch of Bhavnagar.

Keywords: *Groundwater Quality; Seawater Intrusion; Piper Diagram; WQI; GW Chart; Bhavnagar*

Critical Analysis of Environmental Issues of Ken-Betwa River Linking Projects

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Abstract: Interlinking of Rivers Programme of the country will be a real push towards country's water security as well as to mitigate adverse impact, climate change, etc. The successful completion of individual project under interlinking of rivers shall resolve the dual phenomena of flood & drought syndrome. The present study has been attempted to evaluate the adverse impact of environmental concern under one of priority interlinking project namely Ken-Betwa Link. It has been assessed that project has kept a healthy balance between environmental concern, afforestation issues and mitigation measures of wildlife with compare to huge benefits of 11 lakh ha. Irrigation. The study is concentrative towards implementation of Ken-Betwa Link Project, mitigation of its inter-state environmental, R&R, land scape management issues as well as healthy distribution of water amongst water starved Bundelkhand region of Uttar Pradesh and Madhya Pradesh. It is found that satisfaction environmental needs namely flora and fauna as well as providing assured water of 4800 MCM, plan for free movement of wild animals and their increase in number which shall have a win-win situation for plants, wild animals, forestry and command area development.

Keywords: *Public; Acceptability; River Linking; Water Scarcity*

Arsenic removal from wastewaters via electrocoagulation process using Co/MoS_2/conducting polymer composites electrocatalyst

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Abstract: Arsenic is a naturally occurring toxic heavy metal found in the abundance in discharged wastewater. Arsenic compounds are considered to be group 1 carcinogens by the International Agency for Research on Cancer (IARC). The current standard for the maximum contaminant level (MCL) of arsenic in drinking water recommended by the World Health Organization (WHO) is 10 μg L^{-1}. [1] If not treated properly arsenic can cause adverse damage to both living organism and the environment. Numerous approaches are available for the arsenic elimination from water, however, most of the available techniques are not feasible because these processes require oxidant and use adsorbents possessing inadequate adsorption capabilities. [2] [3] Electrocoagulation performed using aluminium or iron electrode or a combination of both is a capable technology for arsenic elimination. Electrocoagulation (EC) has recently come into prominence as an excellent tactic for phosphate removal. [4] [5] The EC involves the following steps: (1) metal ions travel to oppositely charged electrode (electrophoresis), where accumulation results from charge neutralization; (2) the cation or hydroxyl ion (OH^-) forms a precipitate with the pollutant materials; (3) the metallic cation interacts with OH^- to form a hydroxide, which has high adsorption properties, forming bonds to the pollutant; and (4) the hydroxides form larger lattice-like structures and sweep through the water (sweep coagulation), (5) arsenic is removed via precipitation. Active carbon fiber and graphite cathodes improves precipitation of arsenic compounds via boosting the EC process. Moreover, coating these materials with mixed metal oxides and conducting polymers as photo/electrocatalyst further promotes the electrocoagulation of arsenic. [6, 7] In the present work, we focus on the application Co/MoS_2/conducting polymers on carbon fiber system for the degradation for phosphate removal via photo/electrocoagulation process. The catalytic reaction material will be characterized using various physicochemical techniques like XRD, SEM, TEM, EDAX, FT-IR and Raman spectroscopy. Kinetics of the catalytic arsenic compounds removal will be performed using various UV-visible spectroscopy. Moreover, different concentration of arsenic will be investigated for removal by using stainless/alumia electrodes via connecting them with the DC source and measuring the time taken for its removal. The sacrificial anode corrodes due to applied potential and forms coagulant, while the simultaneous evolution of hydrogen at the cathode allows pollutant removal by flotation. Effect of parameters like pH, current intensity, initial arsenic concentration and existence of other competing anions will be investigated using electrocoagulation.

Keywords*: Group 1 Carcinogen; Hydroxide (OH-); Cobalt; MoS_2; Conducting Polymer*

Removal of phosphate from wastewater by electrocoagulation process

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Abstract: The industrial and agricultural revolution has meaningfully augmented the manufacture of waste phosphates. Furthermore, the overuse of fertilizers globally via rigorous farming practices has led to the generation of agricultural effluent the most important manufactured phosphate source. Furthermore, increasing human population has further concentrated water bodies with phosphate-containing products. Other industries like fossil fuel, detergents, cosmetics are also significant contributors of phosphates to industries. The excess phosphate accumulation in environment promotes algal growth and limits substantially limits sunlight, CO2 and O2 content in water bodies. This phosphate is also responsible for the entangling of water pipes and interrupts removal other dangerous pollutants like arsenate leading to negative health effect. Therefore, concentrated efforts to remove this phosphate contaminates is highly desirable. Electrocoagulation (EC) has recently come into prominence as an excellent tactic for phosphate removal. [1] [2] The EC involves the following steps: (1) metal ions migrate to an electrode with an opposite charge (electrophoresis), where aggregation results from charge neutralization; (2) the cation or hydroxyl ion (OH-) forms a precipitate with the pollutant materials; (3) the metallic cation interacts with OH- to form a hydroxide, which has high adsorption properties, forming bonds to the pollutant; and (4) the hydroxides form larger lattice-like structures and sweep through the water (sweep coagulation) , (5) phosphate is precipitated as aluminum phosphate and removed as phosphate. Active carbon fiber and graphite cathodes improves precipitation of phosphates via boosting the EC process. Moreover, coating these materials with mixed metal oxides and conducting polymers as photo/electrocatalyst further promotes the aluminum phosphate formation. [3, 4] In the present work we proposed application Cu/TiO_2/polyindole carbon fiber system for the degradation for phosphate removal via photo/electrocoagulation process. In addition to this, effect of various parameters like pH, catalyst concentration, concentration of organic dye stuffs will be also investigated for the degradation of organic contaminates. The catalytic reaction and catalysts will be monitors via miscellaneous physicochemical techniques like XRD, SEM, TEM, EDAX, FT-IR and Raman spectroscopy. In this research work we are focusing on different concentration of dyes degradation by using stainless/alumia electrodes via connecting them with the DC source and measuring the time taken for phosphate removal. The sacrificial anode corrodes due to applied potential and forms coagulant, while the simultaneous evolution of hydrogen at the cathode allows pollutant removal by flotation.

***Keywords**: Electro Coagulation; Mixed Metal Oxides; Conducting Polymers; Phosphates*

Removal of synthetic azo dyes from wastewater through application of Electro-Fenton and Photo electro-Fenton process

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Abstract: The elimination of chemical compounds generated by several human activities, such as textile industry discharges into water bodies, has led to an increase in serious environmental issues in recent years. Therefore, it is critical to get rid of these organic contaminants based on dyes. Recent developments in electrochemical advance oxidation techniques that can eliminate a number of organic chemicals in wastewater have been made in this context. [1] [2] Among all electrochemical methods, electrocoagulation (EC) has recently come into prominence as a superb method for degrading organic contaminants. The EC involves the following steps: (1) metal ions migrate to an electrode with an opposite charge (electrophoresis), where aggregation results from charge neutralization; (2) the cation or hydroxyl ion (OH-) forms a precipitate with the pollutant materials; (3) the metallic cation interacts with OH- to form a hydroxide, which has high adsorption properties, forming bonds to the pollutant; and (4) the hydroxides form larger lattice-like structures and sweep through the water (sweep coagulation) , (5) pollutants are converted to less toxic species by oxidation ,(6) dyes are removed by electro-floatation or sedimentation and adhesion to hydrogen bubbles. Furthermore, the efficiency of the EC process can be further improved by clubbing it with the Electro- Fenton (EF) type reaction. The EF creates a mixture of iron ions (Fe^{2+}) and hydrogen peroxide (H_2O_2), electrochemically generated at the cathode by oxygen reduction via two electrons in acidic media. UVA irradiation improves the regeneration of Fe^{2+} ions, enhancing the °OH production generating the Photoelectron- Fenton process.[3] Active carbon fiber and graphite cathodes improves the H_2O_2 generation through oxygen reduction on EF treatment on dyes such as methyl orange, methylene blue, methyl red etc. Moreover, coating these materials with transition metal chalcogenides and conducting polymers as photo/electrocatalyst further improvised the degradation kinetic of the organic dyes. [4, 5] In the present work we proposed application CF-MoS_2/polyindole system for the degradation of dye based organic pollutants via photo/electrocoagulation process. In addition to this, effect of various parameters like pH, catalyst concentration, concentration of organic dye stuffs will be also investigated for the degradation of organic contaminates. The dyes are measured using UV-Visible spectroscopy and the catalytic material will be characterized using miscellaneous physicochemical techniques like XRD, SEM, TEM, EDAX, FT-IR and Raman spectroscopy. In this research work we are focusing on different concentration of dyes degradation by using stainless steel electrodes by connecting them with the DC source and measuring the time taken to degrade the dyes and deposition. The sacrificial anode corrodes due to applied potential and forms coagulant, while the simultaneous evolution of hydrogen at the cathode allows pollutant removal by flotation. The performance of dye removal by EC depends upon the solubility of the dyes. We have observed that the dyes with low solubility, such as disperse dyes have generally reported to be removed well by flocculation and/or EC method.

***Keywords**: Azodyes; AOPs; Electro-Fenton; Oxygen Reduction; Photo Electro-Fenton; MoS_2, Conducting Polymers*

Electrochemical deposition of TiO_2 on Al plates: An Insight on the deposition of Ti from Redmud

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Abstract: Titanium (Ti) is the ninth most abundant element in the earth that is difficult to extract in nature. Ti ores are plentiful in the earth's crust but the demand for Ti metal is restricted by its high cost in spite of its excellent mechanical properties, corrosion and oxidation resistance and low density. Ilmentite ($FeOTiO_2$), leucoxene ($Fe_2O_3.nTiO_2$), and rutile (TiO_2) are the notable major Ti ores. Ti is also available in combination with other ores like bauxite residue (red mud). Red mud is one of the by-products excluded from the industrial production of alumina plants and having a high content of alkaline and is a rich source of many valuable metals such as iron, aluminium, titanium and other rare earth elements (REE), etc., The primary and secondary deposits were used to extract TiO_2 and Ti metal, used in advanced applications such as in the production of paints, aircraft, photovoltaic cells, medicines and biomedical engineering. Various titanium metallurgical processes have been developed for TiO_2 and Ti metal, however the process generally remains expensive. Hence in this work, we aim to develop a method to deposit TiO_2 through the formation of peroxotitanium complex by cathodic as well as electrophoretic deposition. The effect of electrolyte pH, deposition voltage, deposition time, concentration, area of the electrode and repeatability has been investigated. The deposits were duly characterized by both morphological and structural characterization techniques. In addition, the photochemical properties of the electro deposited TiO_2 were investigated. The results showed a promising platform/methodology to extract Ti from Redmud which has potential industrial application.

Keywords: *Titanium Ores; Titanium Dioxide; Electrochemical Deposition; Eco-friendly*

Numerical investigations of hydrodynamic cavitation for wastewater treatment: From bubble dynamics to novel cavitating reactor

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Abstract: Industries release effluents with a variety of contaminants. The consequence of the presence of such harmful contaminants in the wastewater is adverse on the ecosystem. Several wastewater treatment methods have been documented and applied successfully in the past. However, in this literature review, we discuss yet another novel, efficient and a cost-effective method to treat wastewater: hydrodynamic cavitation which can be described as the generation and the eventual implosion of bubbles inside a cavitation device or reactor. The collapse of the bubbles releases excessive amounts of energy which in turn can be harnessed to breakdown and/or decompose pollutants. In this paper, we present a three-dimensional CFD analysis of a novel cavitating device called a swirling jet reactor. We use a one-phase model considering only water flowing into the reactor. We use ANSYS Fluent R2022 to perform the simulations. Variations in cavitating conditions were observed with respect to changing inlet pressures. Further, this paper also investigates dynamics of bubble growth and decay. The effective implementation of hydrodynamic cavitation requires the study of bubble dynamics in detail where the effects of each parameter on cavitation process can be minutely studied so that the process can be eventually optimized and fine-tuned to get the highest possible degradation of pollutants. The dynamics of a spherical cavitation containing a non-condensable gas with consideration for the surface tension and viscosity of the fluid can be studied by using the widely known Rayleigh-Plesset (RP) equation. This equation works on the assumption that liquid is incompressible thus making its results inaccurate and unreliable, especially for higher amplitudes. Thus, Keller-Miksis (KM) model is considered to study the dynamic behaviour of cavitation in compressible fluids to obtain more accurate results on the cavitation's radius and implosion time over the course of several oscillations even after the initial implosion of the cavitation. However, RP equation and KM equation discuss the dynamics of a single spherical cavitation and further progress has to be made for the study of multi-bubble systems since the presence of one bubble greatly affects the oscillations of the surrounding bubbles and the overall dynamics are greatly varied. In this paper, we use the KM model and its various forms to study the single and double-bubble systems in greater detail by taking into account the various physical and chemical effects of cavitation such as radial profile, energy consumption, free radical production, cavitation noise, eddy generation, energy dissipation, cavitation trajectory and impact pressure. An attempt is also made towards a deeper understanding of multi-bubble system in hopes of optimizing the physical and chemical cavitation effects for wide-scale usage of hydrodynamic cavitation for wastewater treatment in the near future.

Keywords*: Hydrodynamic Cavitation; Swirling Jet Reactor; CFD Analysis; Rayleigh-Plesset Equation; Keller- Miksis Model; Multi-bubble System*

Reusable Fe_3O_4 - TiO_2 Magnetic photocatalyst for organic dye removal from textile effluent

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Abstract: The products used in the treatment process of organic dyes in textile effluent often leads to secondary pollutants. In most cases the effluents are converted from liquid pollutants to solid pollutants which cannot be considered eco-friendly. Therefore a reusable photocatalyst with Fe_3O_4 as core has been designed which can be removed by external magnet at the end of treatment process and can be reused again and again. To improve the photocatalytic efficiency of this magnetic photocatalyst, the Fe_3O_4 core is coated with TiO_2, a chemically stable and an efficient photocatalyst.

***Keywords**: Organic Effluent; TiO_2 Photocatalyst; Removable Magnetic Photocatalyst*

Synthesis and characterization of $CaMnO_3$ for peroxydisulfate activation and its application to the degradation of chlorinated pesticide in water

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Abstract: Recently, perovskite oxides have gained attention because of their promising performance in peroxydisulfate (PDS) activation. Previous studies have mainly focused on Co-based or rare- earth metal (La, Sr)-based perovskite oxides for peroxymonosulfate (PMS) activation. In this study, perovskite $CaMnO_3$ metal oxide was used for PDS activation to degrade chlorinated pesticides in a water matrix, such as 2,4-dichlorophenoxyacetic acid (2,4-D), and the impact factors, including initial pH, PDS concentration, $CaMnO_3$ dosage, and reaction temperature, were investigated. The $CaMnO_3$/PDS system could be applied in a wide pH range from 4 to 12 and exhibited better performance under basic conditions. The results showed that 2,4-D could be efficiently degraded and mineralized by the $CaMnO_3$/PDS system; a basic pH would accelerate 2,4-D degradation. The degradation efficiency of 2,4-D was improved with increasing $CaMnO_3$ dosage, PDS concentration, and reaction temperature. The experiments indicated that both sulfate radicals ($SO_4^{\cdot-}$) and hydroxyl radicals ($^{\cdot}OH$) were responsible for the 2,4-D degradation. The transformation intermediates were identified by gas chromatography-mass spectrometry (GC–MS), and possible reaction pathways were proposed based on the measured results. This method of activating PDS with $CaMnO_3$ may offer eco-friendly and low-cost Ca and Mn element-composed materials for the remediation of herbicide- contaminated water.

***Keywords:** Perovskite Oxides; Persulfate Method; Peroxydisulfate-activation; Chlorinated Pesticide; 2,4-D Degradation*

Bacterial community analysis of Rangori spring of Uttarakhand, India by 16S-rRNA Gene sequencing

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Abstract: The focus of this research is to conduct a large-scale metagenomic investigation of a notable spring in Uttarakhand i.e., Rangori spring in the ecologically unique region of Ramnagar in order to identify the resident microbial population. The sample was collected from Ramnagar, Nainital district of Uttarakhand the identification. The goal of this study is to look at the bacterial diversity in spring water. The MiSeq high-throughput sequencing was used to analyze and compare the bacterial diversity and community composition of samples from spring water samples. Overall, 519 optimized reads were obtained from the samples based on high-throughput sequencing of the V4 region of the 16S rRNA gene. Bacterial species detected in these samples covered 46 phyla, 53 orders, 121 families, 422 genera and 521 species. According to the analysis it was found that the samples included a plethora of bacterial variety. The dominating bacteria's distribution features revealed patterns of a high number of unusual species and a few common types. Taxonomic assignment analysis indicated that Proteobacteria, Bacteriodes, OD1, Cyanobacteria Planctomycetes, Actinobacteria, Acidobacteria, Chloroflexi, Chlamydiae and Verrucomicrobia dominated in the water and accounted for 93.36% at phylum level. The predominant groups were Heliscomenobacter, Lacibactor, Lysobacter, Novosphingobium, Planctomyces, Reyranella, Rheinheimera, Rhodobacter, Sediminibacterium, Sphingobiumat genus level. At species level vibrioides, somerae, colicanis, prausnitzii, rhizosphaerae, cauensis, brunescens, australicum, massiliensis, yanoikuyaewere the abundant taxa, while very small community of Archaea were presented: Methanocullaus, Cenarchaeu, Candidatus Nitrososphera This research deepens the understanding on microbial community in spring water and provide references for the association of bacterial composition and diversity along with their significance.

***Keywords:** Rangori; Microbial; Population; Spring*

Treatment of waste water using conducting polymer/magnetite (Fe_3O_4) based magnetic adsorbent materials

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Abstract: Synthetic organic dyes are widely used in various industries such as textile, paper, cosmetics and leather industries. These industries discharge various kind of dyes in the natural water sources which results in the bioaccumulation of these dye molecules in the natural biotas. These dyes form a layer on the surface of water which reduce the amount of solar radiation penetration inside the water. The reduced amount of photosynthesis and dissolved oxygen. In this research, first we have synthesised conductive polymer polyaniline (PANI) via oxidative polymerization using Ammonium Peroxydisulphate (APS) as an initiator for the polymerization process. The prepared Polyaniline was then characterized using FT-IR, XRD and FE-SEM characterization methods to ensure the formation of the polyaniline nanotubes. Once the polyaniline is successfully synthesized, it was magnetized using magnetite in a in-situ co-precipitation method. We synthesized composite materials of PANI/Fe_3O_4 of Fe_3O_4 with respect to the Polyaniline, where 1%, 5% and 10% amount of Fe_3O_4 was taken with respect to the polyaniline. The synthesized materials were then characterized using FT-IR, XRD and FE-SEM characterization methods. The photocatalytic activity of the synthesized materials was evaluated using dark adsorption study and photocatalytic degradation studies on methyl orange (MO) dye.

A facile approach for refining waste lubricant oil: a hazardous water contaminant

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Abstract: The requirement for lubricant oil is rising due to the growth in the number of vehicles and the development of new industries, which has increased the consumption of motor and industrial oil worldwide. Oil lubricants are widely used to minimise friction and avoid corrosion. When lubricating oils get used frequently, they become contaminated with harmful heavy metals, polychlorinated biphenyls (PCBs), and aromatic hydrocarbons (PAHs). Used lubricant oil (ULO) is considered hazardous because it includes heavy metals from degraded additives. ULOs are harmful and dangerous to the environment, especially to water. Disposal or dumping on the surface may affect groundwater or sewage, causing severe environmental problems. Water cannot mix with oil; thus, it produces a thick layer of sludge in the water instead. This suffocates fish, tangles in the feathers of seabirds, prevents them from flying and dims the light that affects photosynthesis. Therefore, purification, reclamation, or recycling of used lubricating oils has become necessary. Adsorption is a simple, affordable, and practical method for re-refining used lubricating oil. Therefore, this study aims to develop facile, simple, inexpensive conducting polymer-based compositions. Polyaniline based composites are being synthesised for the project, and their potential as an adsorbent material for recycling ULOs has been investigated.

Keywords: *Used Lubricant oil; Recycling; Water pollutant; Adsorption*

Adsorption of cationic dyes and heavy metal ions on zeolite HY from aqueous solution

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Abstract: Water is essential for every living species on the earth. Intentionally or unintentionally, we humans are contaminating the water in several ways. Textile dyes and heavy metals are one of the majorly contributing pollutants in wastewater. Both dyes and heavy metals are hazardous to human health and have adverse effects on the environment as well. Zeolites are excellent adsorbent materials for various types of pollutants including organic and inorganic such as dyes, heavy metals, ammonium ions, etc. In this study, we have presented the synthesis, characterizations, and application of zeolite HY for the removal of cationic dyes and heavy metal ions from the solution. Zeolite HY was synthesized by hydrothermal approach. Basic characterization techniques such as Fourier Transform Infra-Red (FTIR), Field-Emissions Scanning Electron Microscope (FE-SEM), and X-Ray Diffraction (XRD) were used for the characterization of zeolite HY. The synthesized material zeolite HY (ZHY) was then employed for the removal of cationic dyes methylene blue and crystal violet, and heavy metal ions from the aqueous solution.

Keywords*: Zeolite; Adsorption; Dyes; Wastewater*

Synthesis and characterization of Zeolite 4A for waste water treatment

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Abstract: Zeolites are the porous, negatively charged and inorganic aluminosilicate adsorbent material. They possess large surface area and contains many ions exchange sites that makes it very feasible for the removal of contaminates like metal or dye from industrial water using adsorption. Among the various available techniques such as ion exchange, extraction, reverse osmosis etc., adsorption is the most promising technique, as it is reliable, less destructive and more economical. This paper reports the synthesis of zeolite 4A from kaolin using minimal chemicals to make it cost effective as compared to the hydrothermal method of synthesizing zeolites that relatively requires a greater number of chemicals. Metakaolin was converted to zeolite 4A using sol gel method. The synthesized zeolite was characterized using FE-SEM, XRD and FTIR. Further it was tested for its efficiency to remove colored pollutants from aqueous solution. The objective of the study was to design a facile, economic and sustainable synthesis process of zeolite and testing its potential in for wastewater treatment.

Keywords*: Zeolite; Metakaolin; Wastewater Treatment; Pollutants; Sustainable*

Modification of Graphene as an Effective Photo-Driven Catalyst for Photo-assisted Degradation of Chlorpyrifos

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Abstract: Currently, the consumption of agrochemicals has increased significantly over the last few years. The use of agrochemicals in agriculture for the production of crops has become very demanding to suffice the increased food demand. The accumulation of agrochemicals in water bodies is a major source of water pollution. Scientists have attempted several approaches for the treatment of these pesticides which are present in water and also have adverse effects on human and aquatic fauna. Attempts have been made to explain the potential of graphene and graphene derivatives for the effective removal of chlorpyrifos. It was observed that pristine graphene shows maximum % removal of 80 % as compared to GO and rGO shows 17 % and 47 % removal respectively. Synthesized materials were characterized by XRD, RAMAN, and IR analysis and used for the photocatalytic degradation of chlorpyrifos. The study points toward the role of chemical functionality as an important parameter in deciding the photocatalytic activity.

Keywords: *GO; rGO; Photocatalytic Degradation; Chlorpyrifos; Agrochemical*

Polyaniline/ Sodium Alginate (PANI/SA) composites as an efficient adsorbent for Cr (VI) removal

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Abstract: The increase in urbanization and industrialization has led to heavy metal contamination. The release of Cr (VI) has a negative effect on both living organisms and the environment. Therefore, it is essential to come up with an adsorbent material that has a high adsorption capacity. The present work demonstrates the synthesis of polyaniline/sodium alginate (PANI/SA) composites by in-situ oxidation method. The obtained composites with different loading of SA (1, 5, 10 wt%) with respect to PANI were characterized using fourier transform infrared spectroscopy (FT-IR), and field emission scanning electron microscopy (FE-SEM). The synthesised composites were used to test its adsorption efficacy towards the removal of Cr (VI) as a model heavy metal from the aqueous solution. The results revealed that the composite with a 5 wt% loading of SA onto PANI showed the best adsorption performance of 73.20% in 1440 min at room temperature and pH 7.4. Further, a detailed study on the adsorption kinetics was investigated. The mechanism governing the adsorption between the composites and Cr (VI) has been discussed.

Keywords*: Water Contamination; Adsorption; Polyaniline/Sodium Alginate Composite; Cr (VI) Removal*

Wastewater treatment through bio-coagulant and uses of treated water in construction sector

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Abstract: Fresh water is consumed in large amounts in the construction sector and manufacturing industries. Focusing on the construction sector, water is utilized for various purposes such as for producing concrete, curing, washing of vehicles and many more. Approximately 500 liters of water is required in a batch plant for producing one cubic meter of concrete. Considering the increase in demand of concrete for the upcoming infrastructural development, the demand for use of fresh water will also increase. To cater for the emerging freshwater crisis, this research paper discusses the findings for using treated wastewater in concrete production, in place of fresh water. A literature review on the effects of water quality parameters such as chlorides, sulphates, total solids, total alkalinity, turbidity and pH in wastewater was conducted. The latter are responsible for altering the properties of concrete such as workability, durability and compressive strength. As per BIS norms, the permissible limit for Chloride content in concrete is 2000 mg/l in case of Plain Cement Concrete (PCC) and 500 mg/l for Reinforced Cement Concrete (RCC), the sulphate content is about 400 mg/l with a pH greater than or equal to 6, and total suspended solids about 2000 mg/l. In this study, the samples of wastewater are collected and treated using varying dosages of bio-coagulant and the pre and post treatment water quality parameters were recorded. It was inferred that the chloride content reduced by 20%, turbidity reduced by 90% and the Total dissolved Solids (TDS) reduced by 3% in the treated wastewater. A reduction of 1% was observed in the pH of the treated wastewater. Further the water quality parameters of the treated wastewater are found to be in the desirable range, which is being used to prepare concrete. Following this, comparative studies of the concrete prepared using fresh water and treated wastewater samples are being performed. It is to be inferred that the treated wastewater can be utilized for the concrete production or other applications in construction sector, through the derived optimized treatment.

***Keywords**: Wastewater; Turbidity; Durability; Construction*

Optimizing the Impact of Operating Parameters on Hydrodynamic Cavitation for Methylene Blue Degradation

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Abstract: The study aimed to investigate the degradation of methylene blue (MB), a synthetic dye using hydrodynamic cavitation (HC). Different cavitating devices, including four venturi and eight orifice plates, were optimized in terms of inlet pressure to achieve the highest level of degradation. The impact of various operating parameters, such as initial dye concentration, pH of the solution, and cavitation number, was investigated to determine their effect on the degradation of MB. Geometrical parameters, including the ratio of throat flow area to pipe cross-sectional area, ratio of throat perimeter and its cross-sectional area, throat shape and size, were also analysed. The results showed that a 68 % degradation with 11.1×10^{-3} min^{-1} was achieved using a 3 mm circular venturi alone at an optimum pressure of 4 bar and solution pH of 10. The kinetic study showed that the degradation followed the first-order kinetics. Furthermore, the effect of ozone and H_2O_2 on the extent of degradation of MB was also examined. The results revealed that almost 100% degradation was achieved using HC coupled with 2 $g.h^{-1}$ ozone feed rate. The study demonstrates that HC coupled with ozone can be a promising technique for the degradation of synthetic dyes. The optimization of cavitating devices and operating parameters, along with the analysis of geometrical parameters, can lead to improved efficiency in the degradation process. The use of ozone can further enhance the effectiveness of HC in the degradation of dyes. Overall, the study highlights the potential of HC as a sustainable approach for the treatment of dye-containing wastewater.

***Keywords**: Hydrodynamic Cavitation; Methylene Blue; Degradation; Wastewater Treatment; Optimization*

Optimization of Photocatalytic Reactor for Color Removal using different Substrates and Sensitizers

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Abstract: This study optimized a photocatalytic reactor for color removal by coating various substrates (Transparent glass and stainless-steel mesh) with photocatalyst materials. The design comprised a wastewater effluent compartment, a quartz tube sample compartment for the photocatalytic process, and a pump to maintain continuous flow. The photocatalyst materials utilized in the testing were thin films of titanium dioxide (TiO_2) synthesized by the sol-gel method and coated by the dip coating method on substrates. The dosage and number of coating layers of photocatalyst thin film, as well as the water flow rate and UVC light distance from the reaction tube, were varied. A combination of dyes, including methylene blue and Rhodamine B, was utilized as sensitizers for measuring the efficiency of the photocatalytic oxidation process. The results demonstrated the photocatalytic reactor's impressive elimination efficiency. The efficiency of the reactor improved as the flow rate and light distance were raised. The study demonstrates that the color of wastewater effluent can be effectively removed by optimizing the photocatalytic reactor with photocatalyst materials coated on various substrates. Additional research can be undertaken to determine the ideal conditions for eliminating different types of contaminants.

***Keywords**: TiO_2; Photocatalysis; Optimization; Color Removal; Dyes*

Fouling and its Mitigation study of polysulfone membrane: A Review

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Abstract: Polysulfone (PSF) has been widely used as ultrafiltration (UF) membrane material due to its thermal and chemical stability. It is a type of polymer that is often used in the manufacture of membrane filters for water treatment and other industrial processes. However, membrane fouling becomes a serious issue, severely restricting the capability of the PSF membrane. This fouling is mostly caused by organic deposition on the membrane surface, which reduces permeate flow. Membrane fouling is often induced by the precipitation and deposition of molecules or particles on the membrane surface or membrane pores in practically all membrane processes. It is a major challenge in all pressure-driven membrane separation processes, reducing flux and membrane life span. There are four fouling mechanisms: cake formation, standard blocking, intermediate blocking, and total blocking. The types of fouling mechanisms that occurred in PSF-based UF membranes during waste water filtering were examined in this work. In this review paper, we will limit ourselves to polysulfone which is a very popular membrane material due to its high performance, and low-cost profile, for which various modification methods have been published. The modification methods can be divided into the following main groups: composite, chemical, blending, coating, grafting, plasma treatment, or a combination of methods by using nanofiller such as co-polymer, nanoparticles, and metal organic framework (MOF). All of these methods provided significant results in terms of contaminant/pollutants reduction in the waste water. Surface modification of filtering medium has been researched for over 50 years, and a few dominant approaches have arisen. UV irradiation and plasma treatment have captivated the concern of many researchers, particularly for grafting hydrophilic polymers to membrane surfaces. Commercial manufacture of UF membranes uses plasma treatment, while the fabrication of polymeric membranes generally includes blending and coating treatment.

Keywords*: Fouling; Polysulfone; UF Membrane; Modification; Water Treatment*

Modification of PVDF membrane to mitigate its fouling tendency: A Review

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Abstract: The proper disposal of wastewater from the industries before entering the river system could be a great step towards the conservation of natural resources. The use of modified or hybrid membranes for water and wastewater treatment has shown the enormous potential that can reduce energy consumption and production costs, improve the quality of reuse, and enhance the industrial competitiveness of countries, especially where there is a scarcity of freshwater resources. Fouling remains a serious issue in membrane filtration technology when water is used as the separating medium. Due to its exceptional qualities like high thermal stability, superior chemical resistance poly (vinylidene fluoride) (PVDF) membranes have been widely used in wastewater treatment. Increment in hydrophilicity of membrane considerably decreases fouling of PVDF membranes. The most prevalent fouling of PVDF membranes is caused by aggregates in water and cake fouling by suspended particles. In this review, based on two fundamental difficulties with PVDF membranes in applications, namely membrane fouling and membrane wetting a thorough study of modifying techniques were reviewed. As a basis, our review concentrates on improving hydrophilicity of PVDF membranes using a variety of techniques, which includes enhancing the membrane synthesis process and modifying the surface of already-existing membranes. By using hydrophilic modifiers, such as polymer materials, Metal organic frameworks (MOFs) and inorganic nanoparticles, PVDF membranes could be made more hydrophilic across the preparation process. Surface modification aims to create a hydrophilic layer on the PVDF membrane surface. Based on how modifiers and membranes interact, surface modification may be broadly divided into two types which are physical modification and chemical modification. Therefore, our study is focused on reviewing on the enhancement of hydrophilicity of PVDF membranes through membrane modification methods.

Keywords*: Wastewater; Fouling; PVDF; Membrane Modification; Hydrophilicity*

Current research and future trends on solar pond with solar distillation system: A systematic review

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Abstract: Solar distillation process is generally used to provide the potable water by use of the Solar energy. Solar pond collects and store the heat obtained by the sun. Combination of solar distillation with solar pond is a sustainable technology to enhance the distillate output. Present review paper shows the systematic review of solar pond with solar distillation. It includes the various researchers work to enhance the distillate output of solar distillation system with use of solar pond. Thermal analysis of solar pond with solar still is also included in present review paper. At last, the future trends on the solar distillation system with solar pond also included.

Keywords*: Solar Pond; Solar Distillation; Distillate Output; Thermal Efficiency*

Evaluation of groundwater quality in an urbanized watershed with a special reference on heavy metal concentration

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Abstract: The management and prevention of groundwater pollution in watersheds requires a thorough assessment of the pollution hazard associated with groundwater pollution. Since several decades, increasing groundwater contamination has been a threat to human health. One of the causes of toxicity in living organisms and ecosystems is heavy metal contamination in groundwater. Examining groundwater quality is also part of Sustainable Development goals of Water resource management. The study area includes a watershed of the Vishwamitri river of Gujarat. This study looked at the distribution of heavy metals in groundwater in the Vishwamitri watershed. Water samples were collected from selected borewells and dug wells in the study area, during the seasons of pre-monsoon (May 2022) and post-monsoon (November 2022). A total of 32 groundwater samples (16 samples per season) were collected and subjected to metals analysis lead (Pb), cadmium (Cd), chromium (Cr), iron (Fe), copper (Cu), and manganese (Mn) using an Atomic Absorption Spectrometer (AA Spectrometer), along with physical parameters like pH and temperature. The results show that the average heavy metal concentrations follows the trend of Fe (0.112 mg/L) > Pb (0.110 mg/L) >Cr (0.0836 mg/L) > Mn (0.0622 mg/L) > Cd (0.0073 mg/L) > Cu (0.0068 mg/L) for pre monsoon, while for post-monsoon trend follows Fe (0.1288 mg/L) > Mn (0.1158 mg/L) > Pb (0.0827 mg/L) > Cr (0.0779 mg/L) > Cu (0.01319mg/L) > Cd (0.0119 mg/L) respectively. Also, Heavy-metal Pollution Index (HPI) was applied to the generated data. The results show that HPI values of all the samples falls below the Critical limit of 100.

Development of PSF ultrafiltration membrane using PANI and GO as composite for wastewater treatment

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Abstract: Polysulfone is frequently used for membranes due to its strong resistance to oxidising agents, surfactants, and hydrocarbon oil. Additionally, because of its resistance to mineral acids, alkalis, and electrolytes. Commercial Graphene oxide (GO) particles were treated with polyaniline (PANI) to prevent particle agglomeration and to increase membrane antifouling capability. Modified membranes have grown in popularity in recent years for the treatment of wastewater. The goal of this work is to make Polysulfone (PSF) using PANI and GO in order to examine and describe the membrane and investigate its efficiency and antifouling characteristics. The phase inversion technique will be used to cast the composite membrane, and the casting solution will contain 15% PSF, 5% PANI, and GO. Through the use of FTIR-ATR, SEM, LLDP, permeability, porosity, protein adsorption, and ultrafiltration, the morphology and hydrophilicity of the membrane will be examined.

Keywords*: Polyaniline; Graphene Oxide; Polysulfone; Membranes; Water Treatment*

Batch Reverse Osmosis: Minimal liquid discharge approach

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Abstract: Batch reverse osmosis is a typical arrangement proposed to achieve higher recovery with minimum energy consumption and lower fouling. Recent developments show that batch and hybrid batch/semi-batch are the most efficient desalination systems. The batch and hybrid batch/semi-batch are associated with the increased recovery of the process and reduced energy consumption. Normally, the batch reverse osmosis process can be achieved using fix bladder or free piston. Batch reverse osmosis uses time-varying pressure to achieve a higher recovery. The batch and hybrid batch/semi-batch processes are developed for the brackish water and seawater reverse osmosis. The potential applications for batch reverse osmosis are industrial wastewater treatment. Minimization and disposal of brine is the biggest challenge to overcome with a different type of water treatment. This review aims to discuss the technology, potential applications, and problem associated with the process.

Keywords*: Batch Reverse Osmosis; Hybrid Batch/Semi-batch Reverse Osmosis; High Recovery; Brine*

Advanced exergy analysis and performance optimization of cascade Rankine cycle driven reverse osmosis system

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Abstract: In this study, a novel solar based cascade rankine cycle driven reverse osmosis system is proposed and evaluated from thermodynamic point of view. Advanced exergy analysis is performed to have better understanding the destruction of components and overall performance of the system. In advanced exergy analysis, the exergy further divided into four sub-parts: Endogenous, exogenous, avoidable and unavoidable exergy destruction. The endogenous avoidable exergy destruction is the exergy that can be reduced by improving operating parameters and by using the efficient material used in system component material. The highest exergy destruction found in solar collector followed by the RO system. The is 24% of endogenous avoidable exergy destruction can be reduced. The performance analysis is carried out by optimization of the system parameters.

***Keywords**: Advanced Exergy Analysis; Optimization; Reverse Osmosis; Organic Rankine Cycle; Steam Rankine Cycle*

LCA of solar powered BRO-BMED advanced processes for water and resource recovery from dairy wastewater treatment

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Abstract: The dairy industry is one of the most wastewaters generating industry in terms of volume as well as its characteristics. Conventionally, effluent treatment plant is used to achieve water discharge norms and after treatment, water is discharged in open water bodies. The advance water treatment processes are required to reduce, recycle and reuse of discarded water from dairy effluents. Also, some reagent chemicals are used to clean the process vessels in dairy industry. If these reagents can be recovered simultaneously with water, then it can add some value and justify the new modification in dairy treatment. The solar powered BRO-BMED is one of the advanced treatments to achieve more than 80% of recovery rate with recovering resources from dairy effluents. LCA tool can provide some insight into this new modification in terms of environmental impact and it can be used in decision making. In this work, the LCA of BRO-BMED is performed to determine the performance and environmental impact of the system in dairy wastewater. The operational phase analysis is performed to determine the impact during performance of the system.

***Keywords:** Dairy effluent; Batch Reverse Osmosis, Bipolar Membrane Electrodialysis; Life Cycle Assessment*

Energy Intensity of Seawater Desalination and Latest Advancements

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Abstract: Water is very essential to run life on earth. It is one of the most abundant resources of the earth means and occupied 70% of the earth. Out of 70%, only 2.5% is fresh water which is in the form of groundwater, Ice Mountains, lakes, and rivers. The rest of the water is in form of sea water which is salty and cannot be used because its salinity ranging is of 35,000–45,000 ppm due to its dissolved salts. According to UNEP (United Nations Environment Programme), 1/3rd of the world's population lives in countries with insufficient freshwater resources, like shortage in many countries around the world mainly developing countries and Middle East region countries. The existing water resources are decreasing due to the unbalanced distribution of rainwater and drought, extreme exploitation of groundwater resources and their insufficient recharge, and degradation of water quality due to the discharge of domestic and industrial wastes without sufficient treatment. Hence enormous efforts are required to make new water resources available and minimize water deficiency in countries with a shortage of freshwater. Desalination of seawater emerges as a boon to most of the population to serve their needs. The different desalination processes required different quantities of energy. Low energy-intensive desalination technologies are most preferable due to energy demand increasing continuously and it affects our environment directly. This abstract gives detailed information on different desalination techniques used across the world. It also highlights the merits and demerits involved in these processes and most importantly the energy requirements of the particular desalination process.

***Keywords:** Seawater Desalination; Nuclear energy; Membrane; Energy Intensity; Non-Nuclear Applications*

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Centre of Excellence in Water Treatment and Management

Centre of excellence in Water is established at PDEU in association of grant received from DST and DBT through different projects. This includes “Low Cost - Renewable Energy Driven (LC-RED) Water Treatment Solutions Centre”; (https://lc-red.wixsite.com/lcred) funded by Department of Science and Technology under "Water Technology Initiative”, and “bIo-mimetic and phyto-techNologies DesIgned for low-cost purificAtion and recycling of water (INDIA-H_2O)”; (www.india-h2o.eu) funded by Department of Biotechnology. Objective of COE in Water at PDEU is to develop, design and demonstrate high-recovery low-cost water treatment systems for saline groundwater and for domestic and industrial wastewaters. The focus for developments will be in the arid state of Gujarat, where surface water resources are very scarce. Cost-effective technologies and systems are proposed with the aim of lowering energy costs through dramatic improvements in energy efficiency, new bio-based approaches to water recycling, and use of renewable energy. Reject waste streams will be minimised or reduced to zero, thus protecting the environment.

Advanced membrane processes, including biomimetic FO and RO and layer-by-layer assembly of ultra/ nano-filtration membranes, will be developed and combined to provide new methods of purifying water from saline groundwater and from municipal and industrial wastewaters, providing water that is safe for drinking or suitable for irrigation. They will be implemented in cost-effective modes in systems incorporating phytoremediation and complementary processes.

Low-cost sensors for real-time monitoring of the key parameters important for efficient operation of membrane processes will be integrated with monitoring and management systems to ease maintenance of performance and ensure sustainability of these systems which have previously suffered from a lack of robust and reliable operational data, leading to frequent early failure and redundancy. The remote monitoring will also make possible collection of data to enable knowledge to be built up about long term performance, feeding into decision support tools for design and operation.

Systems will be developed and integrated to TRL6 as advanced prototypes that will be integrated with renewable energy sources under real operational conditions in the arid and industrialised state of Gujarat, with prospective applications in many other water-stressed and salinized areas such as Rajasthan, Punjab and Tamil Nadu. The development of business models will maximise the use of indigenous supply chains to reduce costs and ensure sustained implementation of the technologies.

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