3rd International Conference on

"Advances in Water Treatment and Management"

(ICAWTM-24)

March 01-02, 2024

Editor

Prof. Anurag Mudgal

Publisher

Pandit Deendayal Energy University (PDEU)
Gandhinagar, Gujarat, India

ISBN: 9789334019520

PDEU PANDIT DEENDAYAL ENERGY UNIVERSITY
Formerly Pandit Deendayal Petroleum University (PDPU)

Organized by

Pandit Deendayal Energy University (PDEU)
Gandhinagar, Gujarat, India

In Association with

Gujarat Council on Science & Technology (GUJCOST)
Gandhinagar, Gujarat, India

Supported by

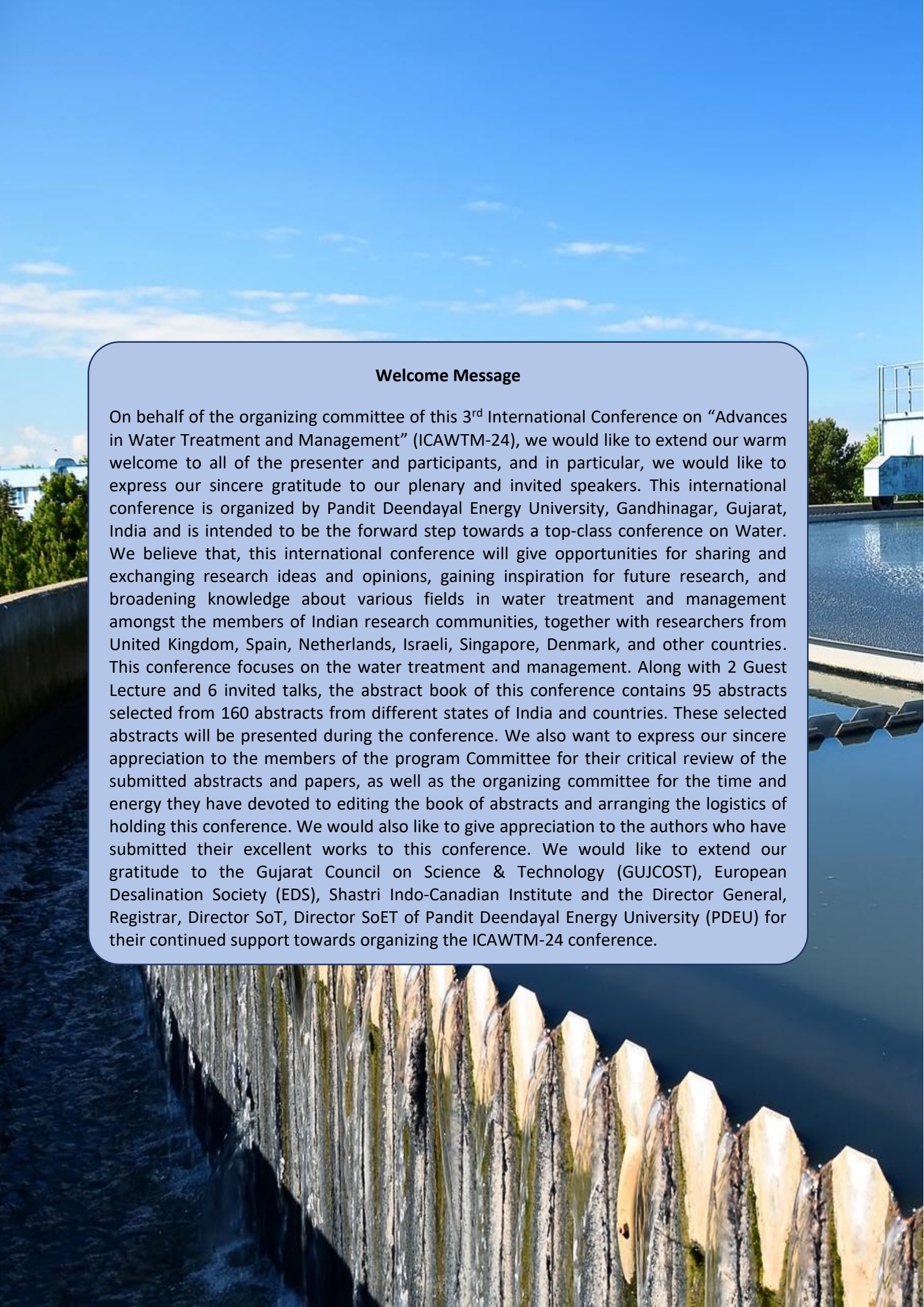
European Desalination Society

L'INSTITUT INDO-CANADIEN SHASTRI INDO-CANADIAN INSTITUTE

Publishing Partner

Springer Environmental Science and Pollution Research

Springer Proceedings



Welcome Message

On behalf of the organizing committee of this 3rd International Conference on "Advances in Water Treatment and Management" (ICAWTM-24), 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 forward step towards a top-class conference on Water. 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 6 invited talks, the abstract book of this conference contains 95 abstracts selected from 160 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), European Desalination Society (EDS), Shastri Indo-Canadian Institute and the Director General, Registrar, Director SoT, Director SoET of Pandit Deendayal Energy University (PDEU) for their continued support towards organizing the ICAWTM-24 conference.

3rd International Conference

on

Advances in Water Treatment and Management (ICAWTM-24)

March 01-02, 2024

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

Our Team

Chief Patron

Prof. S. Sundar Manoharan
Director General
Pandit Deendayal Energy University

Patrons

Prof. Dhaval Pujara
Director, SoT
Pandit Deendayal Energy University

Col (Dr) Rakesh Kumar Srivastawa
Registrar
Pandit Deendayal Energy University

Prof. Anirbid Sircar
Director, SoET
Pandit Deendayal Energy University

Convener

Prof. Anurag Mudgal
Pandit Deendayal Energy University
Gujarat, India

Co-Convener

Prof. Philip Davies
University of Birmingham
United Kingdom

Coordinating Committee

Dr. Neil Stewart
Modus Research and Innovation
United Kingdom

Dr. Vivek Patel
Pandit Deendayal Energy University

Dr. Jatin Patel
Pandit Deendayal Energy University

Dr. Manish Kumar Sinha
Pandit Deendayal Energy University

Organizing Committee

Dr. Vima Mali
Pandit Deendayal Energy University

Dr. Manish Kumar
Pandit Deendayal Energy University

Dr. Abhishek Kumar
Pandit Deendayal Energy University

Dr. Surendra Sasikumar Jampa
Pandit Deendayal Energy University

Dr. Rajat Saxena
Pandit Deendayal Energy University

Dr. Madhavan N
Pandit Deendayal Energy University

Dr. Daya Shankar Kaul
Pandit Deendayal Energy University

Dr. Nausheen Nizami
Pandit Deendayal Energy University

Dr. Himanshu H Choksi
Pandit Deendayal Energy University

Dr. Nanji Hadia
Pandit Deendayal Energy University

Dr. Lakshmana Rao Jeeru
Pandit Deendayal Energy University

Dr. Achinta Bera
Pandit Deendayal Energy University

Dr. Rahul Deharkar
Pandit Deendayal Energy University

Dr. Vivek Jaiswal
Pandit Deendayal Energy University

Dr. Jaykumar Vora
Pandit Deendayal Energy University

Dr. Tanushri Banerjee
Pandit Deendayal Energy University

Conference Managing Team

Dr. Varsha Mudgal
Water Project Staff
Pandit Deendayal Energy University

Dipak Ankoliya
Water Project Staff
Pandit Deendayal Energy University

Dhaval Patel
Water Project Staff
Pandit Deendayal Energy University

Milan Raninga
Water Project Staff
Pandit Deendayal Energy University

Scientific Advisory Committee

Prof. Surendra Singh Kachhwaha	Pandit Deendayal Energy University, Gujarat, India
Prof. T. P. Singh	Pandit Deendayal Energy University, Gujarat, India
Prof. R. K. Vij	Pandit Deendayal Energy University, Gujarat, India
Prof. Vishvesh Badheka	Pandit Deendayal Energy University, Gujarat, India
Prof. Moshe Sagi	Ben Gurion University, Israel
Prof. Maria Kennedy	IHE Delft Institute for Water Education, Netherlands
Prof. Prasanta Dey	Aston University, UK
Prof. Sadhan Ghosh	Jadhavpur University, Kolkata, India
Prof. Dinesh Kumar	Central University of Gujarat, Gujarat, India
Prof. R. K. Srivastava	G.B. Pant University of Agriculture and Technology, Pantnagar, India
Dr. Bhawanisingh Desai	Pandit Deendayal Energy University, Gujarat, India
Dr. Rajesh Patel	Pandit Deendayal Energy University, Gujarat, India
Dr. Praghnesh Bhatt	Pandit Deendayal Energy University, Gujarat, India
Dr. Ashish Unnarkat	Pandit Deendayal Energy University, Gujarat, India
Dr. Guillermo Zaragoza	Centre for Energy, Environment & Technology Research, Spain
Dr. Guofei Sun	Aquaporin, Singapore
Dr. Francesca Audino	LEITAT Technological Center, Spain
Dr. Cristina Yacoub Lopez	LEITAT Technological Center, Spain
Dr. Nirajan Dhakal	IHE Delft Institute for Water Education, Netherlands
Dr. Gabriela Cuadrado Quesada	IHE Delft Institute for Water Education, Netherlands
Dr. Suphiya Khan	Banasthali University, Rajasthan, India
Dr. Lidia Roca	Centre for Energy, Environment & Technology Research, Spain
Dr. Kiho Park	Chonnam National University, Republic of Korea
Dr. Ravi Saini	CSIR-Central Electronics Engineering Research Institute, Rajasthan, India
Dr. Satyam Srivastava	CSIR-Central Electronics Engineering Research Institute, Rajasthan, India
Dr. Isaac Fernández Rodríguez	Fundacio Centro Technologico de Investigation Multisectorial (CETIM), Spain
Dr. Dominic Standing	Ben Gurion University, Israel
Dr. Atya Kapley	CSIR-National Environmental Engineering Research Institute, Nagpur, India
Dr. Nitin Labhsetwar	CSIR-National Environmental Engineering Research Institute, Nagpur, India
Dr. Paras Pujari	CSIR-National Environmental Engineering Research Institute, Nagpur, India
Dr. Ritesh Vijay	CSIR-National Environmental Engineering Research Institute, Nagpur, India
Dr. Y L P Thorani	The Gandhi Institute of Technology and Management, Visakhapatnam, India
Dr. Barnali Nag	Indian Institute of Technology, Kharagpur, India
Dr. Anupam Ghosh	Indian Institute of Technology, Kharagpur, India
Dr. Satyendra Upadhyay	Somaiya Vidyavihar University, India
Dr. Monica Khanna	Somaiya Vidyavihar University, India
Dr. Vinod Kumar Shahi	CSIR-SCMCRI, India
Ariadna Claret	LEITAT Technological Center, Spain
Ruben Rodriguez Alegre	LEITAT Technological Center, Spain
Abel lara Caceres	LEITAT Technological Center, Spain
Robyn Plaice-Inglis	Modus Research and Innovation, UK
Liam Burlace	University of Birmingham, UK
Tim Naughton	University of Birmingham, UK
Sergio Cebral	Fundacio Centro Technologico de Investigation Multisectorial (CETIM), Spain
Vaishnav Davey	Davey Products, Chennai, India
Shrenik Merchant	Gujarat Chamber of Commerce and Industry, India
Rohit G. Mehta	Madhur Dairy, Gujarat, India
Mayur Vaishnav	Madhur Dairy, Gujarat, India
Riyaz Vohra	Jindal Worldwide Ltd., Ahmedabad, India

Keynote Speaker

Dr. Neil Stewart
Modus Research and Innovation
Scotland, UK

Dr. Jaichander Swaminathan
Indian Institute of Science (IISc), Bengaluru

Invited Speakers

Dr. Alba Ruiz-Aguirre
Centre for Energy, Environment & Technology Research, Spain

Dr. Xialei You
LEITAT Technological Center, Spain

Ruben Rodriguez Alegre
LEITAT Technological Center, Spain

Dr. S. N. Sharma
CSIR-National Physical Laboratory (NPL), Delhi, INDIA

Dr. P. R. Gogate
Institute of Chemical Technology, Mumbai

Prof S.N. Singh
Indian Institute of Technology Delhi, India

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 Dr. Neil Stewart, Modus Research and Innovation, UK
11:30 to 12:00	Keynote Lecture by Dr. Jaichander Swaminathan, IISc Bengaluru, INDIA
14:00 to 14:30	Invited Talk-1: Dr. S. N. Sharma, CSIR-National Physical Laboratory (NPL), Delhi, INDIA
14:30 to 15:00	Invited Talk-2: Dr. Alba Ruiz-Aguirre, Centre for Energy, Environment & Technology Research, Spain
15:30 to 17:30	Paper Presentation: Track 1 - 4

Day-2

10:00 to 10:30	Invited Talk-3: Dr. Parag Gogate, Institute of Chemical University, Mumbai, INDIA
10:30 to 11:00	Invited Talk-4: Ruben Rodriguez Alegre, LEITAT Technological Center, Spain
11:15 to 13:15	Paper Presentation: Track 5 - 8
14:30 to 15:00	Invited Talk-5: Dr. Xialei You, LEITAT Technological Center, Spain
15:00 to 15:30	Invited Talk-5: Prof S.N. Singh, Indian Institute of Technology Delhi, India
15:45 to 17:30	Paper Presentation: Track 9 - 12
17:30 to 18:00	Valedictory Function and Feedback session

Paper Presentations

Photoelectrochemical Water Splitting and Photocatalytic Oxidation Reaction Rate Tuning through Photocatalyst Particle Size Optimization

Vanshika Jain[a], Gautam Sinh Gohil[a], Ravi Tejasvi [a*]

[a] *Department of Chemical Engineering, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar: 382426, India*

Abstract: In this study, we investigate an integrated approach to wastewater treatment, where photoelectrochemical (PEC) water splitting is combined with photocatalytic oxidation for organic dye removal, emphasizing the synchronization of reaction rates to fully utilize the oxygen generated from water splitting in dye degradation. The effectiveness of various sizes of photocatalytic anatase TiO_2 is examined for both processes. TiO_2 is a known and time-tested photocatalyst. Although TiO_2 can form the Rutile/Anatase homojunction, which significantly enhances the photoactivity, finding the optimum particle size will address the challenges of tuning PEC and PC reaction rates. Practicing such integrated systems in environmental management and renewable energy generation is essential, especially for sustainable hydrogen purification techniques. This research aims to optimize the reaction kinetics, ensuring that the oxygen produced in PEC water splitting is effectively used in photocatalytic oxidation, thus enhancing the process's efficiency, sustainability, and overall value.

Keywords: photoelectrochemical (PEC) water splitting; photocatalytic oxidation; green hydrogen; sustainable hydrogen purification; hydrogen purification augmented wastewater treatment; Wastewater treatment

---

Mixed-Metal-Oxide Based Electrooxidation of RR120 Azo Dye

Maaz Alam[a], Abhipsa R Makwana[a]

[a]*Civil Engineering Department, Faculty of Technology and Enginering, The Maharaja Sayajiao University of Baroda, Vadodara, Gujarat, India*

Abstract: This study was performed with a lab-prepared mixed metal oxide (MMO) electrode with 1.65 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 of different dye concentrations (50-125 mg/L) was carried out for 2 h at various current densities (1, 5, and 10 mA/cm^2), electrolyte dose (2, 4, 6, and 8 g/L) at raw (7 pH), 5, and 3 pH. An increase in current density from 1 to 10 mA/cm^2 imparts a rise in process efficiency from 29 to 95% after 30-minute electrolysis. Acidic pH of 3.0 showed increase process efficiency upto 98% after 120 min but also increase the requirement of chemical to initially set the pH to acidic condition and then to neutral to achieve disposal standards. An electrolyte reduces the voltage requirements to maintain a specific current but imparts its own cost. The rise in dye concentration showed adverse impact on color removal. To achieve more than 90% color removal 60, 90, and 120 min time was required for 50, 100, and 125 mg/L solution. This paper provides sufficient insight to all the researchers who are interested in establishing electrochemical treatments as a feasible, commercial treatment for persistent pollutants.

Keywords: MMO; electrooxidation; RR120; electrode; current density; Azo dye

---

Effect of current density and pH on mixed-metal-oxide-based electrooxidation of leachate

Dhanvi Mengar[a], Abhipsa R Makwana[a]*, M. Mansoor Ahammed[b]

[a]*Civil Engineering Department, Faculty of Technology and Enginering, The Maharaja Sayajiao University of Baroda, Vadodara, Gujarat, India*

[b] *Department of Civil Engineering, Sardar Vallabhbhai National Instititute of Technology, Surat – 395007, India*

Abstract: The effect of current density (CD) and pH on the electrooxidation of a highly concentrated real leachate from an industrial landfill site with an initial COD ranging from 210 to 280 mg/L is reported in this paper. The study employed a lab-prepared mixed-metal-oxide electrode with 1.7 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 using the standard thermal decomposition method. The batch tests were carried at different CDs (1-45 mA/cm^2) for a period of 270 min. Current densities below 5 mA/cm^2 failed to achieve the 100 mg/L COD standard even after 270 min of reaction time, while reaction times of 225, 135, 90, and 45 min were needed to achieve 100 mg/L COD at CDs of 10, 15, 30 and 45 mA/cm^2, respectively at the raw initial pH of around 7.0. Effect of pH was also studied at CDs of 5, 10, and 45 mA/cm^2 in the pH range of 3-11. At 5 mA/cm^2 CD, COD removals of 70, 51, 41, 28, and 21% were obtained within 270 min at pH 3, 5, 7, 9, and 11 respectively. At a higher CD of 45 mA/cm^2, complete mineralization of leachate was obtained within 135 and 90 min respectively at pH 3 and 5. The mineralization was thus pH specific, and the process efficiency increased at higher current applications. The mineralization of leachate is discussed based on the reaction kinetics.

Keywords: MMO; electrooxidation; leachate; electrode; current density

Ciprofloxacin Removal from Aqueous Solution Using Graphene Oxide and Reduced Graphene Oxide

Shashi Prakash Gupta[a], Sujoy Kumar Samanta

[a] *Department of Chemical and Biochemical Engineering, Indian Institute of Technology Patna, Bihta, Patna 801106, India*

Abstract: The antibiotics consumption has been increased rapidly and their unmetabolized form discharged directly or indirectly in water bodies. Increasing concentration of antibiotics in water bodies create the serious environmental risks. Ciprofloxacin is an important antibiotic, has been used widely to treat bacterial infections in human. The concentration of ciprofloxacin in water bodies present in range of ng/L to µg/L. In this study graphene oxide and reduced graphene oxide were used to remove the ciprofloxacin from aqueous solution. Graphene oxide was synthesized by modified hummer methods and reduced graphene oxide was obtained by thermal reduction of graphene oxide. The concentration of 10ppm ciprofloxacin was investigated. The result showed that 95% ciprofloxacin removal was achieved with graphene oxide in 120 minutes. Whereas only 62% removal was observed with reduced graphene oxide in 120 minutes. The removal was investigated without pH adjustment. The synthesized graphene oxide and reduced graphene oxide were characterized by Fourier transform infrared (FTIR) spectroscopy, powder X-ray diffraction (XRD), thermogravimetric analysis (TGA), scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy. Toxicity evaluation was also carried out by ECOSAR software. Overall, this work could provide an environmentally friendly technique to eliminate ciprofloxacin from aqueous solution without using any external energy

Keywords: Wastewater, Ciprofloxacin, Graphene oxide, Reduced graphene oxide;

Decolorization of Reactive black 5 dye with Electrocoagulation using Flyash as an adsorbent

Malika Shrivastava[a], Kosha A. Shah[b*]

[a] *M.E. dissertation student, Civil Engineering Department, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara-390001, India.*

[b] *Assistant Professor, Civil Engineering Department, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara-390001, India.*

Abstract: This study was carried out to investigate the decolorisation of Reactive Black 5 dye (RB5) by direct current electrocoagulation (EC). Flyash is a waste generated from thermal power plants. With the aim to effectively handle the waste fly ash as well as to use it as an adsorbent to augment the efficiency of the EC process, flyash was used as an adsorbent with the EC. The process of EC and EC with flyash were compared for the RB5 removal efficiency. The effect of influencing parameters such as pH, dye concentration, current density, and time were studied in EC and EC with flyash process.The results indicate that for EC, under the conditions of an initial dye concentration of 100 mg/L, initial pH of 6 , current density of 5 A/m2, stirring speed of 300 rpm, the color removal efficiency reached 69.19% . For EC with flyash, under similar conditions and at flyash dose of 0.1 g/l, the color removal efficiency reached 87.85 %. The energy consumption of EC without flyash was 1.703 kWh/kg dye and for EC with flyash was 1.290 kWh/kg dye. The study proved that the removal of RB5 by EC with flyash was better than by EC in terms of cost effectiveness, energy consumption and removal efficiency.

Keywords*: Electrocoagulation; Reactive black 5 dye; Decolorization; Flyash; Energy consumption*

Effect of Various Parameters on Optimum Coagulant Dose- A Case Study

Dr. S.V. Ambekar

Professor, civil engineering department, Yeshawantrao Chavan College of Engineering

Abstract: Turbidity is an important physical characteristic of water. The turbidity present in water is generally removed by providing a series of treatment, viz. coagulation, flocculation followed by sedimentation and rapid sand filtration. Alum is the most popular coagulant because of its lower cost and its widespread availability. The coagulation performance of Alum was tested on turbid water i.e.50 NTU± 5. In this study, the effectiveness of aluminum sulphate was evaluated at different pH values and for different coagulant dosage. The efficiency was measured in terms of turbidity removal and residual aluminum after the completion of coagulation process. The effect of addition of sulphate was also studied. Results obtained in this case study proved that using low doses of alum, coagulation process was able to treat turbidity. Studies reveal that turbidity removal is dependent on pH and coagulant dose. The better turbidity removal optimize when pH was kept around 7 to 9. Presence of sulphates in water also affect the optimum coagulant dose.

Keywords: - *Coagulation, turbidity removal, aluminum sulfate,*

Recent Advancement of Coagulation-Flocculation Process to Treat Wastewater

Stuti Thakur[a] and Shabiimam M A[b*]

[a]*Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*
[b*]*Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

Abstract: This study's main objective is to give a comprehensive understanding of the method of coagulation-flocculation and its uses in water and wastewater. For the purpose of getting rid of colloidal particles, coagulation is essential. Even though it has seen significant improvements, this kind of water treatment is still the most common. Coagulant types, coagulation processes, and colloid stability are the main topics of this review. Novel synthetic coagulating agents have been developed as a result of the increased availability of organic substances as ingredients, such as anionic, cationic, and non-ionized polymeric electrolytes. When everything is taken into account, it is evident that the coagulation industry is currently looking for the creation of better compounded coagulating agents, which are both more effective and becoming structurally more complicated than the substances that were formerly used. As remedies, creative advancements in the application of coagulating substances are recommended. Micropollutants are substances, both inorganic and organic, that have the potential to damage the environment, even at extremely minute concentrations. Coagulation represents one approach to the removal of microorganisms and microplastics from water. Still, the effectiveness of this tactic might change based on the details.
Keywords: Coagulation, Flocculation, Alum

An assessment of different tides and anthropogenic influence on coastal surface water at Bhavnagar coast, Gulf of Khambhat, India

Hardik Giri Gosai[a*] and Pradeep Mankodi[b]

[a]*Department of Environmental Studies, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara – 390002, Gujarat, India*
[b]*Division of Marine and Fresh Water, Department of Zoology, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara – 390002, Gujarat, India*

Abstract: Tidal fluctuation could modify the physico-chemical parameters and dissolved heavy metals of the coastal water. The current article attempts to assess the fluctuation in water characteristics during high and low tides concerning anthropogenic or natural influences in the Gulf of Khambhat. Industrialization puts strain on coastal water by releasing wastewater or effluents during low tide, which affects the entire marine ecosystem. The tidal fluctuation is significant because it represents the impact of land-based activity on coastal water. To demonstrate this reasoning, several stations were selected along the coast, and statistical analyses such as Pearson correlation, Box plot, hierarchical cluster analysis (HCA), and factor analysis (PCA/FA) were performed. Physico-chemical parameters such as sea surface temperature, pH, conductivity, total dissolved solids (TDS), total suspended solids (TSS), salinity, dissolved oxygen (DO), 5^{th}–day biochemical oxygen demand (BOD), chemical oxygen demand (COD) and distribution of dissolved heavy metals (Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn) were investigated at Bhavnagar coast, Gulf of Khambhat. The main parameters impacted by human and tidal influences include temperature, DO, BOD, COD, and the heavy metals Cr, Co, Mn, and Fe. The research region displayed an increased pollution load during low tide, which was attributed to land-based anthropogenic influence.
Keywords: *Anthropogenic pollution, Gulf of Khambhat, Multivariate statistical techniques, Temporal and spatial variations, Tidal variation*

Assessing the Potential of Economic Valuation for Water in India: A Pathway to Sustainable Viability amidst Potable Water Scarcity – Insights from a Primary Survey in Kanpur City

Abhishek Kumar [1]

Ph.D. Scholar, IIT Kanpur, Kanpur-208016, India

Abstract: One-third of the population of world does not have sufficient water to meet their basic requirements (Shiklomanov, 1999). The United Nations General Assembly in 2015 agreed upon 17 sustainable development goals to be attained before 2030 across the world. Its primary objective has been to achieve a better and more distributed sustainable future for all. This study in its entirety is concerned with goal 6 which talks of access to clean and safe drinking water for all. In order to address the issue of water scarcity in Urban areas, this study proposes the use of water pricing based on the Ordered Choice model. To arrive at the water pricing using the WTP method this study uses a primary survey of HHs in the city of Kanpur. The study estimates that the households are willing to pay an average amount of Rs 794 for 30 KL of water supply per month while the municipality is charging only INR177 per household for 30 KL/per month. On the other hand, the household is paying on average around Rs 2825 as an implicit cost per year to overcome the various water-related seasonal diseases in the form of implicit cost. Thus, water pricing based on WTP is expected to provide an optimal solution to both the consumers and water supply authority, making both parties better off and also offering a sustainable solution for water scarcity.

JEL Codes: *Q01, Q25, Q56, C83, D61, P28*
Keywords: *WTP, Ordered Choice model, Water pricing, Urban water supply*

Integrated Flood Modelling of Ambika River Basin Using HEC-RAS: A Comprehensive Analysis for Disaster Resilience

Patel Disha N, Dr. Sanskriti S. Mujumdar

Faculty of Technology and Engineering, The Maharaja Sayajirao University, P G Hall; Hall of Residence, Vadodra – 390002, India

Abstract: The Ambika River, a vital water course in Ambika River Basin flowing from Saputara Hills immerge into the Arabian Seas, has been prone to frequent flooding, leading to substantial socio-economic and environmental challenges. In the study, we employ the Hydrologic Engineering Center's River Analysis System (HEC-RAS) to develop a sophisticated flood model aimed at enhancing our understanding the river's hydrodynamics and floodplain interactions. The primary objectives include assessing flood vulnerability, identifying potential inundation areas, and proposing mitigation strategies for disaster resilience. The methodology involves the collection of topographic, hydrologic and hydraulic data, which are integrated into the HEC-RAS model to simulate various flood scenarios. Major flood event occurred in year 1979, 1981, 1984, 1994, 1997, 2001, 2003, 2004, 2006, 2013, 2014. At present, the carrying capacity of the river is approximately about 2.5 lakh cusecs (7071 cumecs). Calibration and Validation of the model are conducted using historical flood events to ensure accuracy and reliability. The study also incorporates climate change projections to anticipate future flood patterns and their potential impacts. Results of the flood model are analyzed specially and temporally, providing insights inti the dynamic of flood propagation, depth and duration. Additionally, the study evaluates the effectiveness of existing infrastructure, such as dams and levees, in mitigating flood risks. The findings aim to inform policymakers, urban planners and emergency responders about potential flood hazards, aiding in the development of sustainable and resilient flood management strategies. This research contributes to the broader field of hydrology and water resources management by presenting a case study that showcases the application of advance modelling techniques for flood risk assessment. The outcomes offer valuable information for decision makers to implement measures that enhance the overall resilience of the Ambika River basin against the impact of flooding. Based on the above case study, it is strongly recommended to construct a retaining wall or either raised the height of the existing wall at a river.

Keywords: Ambika River, HEC-RAS, Flood Modelling, Flood risk management

---

Assessment and Mapping of Heavy Metal Contamination in Groundwater using GIS and Heavy Metal Indices

Rahul Das[1], Tushar Das[1], Santanu Mallik[2], Umesh Mishra[1], Ishwar Chandra Das[3], Rajarshi Saha[3]

[1]*Department of Civil Engineering, National Institute of Technology Agartala, Barjala, Tripura 799046, India.*

[2]*Department of Civil Engineering, Poornima College of Engineering, Sitapura, Jaipur, Rajasthan-302022, India*

[3]*National Remote Sensing Centre, ISRO, Balanagar, Hyderabad -500 037, India*

Abstract: Groundwater is a vital water source for humanity. Groundwater provides drinking water entirely or in part for as much as 50% of the global population and accounts for 43% of all of water used for irrigation. It is, therefore, also susceptible to pollution from a variety of geological and anthropogenic causes. This study aimed to assess the groundwater quality in terms of heavy metal indexing for the Kadamtala Block situated at northern part of Dharmanagar City in North Tripura district. A total number of 30 samples are collected and analyzed using UV-Visible Spectrophotometer in the laboratory for Eight physicochemical characteristics, including heavy metals such as Arsenic (As), Chromium (Cr), Fluoride (F) and other hazardous pollutants such as Nitrate and Iron (NO_3^-, Fe^{2+}) were examined. The heavy metal evaluation index (HEI) and the heavy metal pollution index (HPI), two indices-based techniques, were used in this study to evaluate the heavy metal quality of the water. To comprehend the spatial distributions of Heavy metals and other possible Groundwater contaminants existing in the study area, geographic information systems (GIS) are utilized for mapping. The results indicated that Nitrate (NO_3^-), Iron (Fe^{2+}), Fluoride (F^-), Chromium (Cr) and Arsenic (As) concentration are 37%, 50%, 16%, 30% and 20% respectively that are above permissible limit according to BIS (Bureau of Indian Standards) and WHO (World Health Organization). Spatial maps obtained from GIS mapping shows the concentration of Arsenic and chromium are concentrated mostly near the agricultural fields, and the results obtained from HPI indicate overall good water quality, Overall groundwater quality in the study area can be deduced as good according to HPI and HEI index values, further investigation into the origins of contamination at the local scale is required in order to identify the most effective cleanup strategies. Decision makers will find the study's results useful in understanding the overall heavy metal content as well as other Groundwater pollutants in the study area and come up with its remedial measures.

Keywords: Groundwater; Heavy Metals; Geographic information systems (GIS); Heavy metal pollution index (HPI); Heavy metal evaluation index (HEI)

Spectral and Temporal response from the water of Kiul River within Lakhisarai district, Bihar in the aspect of Turbidity by the Remote Sensing & GIS

Gaurav Kumar[1], Neeta Kumari[1]
[1]*Department of Civil and Environmental Engineering, B.I.T., Mesra, Ranchi-835215, India*

Abstract: Turbidity serves as a crucial measure of liquid clarity, particularly in water, assessing the degree of light scattering caused by materials present. Higher turbidity, indicated by increased light scattering, is often attributed to various factors such as phytoplankton growth, human activities like brick manufacturing and sand mining along riverbanks, and agricultural practices. Additionally, areas prone to bank erosion and urbanized regions contribute significantly to elevated turbidity levels, primarily through storm water pollution from impervious surfaces. Overall, understanding and addressing the sources of turbidity are essential for maintaining water quality in diverse environments. The mapping of water quality in inland waters utilizing remote sensing has been underway since the 1970s, coinciding with the launch of the Landsat series of satellites. Studies have revealed that the red and Near Infrared (NIR) bands exhibit high sensitivity, enabling the estimation of turbidity. Moreover, the temporal changes in turbidity were examined using the Normalised Difference Turbidity Index (NDTI). The study findings indicate a significant and alarming increase in turbidity within a two-decade timeframe in the waters of the Kiul River. Sampling along the Lakhisarai stretch of the Kiul River revealed a decline in water quality, particularly in turbidity. The study incorporated sensor data, utilizing Land Use Land Cover (LULC) and Normalised Difference Water Index (NDWI) maps derived from Landsat 5 TM and Landsat 8 OLI TIRS satellite images spanning the period from 2003 to 2023 at five-year intervals. The analysis distinctly established an increase in turbidity levels in the Kiul River during this timeframe.

Keywords: Spectral, Temporal, Turbidity, Near Infrared (NIR), Normalised Difference Turbidity Index (NDTI), Land Use Land Cover (LULC), Normalised Difference Water Index (NDWI)

Smart Water, Real Solutions: A Review of Intelligent Technologies for Efficient and Sustainable Water Management

Debasis Sarkar[a], Purvesh Raval[b]

[a] *Associate Professor, School of Technology, Pandit Deendayal Energy University, Raisan, 382007, India*
[b]*PhD Student, School of Technology, Pandit Deendayal Energy University, Raisan, 382007, India*

Abstract: This study explores the emerging topic of smart water management, analyzing its capacity to transform water treatment and enhance security. By conducting an extensive analysis of multiple influential research articles, we investigate the wide-ranging uses of advanced technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and Machine Learning (ML) in different areas of water management. The analysis examines the application of predictive maintenance to optimize network systems, the implementation of intelligent early-warning systems to prevent wastewater overflows, and the utilization of data-driven approaches to enhance stormwater management. The effectiveness of intelligent water distribution systems in urban environments has been assessed. The increasing adoption of decentralized rainwater collection in residential regions has also been examined. The evaluation also addresses the difficulties linked to digital transformation in water companies and underscores the necessity for sustainable funding options for intelligent water infrastructure. Available literature has been reviewed in this study and detailed and sophisticated analysis of the possibilities and difficulties associated with smart water management has been assessed. This study sets the stage for future investigations and the adoption of intelligent strategies to ensure a sustainable water supply in the future.

Keywords: Smart Water Treatment, Smart Water Management, Artificial Intelligence, Machine Learning, Internet of Things, Sensors, Sustainable Water Security, Digital Transformation in Water;

Remediation of Sewage Treatment Plant (STP) Waste Water Using Metal Loaded Biochar – A Sustainable Approach for Getting Fertilizer Alike Material

Harsh Pandya, Khushi Jaiswal and Dr. Ashish Unnarkat
Pandit Deendayal Energy University

Abstract: Biochar, being a stable carbon-rich substance, offers substantial potential for water and soil remediation due to its abundant source materials and favorable physicochemical properties. Numerous studies have demonstrated its capacity to absorb nutrients, metals, and complex compounds, filter out suspended solids, promote microbial growth, retain water and nutrients, and boost soil carbon content. Consequently, biochar is emerging as a promising agent for wastewater treatment and an effective medium for soil remediation, with potential applications in gas storage and separation. In recent years, excessive nitrogen (N) and phosphorus (P) levels in the environment have had detrimental effects on both the environment and human health. Phosphorus excess in water sources leads to eutrophication and habitat degradation, harming aquatic life and plants. Phosphate removal is crucial to combat water source eutrophication. Biochar (BC) has gained widespread attention as an efficient adsorbent for N and P removal due to its high removal efficiency, flexibility, economic benefits, and positive environmental impact. Its fine porous structure provides strong adsorption capacity, low solubility, stable physical and chemical properties, and a large surface area. Current research aims to use biochar as a foundation for loading metal oxides that selectively adsorb nitrogen and phosphate. This resulting material will be employed to simultaneously remove N and P from sewage treatment plant wastewater. The spent material will contain essential nutrients for plant growth and soil improvement, making it suitable for agricultural applications.

Application of Heat-Intensified Extractive Double-Partitioned Divided- Wall Column for Purification of Water from Petrochemical

Md Aurangzeb[a*], Subhankar Roy[a], Sudip Banerjee[b], Ravi Tejasvi[a]

[a]*Department of Chemical Engineering, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat, India−382426.*

[b]*Department of Chemical Engineering, Indira Gandhi Institute of Technology, Sarang, Odisha, India−759146*

Abstract: This study introduces an advanced extractive divided-wall column (DWC) technology, specifically tailored for the efficient distillation of water from a challenging mixture of tetrahydrofuran and methanol, which typically forms multiple binary azeotropes. To overcome the azeotropic limitations, we employ a solvent and heat (steam), leading to the development of an extractive double-partitioned DWC (EDPDWC) as our base case. In an innovative advancement, our proposed process recovers waste heat from the vapor at the top of the column by employing vapor recompression. This heat is then reused for separation purposes. Although this approach initially necessitates a high compression ratio, resulting in substantial capital investment, we address this challenge by incorporating a heat integration system. This system enhances the vapor temperature by coupling it with the hot solvent (bottom product), followed by strategic use of an intermediate reboiler and heat exchangers. This novel approach, termed heat-integrated EDPDWC (HiEDPDWC), successfully elevates the vapor temperature by 15 K compared to the reboiler liquid. The HiEDPDWC demonstrates remarkable superiority over both the standard EDPDWC and the vapor recompressed EDPDWC in terms of energy and cost efficiency. Specifically, the HiEDPDWC achieves a substantial energy saving of 61% and a reduction in total annual cost by 19.15%, with an impressive payback period of just 4.2 years. These significant findings underscore the potential of HiEDPDWC in purifying water, particularly in challenging separations involving azeotropes.

Keywords*: Water, Petrochemical, extractive double-partitioned divided-wall column, multiple binary azeotropes, heat integration, energy savings, and cost savings*

Optimizing Reaction Kinetics in Wastewater Treatment: Particle Size Manipulation and Rate Tuning via COMSOL Simulation

Setu Visavadia[ab], Subhankar Roy[a], Ravi Tejasvi[a*]

[a] *Department of Chemical Engineering, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar – 382426, India*

[b] *Department of Chemical Science, Parul University, Vadodara – 391760, India*

Abstract: This study investigates the tuning of reaction rates in photocatalytic and photo-electrocatalytic reactions by manipulating catalyst particle size, leveraging the dependency of reaction rates on the catalytic surface area. Recognizing that the number of active sites, which substantially influences reaction kinetics, correlates directly with the catalytic surface area, this research focuses on adjusting particle size to modulate this area. This method aims to synchronize the rates of two critical reactions: the generation of oxygen as a byproduct in photoelectrochemical water splitting and its subsequent consumption during photocatalytic oxidation in wastewater treatment. The ultimate goal is to optimize the process, ensuring the complete utilization of oxygen thereby enhancing the purity of the hydrogen output. Employing COMSOL for computational analysis, this paper presents a systematic approach to match the reaction rates, proposing a potential avenue for improving the efficiency and sustainability of wastewater treatment systems.

Keywords: photoelectrochemical (PEC) water splitting; photocatalytic oxidation; green hydrogen; sustainable hydrogen purification; hydrogen purification augmented wastewater treatment; Wastewater treatment

---

A Numerical Investigation of Multi-bubble Dynamics in Hydrodynamic Cavitation

Shishir Raut[a], Chirantan Shah[a], Md Aurangzeb[a], Ravi Tejasvi[a], Siddhartha Moulik[b], Subhankar Roy[a,*]

[a] *Department of Chemical Engineering, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar: 382426, India*

[b] *Department of Process Engineering & Technology Transfer, CSIR-Indian Institute of Chemical Technology, Hyderabad 500007, India*

Abstract: This study builds upon the work of Raut et al., 2024, delving into the intricate dynamics of triple and multi-bubble systems (n>3) in hydrodynamic cavitation, specifically in single-hole orifice-plate reactors. Both infinite liquid domains and confined walled environments are examined. Key factors like cavitation radius, cavitation number, bubble spacing, temperature, and pressure are meticulously evaluated using modified Keller-Miksis model for compressible fluids. The study also explores the secondary Bjerknes forces and the impact of solid boundaries on bubble behaviour. The findings highlight the significant impact of each bubble on the oscillations of neighbouring bubbles, resulting in substantial variations in the overall dynamics of the system. This leads to significant deviation of results from both single and double-bubble systems.

Keywords: Triple bubble dynamics; n-bubble dynamics; hydrodynamic cavitation; Wastewater treatment

Iron Oxide and Iron Oxide-Based Nanomaterials for Water Remediation

Saumya Mankad [a], Sakshi Chaudhari [a], Saloni Ghodmare [a], Rohan Mahajan [a], Siddhi Susladkar [a], Niraj Topare [b], Shantini Bokil [c], Vishnu Choudhari [a]

[a] *School of Health Sciences and Technology, Dr. Vishwanath Karad MIT World Peace University, Pune 411038, India*

[b] *School of Chemical Engineering, Dr. Vishwanath Karad MIT World Peace University, Pune 411038, India*

[c] *School of Civil Engineering, Dr. Vishwanath Karad MIT World Peace University, Pune 411038, India*

Abstract: Growing need of water and increase in generation of wastewater globally demands efficient water treatment processes. Conventional water remediation efforts shortfall to cater current water treatment requirements. Nanomaterial water remediation has shown promising results and needs to be explored at greater scale to address these issues. Currently iron oxide magnetic and superparamagnetic NPs and their composite nanomaterials received most attention due several useful properties and advantages such as high after use recovery, targeted quality and cost effectiveness. Organic and inorganic pollutants removed by iron oxide-based nanomaterials by various mechanisms. Furthermore, there are several nanocomposites used to enhance performance and introduce new and beneficial properties. Chemical, green, and biological methods used for preparation of these materials. Various iron-based nanocomposites have shown synergistic properties for water remediation. Various mechanisms of pollution removal such as adsorption, desorption, photocatalysis, flocculation/coagulation targeted while designing NPs. Types of water pollutant and choice of remediation methods and various methods required for QC of these NPs were reviewed. The review discusses various methods of preparation of magnetic nanoparticles, their composite materials, mechanism of pollutant removal, recent applications exploring synergistic behaviour for removal of pollution for efficient water remediation. Issues such as safety toxicity, removal after use and disposal of these materials also discussed. Manuscript provides a quick overview of iron oxide NPs and as reference for advancing further studies in the areas. Efforts anticipated to contribute to the production bibliography about various aspects of iron-based nanomaterials for wastewater treatments.

Keywords: water treatment; iron oxide nanoparticle and nanocomposites; magnetic and supramagnetic; synergistic removal of pollution; organic and metal pollutant; Nanomaterial characterisation.

Strategies for managing wastewater generated during valorisation of lignocellulosic biomass: A comprehensive review

Swachchhatoya Ghosh[a], U. Jayakrishnan[a], *, Mihir Acharya[a], Debosmita Sharmmah[a], Prasansa Rai[a], Subhankar Roy[b], Siddhartha Moulik[a]*

[a] *Cavitation & Mechanochemistry Lab, Department of Chemical Engineering & Process Technology, CSIR-Indian Institute of Chemical Technology, Hyderabad:500007, India*

[b] *Department of Chemical Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat:382426, India*

Abstract: Against the backdrop of the intensifying global imperative to achieve Sustainable Development Goals (SDGs) amidst a growing global population, India has strategically positioned itself as a key participant in addressing the imperative of ensuring food security. The global demand for agricultural products has experienced a substantial rise, marked by a notable increase in percentage terms. This surge can be attributed to evolving consumer preferences, population growth, and a heightened focus on sustainable practices in the agricultural sector. Consequently, this surge in agri product demand has led to increased agricultural activities, intensifying the generation of agricultural residues. Effective management of these residues is critical for maintaining environmental sustainability and addressing waste concerns. Adopting innovative approaches for agri residue utilization becomes imperative to align with modern agricultural practices, ensuring a holistic and eco-friendly approach. Among the major products derived from millet agro residue, NITI Aayog strongly recommends the adoption of biopolymer-based materials. Notably, a key objective involves the disintegration of Lignocellulosic biomass for diverse applications. This initiative aligns seamlessly with the overarching goal of promoting environmentally friendly alternatives. Agricultural residues undergo diverse chemical and mechano-chemical pretreatments for delignification and disintegration of cellulose and hemicellulose. Nevertheless, the wastewater generated during this process comprises recalcitrant organic molecules and diverse array of complex chemicals with high BOD/COD and high total organic carbon values. In this context, the implementation of efficient wastewater treatment methods becomes imperative to address environmental concerns and adhere to regulatory standards. This review presents a comprehensive overview on existing resource recovery techniques and diverse wastewater treatment strategies, incorporating various approaches such as membrane technologies, advanced oxidation processes (AOPs), biological treatment techniques, coagulation-flocculation, sedimentation, ion-exchange, etc., with a focus on wastewater recycling through the Minimal Liquid Discharge (MLD) approach. Furthermore, a comprehensive techno-economic analysis has been undertaken to facilitate the identification and selection of the most efficient integrated treatment approach for a sustainable bio-refinery framework.

Keywords: Sustainable Development Goals (SDGs); Food Security; Agricultural Residues; Bioplastic; Wastewater Treatment Strategies; Minimal Liquid Discharge (MLD)

Bioremediation for Sustainable Dye Wastewater Treatment

Deepa D [a]* , Visvaas S [b] , Shyam Sundar S [b] , Pavendhan P [b]

[a] *Assistant Professor, School of Civil Engineeering, SASTRA Deemed to be university, Thanjavur, India, 613401.*

[b] *Student, School of Civil Engineeering, SASTRA Deemed to be university, Thanjavur, India, 613401*

Abstract: A sustainable way of wastewater treatment is possible through biological methods of wastewater treatment. It is possible through Algae phycoremediation, which involves harnessing the power of algae to diminish or eliminate pollutants from different environmental sources, such as water, air, and soil. Algae possess an impressive ability to absorb and break down various pollutants, including nutrients, heavy metals, and organic compounds, through their metabolic and photosynthetic processes. In this study, we cultivated three types of algae (Spirulina, Chlorella, Dunaliella) in the Zarrouk medium and allowed them to thrive in dye wastewater. The results indicate that Spirulina algae, in particular, demonstrated significant effectiveness in removing pollutants from the dye wastewater. Notably, Spirulina algae reduced Biological Oxygen Demand (BOD) by 55%, Chemical Oxygen Demand (COD) by 44%, and successfully eliminated of the metal content present in the wastewater. Algae have consistently exhibited their ability to flourish and efficiently reduce harmful substances, including chemical contaminants, heavy metals, and color, in dye wastewater. Therefore, they represent a preferable and environmentally friendly alternative to chemical methods in wastewater treatment.

Keywords: Spirulina, Chlorella, Dunaliella, Textile Dye Waste Water, Bioremediation

---

Microbial Bioremediation of Nutrient Pollutants (Ammonical Nitrogen) in Synthetic Wastewater

Dabeer Hussain Mir[a], Mushtaq A. Rather[b]

[1] *Research Scholar, National institute of technology Srinagar Kashmir J& K (India)*

Abstract. Elevated levels of nutrient pollutants, specifically nitrogen and phosphorus compounds, within wastewater present a pressing environmental concern due to their potential for adverse ecological impacts, including the eutrophication of natural water bodies. In response, microbial bioremediation strategies have emerged as effective and sustainable approaches to mitigate nutrient pollution in synthetic wastewater. This abstract explores the utilization of microorganisms for the removal and transformation of nutrient pollutants in synthetic wastewater. It delves into various microbial species, their metabolic pathways, and the factors influencing bioremediation performance. Additionally, recent advancements in bioremediation techniques, such as bioreactor configurations and genetic modification of microorganisms, are highlighted. The potential of microbial bioremediation to address the challenges associated with nutrient pollution in synthetic wastewater is underscored, with an emphasis on its environmental sustainability and economic viability. In summary, this study emphasizes the pivotal role of microbial bioremediation as a promising and eco-friendly tool for efficiently mitigating nutrient pollutants in synthetic wastewater.

Keywords: Microbial Bioremediation, Nutrient Pollutants, Environmental Sustainability

---

Environmentally Sustainable Desalination through Rapid Screening and Design of High-Performance Thin Film Nanocomposite Membranes and Process Optimization Using Artificial Intelligence (AI) – Machine Learning (ML) Framework

Jasneet Kaur Pala[a], Abichal Ghosh[b], Tushar Damani[a], Reddi Kamesh[c], Subhankar Roy[d*], Siddhartha Moulik[c] & Anirban Roy[a]

[a]*Water-Energy Nexus Laboratory, Department of Chemical Engineering Goa, BITS Pilani, Goa: 403726, India*

[b]*Department of Computer Science and Information Systems, BITS Pilani, Goa: 403726, India*

[c]*Process Engineering and Technology Transfer Department, CSIR-Indian Institute of Chemical Technology, Hyderabad: 500007, India*

[d]*Department of Chemical Engineering, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar: 382426, India*

Abstract: The current work focuses on developing AI-ML framework for rapid screening and design of optimal thin film nanocomposite membranes and identifying operating parameters for yielding best performance in terms of flux and salt rejection capabilities. A total of 315 data points were collected from 32 sources and detailed data mining exercise was carried out classifying into various operating as well as membrane synthesis parameters including polymer, solvents, temperature, thin film composite layer formation, and nanoparticle properties. These data underwent comparative analysis using 6 ML models including linear models, tree based models, kernel based model and neural network model (ANN). They were compared on basis of performance criteria like R^2, *AAD* and *RMSE* values of their water flux and salt rejection predictions. It was found that ANN predicted the data most accurately and consistently. Further rigorous inverse design was carried out to determine the optimal TFN composition and desalination operating conditions and best solutions are identified where both flux and salt rejections were > 89 l/m^2.h and salt rejection > 99% and they were (i) nanoparticle weight % (0.02 - 0.3), (ii) optimum pressure = 12 - 38 bar, (iii) feed temperature = 23 - 26 ^{o}C for (iv) 7800-9000 ppm NaCl feed solution.

Keywords: Desalination; Membrane separation; AI-ML; Process Optimization;

Infrared active narrow bandgap Ni doped $LaFeO_3$ nanoparticles for desalination and decontamination of water leveraging interfacial solar steam generation.

Sameena R. Mulani[a], Santosh Bimli[a], Ekta Choudhary[b,c], Harshada Jadhav[a], Ravindra Jangir[c], Parvez A. Shaikh[d], and Rupesh S. Devan[a,e]

[a]*Department of Metallurgical Engineering and Materials Science, Indian Institute of Technology Indore, Simrol, Indore, 453552, India*
[b]*Department of Physics, Indian Institute of Technology Indore, Simrol, Indore, 453552, India*
[c]*Accelerator Physics and Synchrotrons Utilization Division, Raja Ramanna Centre for Advanced Technology, Indore, 452013, India*
[d]*Department of Physics, AKI's Poona College of Arts, Science and Commerce, Pune, 411001, India*
[e]*Centre for Electric Vehicle and Intelligent Transport Systems, Indian Institute of Technology Indore, Simrol, Indore, 453552, India*

Abstract: Photothermal Ni-doped $LaFeO_3$ (NLFO) (LaFe1-x Ni xO3, x=0, 0.2, 0.3, 0.4, and 0.5) microspheres composed of nanoparticles synthesized by hydrothermal method are utilized for interfacial solar steam generation (ISSG) of salty and contaminated water. The orthorhombic to rhombohedral phase transition of LaFeO3 (LFO) at morphotropic phase boundary (MPB) flattens the free energy profile, and high absorbance in the 800-2000 nm Vis-NIR region arises due to the creation of intra-band gap states are accountable for superior activity towards the ISSG for desalination. The La, Ni, and Fe possess the oxidation states of 3+, 2+, and 3+/4+, respectively, showing successful doping of Ni 2+ at the Fe 3+ sites that produce lattice distortion at La/FeO_6 octahedra. LaFe0.5Ni0.5O3 ($NLFO_5$) sample exhibits surface temperature of 50.4 ℃ due to heat localization and produces evaporation flux of 2.89 kg/m^{2}h under IR illumination at the air-water interface. Importantly, $NLFO_5$ loaded cellulose paper shows good repeatability and cyclic stability for 10 consecutive cycles under IR illumination and equivalent evaporation flux of 2.4 kg/m^{2}h under direct sunlight illumination. Moreover, 3.5 wt% saline water shows a drastic decrement in ion concentration after ISSG, as confirmed by atomic absorption spectroscopy. Furthermore, $NLFO_5$ possesses good evaporation flux of 2.27 and 2.20 kg/m^{2}h for water contaminated with RhB and MB organic dye. Our results propose NLFO as distinguished photothermal material for ISSG application and wastewater purification by means of evaporation.

Keywords: Desalination, water decontamination, Ni-doped $LaFeO_3$, Water purification, Interfacial Solar Steam Generation

Review of Ultrasonic Water Treatment for Organic Pollutants

Vinayak S. Wadgaonkar [a], Siraj Bhatkar [a], Dinesh Bhutada[b] , Pallavi Tatpate[b], Himangi Neve [b]

[a]*School of Petroleum Engineering, M.I.T.W.P.U., Pune-411038, India*
[b]*School of Chemical Engineering, M.I.T.W.P.U., Pune-411038, India*

Abstract: Interest in employing ultrasonic technology to purify water by destroying organic impurities has been on the rise. When compared to traditional methods, ultrasonic treatment is faster and more effective. Many stubborn organic contaminants can be broken down using ultrasonic technology. Paper includes ultrasonic degradation of organic pollutants: theory, affecting variables, and multiple techniques. Chemical oxidation, adsorption, and ultrasonic treatment alone or in combination with biocatalysts are examples of these techniques. There is also an examination of the challenges associated with using ultrasonic technology to remove organic pollutants from water, as well as a proposal for further research.

Keywords: Ultrasonic, Organic Pollutants, Biocatalyst

Water Desalination and H_2 Production

Vidhan Thakore[a], Anurag Mudgal[a], Nanji J Hadia[a,*]

[a] *Department of Mechanical Engineering, Pandit Deendayal Energy University, Gandhinagar 382426 India*

Abstract: Growing concerns of climate change has made it imperative to look for alternative and clean energy sources for green future. Further, energy security is also a prime concern for any rising economy. One such source of energy that has gained the spotlight in the recent times is green hydrogen (H_2) energy and economy. Although there are various techniques through which green hydrogen can be produced, one way to produce green H_2 is by water electrolysis using renewable energy. Recent studies have revealed the possibility of hydrogen production by different water electrolysis methods namely alkaline water electrolysis, anion exchange membrane (*AEM*) *electrolysis*, proton exchange membrane (PEM) electrolysis, and solid oxide electrolysis (SOE). Green hydrogen generation through water electrolysis accounts of only 4% of the total hydrogen production throughout the world. Further, this process requires ultrapure water to be used in elecrolyzer. Any salt present in the feed water corrodes the electrodes of electrolyzer and shortens its useful life. However, producing green H_2 at a global scale could strain freshwater sources for drinking and use in numerous industrial processes. The availability of vast seawater may help solve this problem if sweater desalination can be achieved at a lower cost water. Therefore, desalination technologies will play a pivotal role in future H_2 production. This study aims at investigating the effects of water purity on green hydrogen generation. The research also focuses on providing the insights on the effect of feed water salinity on energy consumption, overall efficiency of the elecrolyzer, life of process components, and hydrogen production. The findings contribute to development of strategies for optimizing electrolysis process, considering the diverse water sources available, thereby advancing and maximizing the production rates from the available water sources.

Keywords: desalination; renewable energy; hydrogen economy; electrolysis; seawater

Optimisation of PSF/ZIF-7 mixed matrix membrane for effective removal of organic contaminants from wastewater using Box-Behnken Design

Sapna Gawali[a], Manish Kumar Sinha[a], Surendra Sasikumar Jampa[a*]

[a] *Department of Chemical Engineering, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar 382426, India*

Abstract: It is essential to create mixed matrix membranes to enhance separation performance by combining metal-organic frameworks (ZIF-7) with a PSF membrane. The membranes were characterised by SEM, TGA, WCA, XRD, and ATR-FTIR analyses. The Box Behnken design was utilised to optimise the flux recovery ratio and rejection. Using BBD, the effect of concentration of feed (Humic acid), pH of feed and ZIF-7 loading weight percentage on flux recovery ratio and rejection were studied. The optimal conditions were obtained as; 264.17 ppm concentration of humic acid, 3.2 wt% ZIF-7, and 7.5 pH of humic acid membrane. The optimised flux recovery ratio and rejection were obtained at 0.93(93%) and 95.14%, respectively. The filtration of the BSA protein solution also examined the antifouling of the membranes.

Keywords: PSF, Mixed matrix membranes, Humic Acid, ZIF-7, Box Behnken method.

Artificial intelligence in water treatment for process water optimization and automation in the oil and gas industry: Recent advances and prospects

Dr. Siraj Bhatkar*, Dr. Vinayak Wadgaonkar, Balraj Tavanandi, Aniket Wakle

Department of Petroleum Engineering, MIT-World Peace University, Pune 411038, India

Abstract: Artificial intelligence (AI) has emerged as a potent tool for solving real-world issues, and its applications in a variety of sectors have garnered considerable interest. AI approaches have been used in oil and gas industry-produced water treatment in recent years to optimize the process and provide practical answers to water pollution and further applications. AI applications are also predicted to improve water treatment process operational costs by lowering costs and optimizing chemical usage. This paper outlines several artificial intelligence techniques and their applications in oil and gas industry water treatment. AI systems apply to nearly all interdisciplinary domains, and they have demonstrated their potential in a variety of applications such as optimization, classification, regression, and forecasting. To improve the precision of optimal solution prediction, AI technologies are sometimes employed in conjunction with experimental design techniques such as response surface methodology (RSM). This assessment also identified various problems and research gaps in the field of AI applications in water treatment. Despite the numerous benefits provided by AI, several drawbacks have prevented these techniques from being widely applied in oil industry water treatment systems. Some of the primary issues that must be addressed are data availability and selection, poor reproducibility, and a lack of proof of applications in oil industry water treatment. Recommendations are offered to ensure that AI uses in future process water-related technology are successful. This assessment will be useful to environmental researchers, engineers, students, and other oil industry stakeholders.

Keywords: produced water, process water, artificial intelligence, response surface methodology

---

Performance Modelling and Exergy-Economic Analysis of Thermal Driven Multiple Effect Distillation System for Brackish Water Treatment

Pravesh Chandra[a], Anurag Mudgal[b], Jatin Patel[c], Vivek K. Patel[c]

[a]*Assistant Professor MIT Moradabad 244001, India*

[b]*Professor PDPU Gandhinagar 382010, India*

[c]*Associate Professor PDPU Gandhinagar 382010, India*

Abstract: Multi-effect distillation shines as a thermal desalination technique due to its economic viability and broad range of application. It effectively tackles desalination for seawater and brackish water, regardless of capacity, using a low-temperature (below 70°C) evaporation and distillation process. This study employs exergy analysis to identify the area of exergy destruction within system component followed by exergy-economic analysis to evaluate the performance of a 6-effect Multiple Effect Distillation (MED) system. Exergy, representing the maximum obtainable work from a substance, is examined for both feed water and distillate in the context of their chemical potential differences. The calculated exergy values for different system states are presented, revealing the exergy destruction attributed to irreversibility such as friction and heat transfer. The system's overall exergy efficiency is determined to be 74.47%, indicating that only this portion of feed water exergy is converted into useful distillate exergy. The remaining exergy is lost due to irreversibility. An exergy balance for the 6-effect MED system is provided, showing that 25.53% of the energy input is lost as exergy destruction. Three different economic model are used to estimate the distillate cost for different feedwater temperature and distillate cost found to be 3.63, 1.9, 2.45 $/m^3$ respectively.

Keywords: Multiple effect distillation; Exergo-economic; Exergy; Irreversibility; freshwater cost

An Efficient Removal of Indigo Carmine Dye (IC) From Aqueous Medium Using Environmental Friendly Synthesized $NiFe_2O_4$

Ganesh Dabhade[a], Ankita Nankar[b], Ashok Borhade[b], Sanjay Wacchore[b]

[a] *Department of Applied Science, K. K. Wagh I. E. E. and R Nasik (MS)-422003, INDIA (Affiliated to S. P. Pune University)*

[b] *Department of Chemistry, HPT Arts and RYK Science College Nashik (MS)-422013, INDIA (Affiliated to S. P. Pune University)*

Abstract: Materials have become increasingly vital in many different businesses in recent years, in addition to their obvious use in human existence. For several chemical, food, dye, and pharmaceutical industries as well as environmental treatments, metal oxide and mixed metal oxide (MMO) have been recognized for a few decades now as effective and eco-friendly substitutes. In the current work, nanocrystalline nickel ferrite ($NiFe_2O_4$) has been successfully synthesized by an eco-friendly, cost-effective sol-gel method and used for photocatalytic degradation of indigo carmine (IC) pollutant present in wastewater of different industries, given the significant use of MMO in various fields. Its characterization was done using a variety of suitable techniques, including FT-IR, UV-DRS, XRD, SEM, and TEM.

Keywords*: Photo catalyst; IC pollutant degradation; LCMS; UV- visible.*

Application of waste Peanut Shells to form Activated Carbon and its utilization for the removal of Acid Yellow 36 Dye

Nishtha Valodra[a], Kosha A. Shah[b*]

[a] *M.E. dissertation student, Civil Engineering Department, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara-390001, India*

[b] *Assistant Professor, Civil Engineering Department, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara-390001, India*

Abstract: A low cost activated carbon was prepared from the agricultural waste, i.e peanut shells (PnsAC), using chemical activation by H_3PO_4 for the removal of Acid yellow 36 dye (AY-36) from wastewater. Batch experiments were conducted to study the effects of pH, adsorbent dose and initial dye concentration. The variation of pH was observed for pH 2,3,5,7 and 9. The adsorbent dose was varied from 2 g/l to 5 g/l. Dye concentration was varied from 100 mg/l to 250 mg/l.The experimental results reveal that initial dye concentration of 100 mg/l , adsorbent dose of about 2 gm/litre and initial pH 2 and magnetic stirrer at 160 rpm, colour percentage removal efficency reaches upto 98.72%. The adsorption of dye increases steadily upto 90 min and thereafter becomes constant upto 180 min of contact time. As pH increases, the removal decreases upto pH 9. Overall results indicated that adsorption of AY-36 on PnsAC was cost effective and efficient.

Keywords*: Acid yellow 36; Peanut Shells activated carbon; Chemical Activation; Decolorization.*

Adsorption of Commercial Dyes using Synthetic Adsorbent for Textile Industry Waste Water Treatment

Sushant Korde, Gauri Shinde, Yash Valwe, Om Kudal, Bhushan Chaudhari

Department of Chemical Engineering Vishwakarma Institute of Technology Pune, India

Abstract: The notable increase in the production of hazardous dye-contaminated wastewater by a wide array of industrial sectors remains a pressing concern for public health and a central focus of environmental conservation efforts. This situation presents a significant challenge to the effectiveness of current conventional water treatment methods. In response to this challenge, numerous scientific and technological approaches have been thoroughly explored to address the treatment of such wastewater. Among the diverse treatment methods investigated, adsorption has emerged as one of the most efficient and effective approaches. Its effectiveness stems from its remarkable ability to eliminate contaminants present in wastewater. Adsorption also offers a set of advantages, including straightforward operational processes, cost-efficiency, and the potential for recycling the adsorbent materials used in the process. Considering this, our project centers on the removal of coralene blue dye from water. We achieve this objective by employing Norrit activated charcoal and powdered activated charcoal as an adsorbent material. To quantitatively assess the effectiveness of these adsorption processess, we utilized a UV spectrophotometer to measure the initial concentration of the dye in the water and, subsequently, the concentration remaining after the adsorption process. The collected data was then processed and analyzed. End results shows that powdered activated charcoal is compatible for removing sufficient amount of coralene blue dye from the water.

Keywords – Adsorption process, Activated Charcoal, Coralene N. Blue dye

Investigation on Elimination of Cr (VI) From Waste Water by Powdered Shell of Lima Bean as Adsorbent

Vinayak S. Wadgaonkar [a], Siraj Bhatkar [a], Dinesh Bhutada [b,] Himangi Neve[b], Rupali Sonolikar[b]

[a]*School of Petroleum Engineering, M.I.T.W.P.U., Pune-411038, India*

[b]*School of Chemical Engineering, M.I.T.W.P.U., Pune-411038, India*

Abstract: Due to increase in population coupled with mining, extraction and use of various metals as different industrial household materials, the load of toxic metal pollution in the environment is increasing. Toxic metals can be hazardous even at low concentration. When they get into water supplies and aqueous environments the health of plants and animals as well as humans can be impaired. The demand of chromium has been increasing globally because of its extensive use in various metallurgical, chemical, and leather tanning industries due to its various physic-chemical properties. The adsorption of toxic metals is strongly dependent on pH, temperature, contact time, and initial adsorbate concentration. The studies on adsorption were conducted by varying various parameters such as contact time, amount of adsorbent, concentration, and agitation speed. The increase of adsorbent dose provides more surface area for adsorption hence increased the adsorption capacity of the adsorbent. Agitation speed has little effect on adsorption. Experimental data for the adsorbent was fitted to different isotherm models such as Freundlich and Langmuir isotherm. Langmuir adsorption isotherm was employed in order to evaluate the optimum adsorption capacity of the adsorbent. It was concluded that adsorbent prepared from Lima Bean Shell can be used for removal of Cr (VI) from wastewater.

Keywords: Adsorption; Lima Bean; Heavy Metals; Waste Water Treatment

---

Methylene Blue Dye Removal from An Aqueous Solution by Charcoal Derived from Acid Treated Marigold Flower

Charuta Waghmare[1, *], Khalid Ansari[1], Pooja Sawang[2], Manik Kamble

[1] *Assistant Professor, Department of Civil Engineering, Yeshwantrao Chavan College of Engineering, Nagpur, Maharashtra, India*

[2] *PG Scholar, Department of Civil Engineering, Yeshwantrao Chavan College of Engineering, Nagpur, Maharashtra, India*

Abstract: The current investigation focusses on the effectiveness of activated carbon / charcoal derived from acid-treated Marigold flowers for removing methylene blue (MB) dye from an aqueous solution through a series of batch experimentation. A removal rate of more than 90% was achieved at a pH of 4.0 by employing an adsorbent dosage of 0.25 g/100 mL and an adsorbate concentration of 20 mg/L. A better fit was obtained with the Langmuir isotherm, which had a maximum adsorption capacity of 14.02 mg/gm. Additionally, the data fit a pseudo-second-order kinetic model quite well ($R^2 = 0.99$), indicating that the bio adsorption is a chemisorption process.

Keywords: Marigold Flower, Methylene blue dye, activated carbon, adsorbent, isotherm, kinetic

---

Treatment of textile effluent by biosorption: kinetics and thermodynamic study

Arth Padaria, Balasubramanian Ragunathan*

Department of Petroleum Engineering, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar – 382 426, India.

Abstract: The ecosystem is increasingly at risk from effluent that is contaminated with dye and other pollutants due to the expanding textile sector. The bathochromic shift results in deeper tones of colour when metal ions are incorporated in a dye molecule. The textile industry uses an abundance of water for its operations, and all these chemicals are unable to be utterly blended into fibres during the procedure of dying, so a huge amount of wastewater containing heavy metal ions like Cr (VI), Pb (II), Cd (II), and Zn (II) and metal-containing dyes will inevitably be ejected. Textile effluent decreases oxygen concentrations owing to hydrosulphides and obstructs light flow through water bodies, both of which are detrimental to the aquatic ecology. However, physical and chemical treatment are costly, inefficient in eliminating dyes, and unsuitable for a broad variety of coloured water. This study uses biosorption via chemically activated carbon is used for treating textile effluent. In accordance to the kinetic Analysis of the experimental data collected, matched well with the hypothesis of pseudo-second-order. It was discovered that the thermodynamic behaviour of metal ion via biosorption onto activated carbon was endothermic and spontaneous. The results obtained demonstrate the effectiveness of activated carbon in removing heavy metal as dyes from aqueous solution of effluent pertaining to Textile Industry.

Keywords: Textile effluent; Biosorption; Activated carbon; Environment; Heavy metals.

Comparative Study of Fixed-Bed Column Studies on Cr (VI) Removal from Wastewater by Peas Husk and Lima Bean

Vinayak S. Wadgaonkar [a], Siraj Bhatkar [a], Dinesh Bhutada [b,] Pratiksha Khurpade[b], Rupali Sonolikar[b]

[a]*School of Petroleum Engineering, M.I.T.W.P.U., Pune-411038, India*

[b]*School of Chemical Engineering, M.I.T.W.P.U., Pune-411038, India*

Abstract: Cr (VI) was eliminated from waste water in a packed bed column by Peas Husk and Lima Bean. Investigational data for early Cr (VI) concentration (6-10 mg/l), feed flow rate (3-7 ml/min) and bed height (20-40 mm) was obtained to study breakthrough forms of the adsorption method. Adsorption effectiveness is enhanced by raising initial concentration, bed depth and decreased with increasing flow rate. Adam-Bohart, Bed Depth Service Time and Yoon-Nelson models were applied for adsorption data. Bed Depth Service Time and Yoon-Nelson models were used for results obtained.

Keywords: Adsorption; Breakthrough Cr (VI); Fixed-bed column; Peas Husk; Lima Bean

---

Removal of Methyl Orange dye by using Rice Husk & TEA Waste

Ravi Kumar Goud[a], M.Rajender Reddy[a], K.Sunil Kumar[a], G.Bhaveen[a], Ch.Bharat Reddy[a] and Kurella Swamy[b*]

[a]*Department of Chemical Engineerin, Rajiv Gandhi University of Knowledges (RGUKT) Basar, Telangana, India*

[b]*Department of Chemical Engineering, National Institute of Technology, Srinagar, Jammu and kashmir, 190006, India*

Abstract: The study for adsorbents with low cost and eco-friendly nature for purpose wastewater treatment with the dye removal has been done to look into the substitutions of activated carbon. In this work, the adsorbents prepared from Rice Husk and Tea Waste, which are domestic wastes, were used to remove the Methyl Orange (MO) from an aqueous solution. Adsorption of a basic dye, Methyl Orange, from aqueous solutions onto Rice Husk & Tea Waste has been studied by conducting the different experiments using the batch adsorption technique and the effects of the process variables, such as initial pH, initial dye concentration, dosage of adsorbent, contact time and agitation speed on the adsorption process were observed. Effective dye removal results were found by the solid-liquid phase adsorption. The increase in pH of the solution increased the dye removal. It is observed that percentage removal increases with increase in adsorbent amount (grams) for all other parameters kept constant. Percentage removal increases with increase in agitation speed for all other parameters kept constant. Percentage removal decreased with increase in adsorbate concentration for all other parameters kept constant. Percentage removal increases with increasing contact time of agitation for all other parameters kept constant. It is found that Rice Husk is very effective in removal of dye in a solution than the Tea Waste.

Keywords: Adsorption, Efficiency, Adsorbent Dose, Concentration, Wastewater;

Smart Water Management: The Role of Phyto-Coagulants in Revolutionizing Chemical Industry Wastewater Treatment

Jaydeep Jivani[a*], Jaimin Patel[a], Vanshita Parekh[a] and Meka Srinivasarao[a]

[a]*Department of Chemical Engineering, FOT, DD University, Nadiad, Gujarat (387001), India*

Abstract: A reliable water supply is indispensable for numerous chemical processes, as water plays a pivotal role in virtually every facet of plant operations. However, these operations often generate a substantial amount of wastewater, necessitating effective measures to mitigate environmental pollution. Presently, chemical industries predominantly employ chemical-based coagulants for wastewater treatment, resulting in the production of toxic, non-biodegradable substances and significant sludge. This study seeks to showcase the efficacy and efficiency of phyto-coagulants as a sustainable and eco-friendly alternative to address the challenges posed by synthetic counterparts. Wastewater samples extracted from a polymer plant serve as the basis for this case study, comparing the coagulation methods employed. The investigation introduces different phyto- coagulants, such as Neem leaf, chickpea, and orange peel, and compares their performance against the conventional use of ferric alum. Results indicate that Neem leaf, chickpea, and orange peel, on average, achieved a considerable reduction of total dissolved solids (TDS), total suspended solids (TSS) and a significant decrease in electrical conductivity and turbidity. This study concludes that phyto-coagulants present a cost-effective and promising alternative for wastewater treatment, offering a more sustainable and environmentally friendly approach to address water treatment challenges in the chemical industry.

Key words: Wastewater treatment, Chemical industry, Environmental responsibility, Phyto- coagulants and Sustainable alternative.

Management of Geothermal Water in Abandoned Oil and Gas fields

Tejaswini Gautam [1], Anirbid Sircar [1]* and Kriti Yadav [2]

[1] DPE, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat-382421
[2] Department of Geology, Patna University, Patna, Bihar-800005

Abstract: The use of geothermal water as a dependable and steady energy source is discussed in this paper. It differs from other renewable energy sources as it is independent of meteorological impact. The advantage of the same is that it utilizes Earth's geothermal potential without requiring new wellbores. This method is both economical and environmentally friendly. To separate the water-bearing zones from other subsurface fluids, the well must be re-completed and reopened, with new casing added if necessary. By keeping fluids from earlier extraction activities from percolating and mixing, this not only guarantees the stability of the wellbore but also lessens the impact on the environment. The primary benefit is the well-known lithology of the well that has been abandoned, which increases the economic viability and reduces the possibility of negative environmental effects. This approach enhances the sustainability of geothermal energy extraction while optimizing resource consumption by repurposing existing infrastructure. The paper also examines such repurposing and refinishing the decommissioned wells in Gandhar, Gujarat, India and offers a sensible and eco-friendly method of using geothermal water without sacrificing economy or environmental health. The management of bypassed water zones in Gandhar abandoned oil and gas wells will be the target for future to enhance the recoverable geothermal potential of India. The present researchers are presenting a holistic approach to deal the water zones with subsurface reservoir temperature between 120 and 150 degrees Celsius. This step-by-step methodology may be applied to other places of Indian subsurface were abandoned or depleted oil and gas well exists.

Keywords: *Well bore stability, abandoned well, geothermal potent, geothermal water, Gandhar*

An Explainable-AI Enabled Groundwater Classification System for Irrigation Using Machine Learning

Aakash Bhandary[a], Sachin Lakum[a], Kenil Ghetia[a], Samir Patel[a]

[a]*Department of Computer Science and Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

Abstract: The effective utilization of groundwater as a resource for irrigation is crucial for conservation and sustainability. However, traditional statistical and rule-based classification techniques used for the classification of groundwater samples based on suitability for irrigation often lack accuracy, suggesting the need for advanced approaches. Machine Learning (ML) has proved to be an effective and powerful tool for this purpose, but its lack of interpretability and inherent black-box nature raises questions on its reliability. To address this, Explainable Artificial Intelligence (XAI) frameworks have been developed to help interpret model predictions and enhance the transparency of ML models. In accordance, this paper proposes an accurate and interpretable groundwater classification workflow by comparing ML models after training on groundwater data from the state of Telangana, India based on metrics namely Accuracy, Precision, Sensitivity, F1-Score, True Negative Rate (TNR), and Cross-Validation Score (CVS). Light Gradient Boosting Machine Classifier (LGBC) was identified as the best model based on the evaluation metrics. Further, the classifications made by the LGBC are interpreted using the Shapley Additive Explanations (SHAP) XAI framework. The analyses of the explanations generated by SHAP help in identifying the role of features such as Electrical Conductivity (EC) and Total Dissolved Solids (TDS) on the model's predictions. This paper further cements the role of XAI in aiding the development of reliable classification systems.

Keywords: Machine Learning; Irrigation Suitability; Telangana Groundwater; XAI

Cyber Security Attack detection and Municipal Waste Management for Smart City based on IoT

Yogita P. Shewale[a], Harshalkumar R. Khairnar[b] and Ganesh B. Dabhade[c]

[a] *Department of Information Technology, K. K. Wagh I. E. E. and R Nashik (MS)-422003, INDIA (Affiliated to S. P. Pune University)*
[b] *Department of Information Technology, MET, BKC, Nashik (MS)-422003, INDIA (Affiliated to S. P. Pune University)*
[c] *Department of Applied Science, K. K. Wagh I. E. E. and R Nashik (MS)-422003, INDIA (Affiliated to S. P. Pune University)*

Abstract: Smart cities improve public services administration by utilizing cutting-edge technology including artificial intelligence (AI), cloud computing, big data, and the Internet of Things (IoT). The application of IoT enables the detection and reporting of particular parameters pertaining to several municipal domains, including waste water management, energy, transportation, agriculture, and health. Because of its advantages, LoRa technologies, for example, are utilized to construct Internet of Things solutions for a number of smart city domains. However, occasionally, people—citizens, IT administrators, or city managers—might believe that these qualities pose cybersecurity threats. Many industries, including healthcare, smart grid systems, smart cities, smart homes, and transportation, use the Internet of Things. In order to adopt suitable management mechanisms and successfully reduce security threats and dangers posed by IoT-based smart technology deployment, it is becoming more and more important to conduct security assessments of IoT-based smart environments, such as smart homes and smart cities.

Keywords: IoT, Cyber Security, Detection Techniques, Municipal Waste Management, SDN, Machine Learning.

Improving the quality of process water for ASP flooding applications

Dr. Siraj Bhatkar*, Dr. Vinayak Wadgaonkar, Balraj Tavanandi, Aniket Wakle

Department of Petroleum Engineering, MIT-World Peace University, Pune 411038, India

Abstract: Oil and gas wells Produce water presents disposal and reusability challenges. Produced water contains rare earth metals, oil, and grease, decomposing organic waste, and drilling fluids, which dissolve into the water when it enters the separator. Produced water should be processed, with techniques such as dehydration aiding in the removal of oil, gas, and grease. Following that, the remaining oil and other effluent are removed using hydro cyclones, API separators, skim tanks centrifuges, and gas flotation processes. In certain production facilities, produced water is subjected to a tertiary treatment to eliminate the tiniest particles before being suited for reinjection. Following a further chemical and filtration operation, the newly filtered water is usable and can be used for the day-to-day application and irrigation purposes. The majority of the oil production platforms use desalination techniques, which produce brine that is discharged overboard and is harmful to marine life. Instead, produced water can be filtered further and utilized for various applications. It is more cost-effective and environmentally friendly than desalination and has a lower environmental impact. It can also be piped to shore for further use. In this study, the produced water was efficiently treated with appropriate methods and filters, such as coagulation and flocculation with dose optimization, and various filtering techniques such as selective filtration, series filtration, and Cerini filtration. In order to make treated effluent water appropriate for injection in the formation for pressure maintenance purposes and other applications, a fluid compatibility test was done to detect scale and corrosion, as well as the permeability retention of the XZ formation. The treatment strategy was correctly applied, resulting in desirable parameters within an acceptable range, making the produced water environmentally friendly and sustainable.

Keywords: process water, physicochemical parameters, crude oil, oil recovery, enhance oil recovery, oil industry

---

River Health Monitoring Through Microbial Pollution: A Case Study of Haora River of Tripura

Bodhipriya Saha[1]*, Santanu Mallik [2], Tushar Das[1], Umesh Mishra

[1] *Department of Civil Engineering, National Institute of Technology Agartala, Barjala, Tripura 799046, India*

[2] *Department of Civil Engineering, Poornima College of Engineering, Sitapura, Jaipur, Rajasthan-302022, India*

Abstract: Water is a very important natural resource and is essential for the survival of living beings on earth. Surface water and groundwater are both important for community water supply needs. One of the leading causes of mortality worldwide is waterborne illness. Determining the quality of the water used for drinking is therefore vitally important. The study investigates the status of river health in terms of microbial pollution in a river of Tripura and also to analyze the relationship between river water pollution with Land use Land cover, shedding light on the influence of urban, agricultural, industrial, and natural land uses. The location selected for study area is Haora River in a stretch of nearly 25km.Standard microbiological techniques were used to undertake sampling from 12 different locations. The permissible limit of E. coli in surface water is 126 CFU/100ml as per WHO. It is found that locations such as Jaypur Camp (700 CFU/100ml) and Dashamighat (500 CFU/100ml) which are thickly populated area of Agartala city, exhibit higher levels of E. coli, indicating potential contamination. Possible sources may include agricultural runoff, domestic sewage discharge or local human and animal activities. Conversely, Jhulanta Bridge (20 CFU/100ml) shows lower level of E. coli, suggesting better water quality. In order to provide a thorough picture of the water quality, physical parameters and chemical parameters were tested concurrently. Geographic Information System (GIS) was utilized to analyze land use patterns, enabling the spatial correlation of contamination sources. The results of the study will help decision makers to understand the overall river water quality and contribute vital insights about potential health risks associated with microbial contamination.

Reduction of Chemical Oxygen Demand of Effluent Generated from Production of Pigment, Suthol Red

Chavda Pratiksinh[a]

College of Renewable Energy and Environemental Engineering, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, 385 506, India

Abstract: The burgeoning growth of the India dyes and pigments market, particularly in the pigments sector, is evident in the 2020 production value reaching 133.52 million tons. This upward trajectory is expected to persist, with a projected compound annual growth rate of 11% between 2021 and 2026. As the industry expands, it brings along environmental challenges, notably in wastewater management. This research article focuses on addressing the environmental impact of pigment production, specifically targeting the treatment of wastewater generated during the production of pigment red 49:1. The effluent from this process exhibits a Chemical Oxygen Demand (COD) level ranging from 2500 to 4000 mg/l, significantly exceeding the discharge limit set by the state pollution control board, which stands at 250 mg/l. The experimental methodology employed in this study utilizes the Factorial Completely Randomized Design (FCRD), incorporating Filtration using sand filter, pH reduction using acids (HCl, H_2SO_4 and HNO_3) in different proportion, and Aeration with variable duration. The FCRD design, repeated three times for robust results, allows for a comprehensive analysis of the combined impact of these treatments on COD reduction in the effluent. The unique combination of treatments aims to mitigate the elevated COD levels in the effluent. Notably, the results showcase a remarkable COD reduction of 94% (around 160 mg/l), highlighting the effectiveness of the applied treatment approach.

Keywords: Chemical Oxygen Demand; Pigment Red; Factorial Completely Randomized Design (FCRD); Wastewater management

Treatment of Domestic and Industrial Wastewater with Flow Electrode Capacitive Deionization - A Review

Shubham Kumar Mishra[a], Soujit Sengupta[b], Sarit K Das[a]

[a]Department of Mechanical Engineering, Indian Institute of Technology Madras, Chennai 600036, India

[b]Ngen Water Solution, Tirupati, India

Abstract: In today's world, polluted water has many contaminating agents, such as heavy metals, radioactive elements, oxyanions, highly toxic halogens, and organic ionic species. Substantial scientific activity is being directed toward developing a water treatment technology that consumes less energy and results in more remarkable treatment performance. Flow Capacitive Deionization (FCDI), a novel electrochemical energy-based waste-water treatment technology, has attracted the attention of researchers over the past four years due to its selective removal capacity, low energy consumption, and sustainability. In this technique, suspended activated carbon (~10 μm) is used as flow electrode. These offer a large specific surface area of ~3200 m^2/g which leads to higher ion capturing capacity. Recent studies have shown that it is a practical, chemical-free technology that enables the targeted elimination of a range of organic pollutants and their byproducts like acetates or oxalates, which are challenging to recover using conventional oxidation technologies after adding chemicals during organic wastewater treatment. This article offers a review of existing literature on FCDI technology which covers a range of research aspects related to wastewater treatments such as resource recovery, and extraction of heavy metals, organic and halogen species.

Keywords: Flow Electrode; Electrochemical energy-based technology; waste water; chemical-free; efficient

Advances in Industrial Wastewater Treatment: Addressing Challenges and Improving Efficiency

Preethi Bevinathalapura Shivaswamy[1]; Lingraju Honnuru Gurusiddappa[2]; Charan Kumar Kachintaya[3] and Shankramma Kalikeri[*]

[1*] *Division of Nanoscience and Technology, School of Life Sciences, JSS Academy of Higher Education and Research, Mysuru – 570 015, India*

[2] *Department of Environmental Science, (School of Life Sciences), JSS Academy of Higher Education and Research, Mysuru – 570 015, India*

[3] *#9A, Shankar Colony I Cross, SN Pet, Ballari - 583101, India*

Abstract: Industrial activities, notably textile manufacture, continue to endanger world ecosystems by polluting the environment. The discharge of dye-contaminated wastewater into surface water bodies exacerbates the problem, highlighting the critical need for adequate industrial wastewater management. Despite the use of numerous treatment technologies, sludge management remains a complicated and sometimes ignored element of the process. Strategies such as physiochemical, biological, membrane processes, adsorption, and electrochemical procedures have all been used with variable success rates. Among these, advanced oxidation processes (AOPs) stand out as a viable method for treating polluted wastewaters including persistent organic contaminants. AOP treatment produces enough hydroxyl radicals (OH·) to remove refractory organic compounds, detectable organic contaminants, and some inorganic pollutants, improving wastewater biodegradability. Nonetheless, typical sludge stabilization processes frequently fail to adequately remove heavy metal ions from waste activated sludge, limiting its safe use as fertilizer in agricultural contexts. This limitation highlights the continued need for novel sludge management approaches in the field of industrial wastewater treatment. To summarize, advances in industrial wastewater treatment, notably the use of AOPs, present exciting opportunities for resolving environmental contamination concerns. However, continual research and development efforts are required to overcome existing limits, particularly in sludge management, and assure the long-term viability and efficacy of industrial wastewater treatment procedures.

Keywords: *Industrial contaminated water, Advanced Oxidation Processes (AOPs), Remediation, Environmental sustainability*

Green Initiative: Use of Cow-dung Slurry for treatment of Industrial Effluent

Shivani Thakkar, Megha D Bhatt*, A. B. Joshi, P. B. Vaishnav

Research and Development Department, Gujarat State Fertilizers and Chemicals Ltd, Vadodara

Abstract: Indiscriminate release of highly organic industrial effluents in the environment has raised concerns about health and safety of human beings. This research dives into highlighting potential usage of cow dung as a co-substrate to reduce the organic carbon load of such effluents through semi continuous anaerobic process. Anaerobic digestion has gained a center stage for treating these effluents as it breaks down complex organic structures into simpler and cleaner ones liberating biogas which can be utilized as a green fuel. One such effluent stream is released from Caprolactam producing plant in G.S.F.C. ltd, Vadodara. This stream happens to be one of its kinds as it has a pH of about 2, COD up to 1 lac mg/L which varies often. In this study, a series of laboratory-scale experiments were laid to treat highly organic industrial effluent in different ratios using cow dung as co-substrate in an anaerobic setup. The basic parameters to analyze the performance of system were, chemical oxygen demand (COD) removal efficiency, biogas production and methane constitution within it and effluent quality. The outcome of these experiments demonstrated that the addition of cow dung significantly enhanced the reduction of COD up to 43%, methane production and improved biodegradability of the industrial effluent. Furthermore, pilot scale trials were laid to verify the results of similar treatments on large scale and they confirmed the lab scale results positively. This study aids to add value to the pre-existing knowledge on unexplored anaerobic digestion of notorious effluent streams like P832 using cow dung as a co-substrate.

Keywords: Industrial effluents; Caprolactam; COD, Cow dung; anaerobic digestion

Extraction of Organics and Ammonium Sulphate from Caprolactam Plant Waste Water

Mayur Valodkar, Anantakumar Mishra*, Rachana Patel, Swati Jain & Pujan Vaishnav

Research & Development Department, Gujarat State Fertilizers & Chemicals Limited,

Abstract: This research paper explores an innovative approach to address the challenges posed by wastewater generated by Caprolactam plant. The waste water consists of 90-94% water, 2-4% Ammonium Sulphate and 2-4% complex organic impurities. Traditional treatment methods struggle with these complex organic impurities, prompting the investigation of two novel techniques. 1) The first process involves water removal through distillation followed by extraction of remaining organic impurities using various solvents like Methanol, Methylene dichloride, Toluene, Cyclohexane, Ethanol, Hexane, Tetrahydrofuran, Dimethyl formamide etc. Methanol emerges as the most effective solvent for complete removal of organic impurities and separation of Ammonium Sulphate. Additionally, distillation is employed to isolate Methanol, leaving behind organic impurities for subsequent incineration. 2). Second process involves preparation of a saturated solution of waste water using Ammonium Sulphate, facilitating the easy separation of organic impurities through layer separation. Subsequent steps included evaporation, filtration, and drying to yield fertilizer-grade Ammonium Sulphate. The recovered Ammonium Sulphate in both the processes can be used as fertilizer, whereas the recovered organics can be incinerated to generate energy showcasing a comprehensive and sustainable wastewater treatment strategy.

Keywords: Waste Water; Caprolactam Plant; Organic Solvent; Ammonium Sulphate

---

Efficacy Assessment of Biochar for the Removal of Emerging Contaminants from Industrial Wastewater

Tej Patel[a] and Shabiimam M A[b*]

[a] *Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

[b*] *Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

Abstract: This study investigates the efficacy of biochar in addressing the challenges posed by emerging contaminants in industrial wastewater. The research focuses on understanding the properties and characteristics of biochar derived from natural raw feedstock, emphasizing its potential as a sustainable solution for wastewater treatment. Biochar, produced through the pyrolysis of organic materials, exhibits unique structural features such as high surface area, porous texture, and functional groups, which contribute to its adsorption capabilities. Through a comprehensive assessment, this research explores the process of making biochar from natural raw feedstock such as Wood char, Cow Dung, Bamboo Saw Dust, Rice husk and evaluates its effectiveness in removing emerging contaminants from industrial wastewater. Additionally, the investigation focuses on the role of biochar's inherent properties in enhancing its adsorption efficiency for specific pollutants found in industrial effluents. The results highlight the promise of natural source biochar as an affordable and sustainable approach to reducing the effects of industrial effluent. This research contributes to the optimization of biochar-based treatment methods, offering insights into the development of sustainable practices for water remediation in industrial settings.

Keywords: Biochar; Industrial wastewater treatment; Emerging contaminants; Natural raw feedstock

A Review of Advanced Oxidation Procedures (AOPs) for Industrial Waste Water Treatment

Dhruv Modi[a] and Shabiimam M A[b*]

[a]*Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

[b*]*Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

Abstract: One of the world's most challenging issues in terms of industries is the management of industrial effluent. For the treatment of industrial waste water, numerous technologies and procedures are used to achieve the highest removal efficiency using different chemicals and materials. Sludge management from different treatment systems, however, is comparatively poor. Different approaches, including physio-chemical, membrane removal, adsorption, biological, and electrochemical processes, were applied to treat various effluents. The inadequacies of current sludge stabilization methods prevent them from reliably removing the heavy metal ions from waste activated sludge, preventing it from being used as fertilizer on farms and in agricultural regions. In Current scenario, Advanced Oxidation Processes (AOPs) is the best method for treating polluted wastewaters that contain insoluble organic pollutants. In the case of non-biodegradable substances, advanced oxidation processes (AOPs) have been used as an alternate and efficient approach for treating industrial wastewater. Due to its benefits, including its high oxidation efficacy and lack of secondary contaminants, advanced oxidation is an effective method for treating wastewater. AOPs are oxidation processes that result in the production of reclaimed effluents in sufficient quantities of reactive oxygen species, such as hydroxyl radicals (HO). The redox potential of HO radicals is large and they are non-selective, capable of harming organic molecules. There are numerous ways to carry out advanced oxidation processes, including ozonation, Fenton, electrochemical oxidation, photolysis, etc. These techniques have been frequently used to degrade new contaminants that cannot be eliminated by traditional procedures. Furthermore, numerous forms of advanced oxidation processes and their mechanisms are thoroughly explained in the current study. The difficulties encountered while using oxidation, electrochemistry, Fenton and photocatalysis to remediate wastewater are thoroughly described. With a few tweaks, the advanced oxidation process can be seen as a promising method for treating wastewater and resolving problems.

Keywords: Advance Oxidation Process (AOPs), Hydrogen Radicals, Stabilization of Sludge.

Rural Water Quality Assessment in Close Vicinity of Slaughterhouses at Mathura bypass Road Aligarh U.P.

Sohail Ayub*[a], Shadab Ansari[b], Yaser Saleem[b], Siddiqui Hadeel majid Hussein[c]

[*a] *Professor, Department of Civil Engineering, Aligarh Muslim University, Aligarh, U.P. 202001, India*

[b] *Research scholar, Department of Civil Engineering, Aligarh Muslim University, Aligarh, U.P.202001, India*

[c] *Lecturer, Department of Civil Engineering, Ashur University, Baghdad Iraq*

Abstract: This article examines the condition of water in rural regions surrounding slaughterhouse industries on the Mathura bypass road in Aligarh, Uttar Pradesh, India. A total of seven villages were chosen for sample collection, with two samples from each village - one from a hand pump and the other from a submersible pump. A total of 14 samples per month were collected for analysis for their physical, chemical, and biological attributes. The study was conducted for 3 months. Based on these findings, it can be inferred that the groundwater quality in Naugawan Arjun and Amarpur Kondla has been severely impacted by effluent from slaughterhouse industries. Water samples from hand pumps showed higher concentrations of all parameters compared to those from submersible pumps, indicating better water quality from submersible pumps. However, given the current trend, it is predicted that the water quality may deteriorate in the future due to increasing industrial and commercial activities in Aligarh.

Keywords: Hand pump; submersible pump; groundwater; slaughterhouse

Surface Water Quality Assessment near Municipal Solid Waste Landfill

Jagriti Patel[1*], Sanskriti Mujumdar[2], Vijay Kumar Srivastava[3]

[1*]*Department of Environmental Studies, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara – 390002, Gujarat, India*

[2]*Civil Engineering Department, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara – 390002, Gujarat, India*

[3]*The Maharaja Sayajirao University of Baroda, Vadodara – 390002, Gujarat, India*

Abstract: To determine the condition of water bodies surrounding the Jambuva landfill, a comprehensive study was conducted. This landfill, which serves as a dumping ground for approximately 750 metric tons of waste each day, has the potential to negatively impact the surrounding environment. The study examined a total of six surface water bodies, including ponds and rivers, both in close proximity to and farther away from the landfill. To assess the quality of the water, a range of tests were performed, including analysis of biological oxygen demand, chemical oxygen demand, chloride levels, turbidity, alkalinity, total hardness, total dissolved solids, sulfate levels, and ammonia levels. Samples were also tested for heavy metal concentrations using Atomic Absorption Spectroscopy. The results of the analysis showed that Chromium was the most prevalent element found in the surface water samples. However, other elements, such as Mn, Ni, Cd, Pb, Cu and Fe, were within the permissible range as set out by BIS standards. The study concluded that the water bodies surrounding the landfill are at risk of significant pollution due to leachate infiltration from groundwater. As such, continued monitoring is crucial to mitigate potential environmental risks.

Keywords: Contamination, Heavy metals, Leachate, Physicochemical, Surface water

Enhancing Water Quality Assessment through Machine Learning Techniques

Satvi Makati[a], Hinamshu Gajera[a]*

[a]*Pandit Deendayal Energy University, Gandhinagar, Gujarat, India*

Abstract: As a vital resource, water plays a critical role in sustaining life, with quality being paramount for essential practices like drinking, agriculture, and industry. Excessive levels of contaminants in drinking water can lead to various adverse health effects, including gastrointestinal illnesses, impacts on the nervous system, reproductive functions and the development of chronic diseases like cancer. Addressing this global health crisis is imperative, as untreated sewage contributes to environmental pollution and diseases. Enhancing access to safe drinking water can yield tangible health benefits. To address this critical issue, we propose a computer-aided water quality assessment system utilizing ensemble learning in machine learning. Ensemble methods provide a comprehensive understanding of water contamination through the integration of diverse models. This approach emphasizes the significance of different features in predicting water quality and guiding decision-makers in prioritizing monitoring efforts. By fostering community engagement, proposed strategy empowers local communities and decision-makers to tackle water quality challenges collaboratively, ultimately safeguarding public health.

Keywords: Drinking Water, Quality Assessment, Contaminant Detection, Ensemble Learning, Machine Learning, Public Health

Analyzing Water Wastage in Reverse Osmosis (RO) Systems: Unraveling Causes and Proposing Solutions

Dr. Navtika Singh Nautiyal[a], Dr. Ripal Gupta[b]

[a] *School of Law and Forensic Justice and Policy Studies, National Forensic Sciences University, Gandhingar, Gujarat*

[b] *School of Law and Forensic Justice and Policy Studies, National Forensic Sciences University, Gandhingar, Gujarat*

Abstract: One of the most important and essential human rights guaranteed by Article 21 of the Indian Constitution Act of 1950 is the right to drink water. Having enough water to meet basic needs is a major concern for many countries. Thus, it is imperative and vital that action be taken at this time to manage water waste. Water is a vital necessity for all industries, yet it is used in households in many different ways on a regular basis, wasting water that cannot even be recycled. Finding a way to manage waste water from each home might be a simple way to handle waste water. Nowadays, many major societies use RO purification in their daily lives to obtain clean drinking water. However, rather than cleansing the water, RO purifiers waste and leak water. If we could figure out a method to manage the same water or utilise RO waste water, this may be the main industry. In addition to providing other uses for the water, it raised awareness of the need for water management. The study will employ empirical research to determine how individuals use RO waste water in various ways. The objectives of this research are to assess the extent of water wastage occurring during the operation of Reverse Osmosis (RO) systems for domestic usage, and understand the environmental impact associated with water wastage in RO systems, including its contribution to water scarcity and energy consumption, to develop recommendations and guidelines for optimizing RO system design, operation, and maintenance to reduce water wastage while ensuring water quality and safety further to propose educational and awareness campaigns aimed at promoting responsible water usage practices among RO system users and stakeholders. The methodology for this research is to conduct a comprehensive review of existing literature on water wastage in RO systems, including academic papers, industry reports, and technical documents. Where the researcher would also collect the data through questionnaire from different RO users for the findings related to causes of water wastage and re-use of the same water and also to find the solutions along with the gaps in current knowledge. Further to synthesize research findings to develop the recommendations for minimizing water wastage in RO systems.

Keywords: Wastage Water, Environment, RO System, Drinking Water;

Quality assessment of proposed process water for sustainable development

Dr. Siraj Bhatkar*, Dr. Vinayak Wadgaonkar, Balraj Tavanandi, Aniket Wakle

Department of Petroleum Engineering, MIT-World Peace University, Pune 411038, India

Abstract: Identification and handling of process water quality is essential for conserving bore well water and oil industry-produced water, which are needed for sustainable growth. The quality of produced water and bore well water needs to be studied before finalization for further application after treatment. After the assessment of the type of impurity and its quality present in the bore well and produced water, proper treatment is proposed. This will make water fit for reuse, which will help in sustainable growth in that particular area. Sometimes the cost of the treatment is very high making it non feasible for the oil operator company to reuse the water. Identifying suitable treatments and chemical dosing requirements makes the water fit for further application purposes. In this research work quality of process water is assessed in the laboratory to identify the water for further suitable applications and reuse for sustainable growth. Once the quality assessment is done, further water treatment can be suggested knowing the desired range required for application purpose.

Keywords: Process water, bore well water, oil industry, sustainable, Operator Company, produced water.

Determination of Trace Metal Pollutants in Wastewater from Industrial Zones of Ahmedabad using Laser Induced Breakdown Spectroscopy

Darshitsinh Parmar[a], Rohit Srivastava[a], Rajesh K. Kushawaha[b], Prashant Kumar[b]*, Prahlad K. Baruah[a]*

[a] *Department of Physics, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

[b] *Physical Research Laboratory, Ahmedabad – 380009, Gujarat, India*

Abstract: This study presents a comprehensive analysis of trace metal concentrations in wastewater samples collected from industrial and municipal sources. The identification of trace metals in wastewater is crucial to assess environmental pollution and water quality. The presence of these metals raises major environmental concerns because they can accumulate in ecosystems and pollute water sources, threatening aquatic life and human health. Hence, it is essential to detect and remove these hazardous species in order to prevent water pollution. Traditional techniques for detecting pollutants in water are costly and time-consuming, and some can even end up causing secondary contamination. Alternatively, Laser-induced breakdown spectroscopy (LIBS) is a simple and quick analytical technique for obtaining qualitative and quantitative elemental information from materials without damaging them. Calibration-based LIBS measures the quantitative concentration of components in unknown materials by generating a calibration curve from standard reference samples of known concentrations. Calibration curves were established to correlate LIBS signal intensities with known concentrations of target metals, enhancing the accuracy and reliability of quantitative analysis. Elemental analysis of wastewater samples from diverse sources using LIBS detected trace metals, including copper, chromium, and aluminium, effectively, and detection limits are found to be around less than the ppm level. Furthermore, the real-time capabilities of LIBS make it a viable tool for on-site analysis and environmental monitoring, providing crucial insights into water management plans and pollution reduction initiatives. This study demonstrates the efficiency of calibration-based LIBS as a reliable technology for detecting trace metals in wastewater, with implications for improving water quality and environmental sustainability.

Keywords: wastewater, trace metals, Laser-Induced Breakdown Spectroscopy (LIBS), environmental monitoring

---

State-of-the-art Water Quality Studies Focused on Gujarat, India: A Review

Sugayaalini Ramsubramanian [a], Bhasuru Abhinaya Srinivas [a] and Vivek Jaiswal [a]

[a] *Department of Mechanical Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar 38242, India*

Abstract: Water is an essential human need and a cause for concern, as the source of fresh water is constantly depleting. The detection of contaminants or pollutants and their sanitation are still considerable questions for all nations. Water quality status relies on several factors, such as total dissolved salts (TDS), alkalinity, pH, turbidity, dissolved oxygen, and demographic conditions. A few articles have focused their investigation on the western part of India, especially Gujarat. The present article aims to present a comprehensive review of the state-of-the-art water quality studies conducted in Gujarat. This work will be a stepping stone in understanding which contaminants or pollutants are dominating or present in high concentrations region-wise. In the current status, the concentration of potassium and sodium, alkalinity, and oxygen concentration are four parameters that present a strong case for in-depth study. Also, we will be reviewing treatment techniques to suggest possible outcomes. The research on water treatment technologies could look forward to applying advanced treatment technologies such as electrocoagulation, U.V. disinfection, and membrane filtration to eliminate pollutants from water safely. In addition, exploring the latest developments, like decentralized wastewater treatment systems and filtration based on nanomaterials, provides the possibility of sustainable water management. Collaboration with industry and academic institutions could encourage innovation and provide sustainable, cost-effective solutions. Acknowledging these advances ensures an equitable and prosperous future while improving Gujarat's refusal to embrace problems with water quality.

Keywords: WQI; Gujarat; TDS; contaminants; pH; water

Application of Membrane Bioreactors for Wastewater Treatment

Gautamsinh Gohil[a], Devam Bhadaniya[b], Vanshika Jain[c], Arjun Bansal[d], Dr.Manish Kumar Sinha[e]

[a, b ,c, d ,e] *Pandit Deendayal Energy University, Knowledge Corridor, Gandhinagar – 382007, Gujarat, India*

Abstract: This review discusses the efficiency of Membrane Bioreactor (MBR) technology in treating wastewater. MBRs are more effective than traditional methods due to their compact design, higher biomass concentrations, and reduced sludge generation. They can sustain slow-growing organisms, control solid retention time, and adapt to different environmental conditions. MBR technology offers promising advantages in addressing natural water scarcity and industrial wastewater treatment, offering equitable access to clean water resources in a sustainable manner. MBR technology differs from traditional biological treatment methods due to its gap in design features, making it applicable for industrial use. The paper discusses the extensive application of MBRs for municipal wastewaters and industrial effluents, as well as its potential to address emerging contaminants like endocrine disruptors and other pollutants. Other options in MBR systems include affinity membranes, immersed membranes, membrane contactors, and micellar enhanced ultrafiltration. The review also addresses the major problem of energy efficiency and proposes optimized high flux membrane materials and improved aeration efficiency through hydraulic promotion. The paper concludes with a comprehensive review of relevant case studies, illustrating successful MBR applications in various settings. This review serves as a valuable resource for researchers, practitioners, and policymakers, offering insights into the current state of MBR technology and guiding future developments in wastewater treatment.

Keywords: wastewater; water-scaricity; MBR; Membrane; Bio-reactor; Fouling

Review of Membrane Fouling in the MBR System: Mechanism, Effects, and Control Measures

Vinayak S. Wadgaonkar [a], Siraj Bhatkar [a], Dinesh Bhutada [b,] Himangi Neve[b]

[a]*School of Petroleum Engineering, M.I.T.W.P.U., Pune-411038, India*
[b]*School of Chemical Engineering, M.I.T.W.P.U., Pune-411038, India*

Abstract: The ability of membrane-based treatment methods to retain particles and salts and even disinfect water makes them stand out from other wastewater regeneration treatment methods and produce water that is appropriate for irrigation and other uses. In comparison to the traditional activated sludge process, a membrane bioreactor (MBR) has a lot of benefits, like higher wastewater quality, a compact design, minimum production of leftover sediment (sludge), and simple computerized control. However, fouling of the membrane has become a significant roadblock to the extensive application of membrane bioreactor MBR. By analysing and compiling more than 140 publications this paper intended to give a thorough knowledge of intricate fouling mechanisms and characteristics appearing in MBR systems. This study reviews in detail the description, mechanism, influencing parameters, and prevention of membrane fouling. It is observed that the dynamic variations in membrane foulants over the course of a prolonged process should be understood to optimize the membrane. Even though extracellular polymeric substances (EPS) are linked to many publications for having a significant impact on the fouling process, modifying operating parameters including hydrodynamics and flux as well as improving module design can reduce fouling.

Keywords: Membrane bioreactor (MBR); membrane fouling; soluble microbial products (SMPs); wastewater treatment

Integrated Constructed Wetland and Microbial Fuel Cell for the Treatment of Stabilised landfill Leachate

SubhashKannan. M [a], Soundaranayaki. K [b*], Bhuvaneshwari. U[c]

[a,c] *PG student, Centre for Environmental Studies, Anna University, Guindy campus, Chennai -600025, India*
[b] *Assistant Professor, Centre for Environmental Studies, Anna University, Guindy campus, Chennai -600025, India*

Abstract: Co-treatment of Stabilized Landfill Leachate (SLL) with sewage in an integrated Constructed Wetland and Microbial Fuel Cell (CW-MFC) was explored. Two wetlands, CW and CW-MFC were packed with sand and gravels and planted with Canna Indica respectively. In addition, carbon anode and cathode were attached as an electrode in CW-MFC. SLL and sewage were mixed in the ratio of 1:1 and fed as influent. The wetlands were operated in batch mode and continuous mode. During batch mode operation of 7, 5 and 3 days Hydraulic Retention Time (HRT), the maximum removal efficiency of COD was 87±4% and 94±5% in CW and CW-MFC respectively at 7 day HRT. The systems were operated in continuous mode with a flow rate of 5L/Day. During the continuous flow, Biochemical Oxygen Demand (BOD5)75±3% and 81±5%, Chemical Oxygen Demand (COD)87± 4%and 96±2%, Total Nitrogen (TN) 54±6% and 61±4%, Total Phosphorus (TP)59±3% and 67±2% removal percentage were obtained in CW and CW-MFC respectively. Mean voltage production across the CW-MFC was 473 mV and average power density was 5.78mW/m2. Low coulombic efficiency of 1.17% seems to have affected the current production. However, an increase of about 9-10% COD removal efficiency was attained by including the MFC in the wetland. These results indicate that CW-MFC can treat stabilized landfill leachate.

Keywords: Integrated constructed wetland with microbial fuel cell; stabilized landfill leachate; power generation.

Hydrodynamics of microbubbles in a rectangular bubble column for treatment of wastewater: A CFD study

Vishal Rasaniya[1] and Arijit Ganguli*[1]

[1]*School of Engineering and Applied Sciences, Ahmedabad University*

Abstract: Bubble aeration for bioremediation of waste water is an important technique of waste water treatment like activated sludge. Conventional milli-sized bubbles promote good mixing of the water column but the oxygen transfer efficiency is limited to 6-10%. Milli and nano bubbles due to their high surface to volume ratios provide more efficiencies. Understanding of bubble dynamics is vital for achieving accurate bubble size as well as gas holdup for good mass transfer characteristics. CFD simulations have been carried out for a 3D experimental bubble column available in the literature using commercial software Ansys Fluent 18. A Eulerian- Eulerian model has been used to simulate the two-phase hydrodynamics for a bubble column operating in the homogeneous regime. The model is validated by comparing both the literature available experimental data and simulation results (obtained using OpenFoam). A good agreement with a deviation of 10-12% was obtained. Operating parameters like superficial velocity was varied for understanding the hydrodynamics and quantitative results in the form of radial profiles of gas-holdup, turbulent kinetic energy, dissipation energy and velocity magnitude for different axial locations were plotted and qualitative contours of these quantities at central plane were plotted. The ovemixing characteristics of the column showed uniform mixing after a particular superficial velocity. Studies of bubble size distribution and bubble dynamics would be carried out in future work.

Efficacy Assessment of Sewage Treatment through Innovative Filtration Techniques

Jesic Patadiya[a] and Shabiimam M A[b*]

[a] *Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

[b]* *Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

Abstract: Effective sewage treatment is imperative for safeguarding environmental health. This study addresses the optimization of sewage treatment through advanced filtration methods, emphasizing the characterization of different filter media, including support media and filter media. A key focus is placed on the innovative utilization of sewage sludge as a biochar for sewage wastewater during the filtration process. The research entails a comprehensive investigation into various filter media materials, evaluating their physical, chemical, and mechanical properties. The study delves into the selection and characterization of support media designed to enhance the stability and efficiency of the filtration system. Additionally, the research explores the unique attributes of filter media, emphasizing the potential of sewage sludge to act as a dual-purpose material for both wastewater treatment and sludge management. By systematically analyzing the filtration performance and the impact of different filter media configurations, this research aims to provide insights into sustainable sewage treatment practices. The utilization of sewage sludge biochar as a filter medium not only contributes to wastewater purification but also addresses the challenge of sludge disposal. The findings of this study have significance for the creation of economical and ecologically friendly sewage treatment methods, supporting the concepts of the circular economy in wastewater management.

Keywords: Sewage treatment, Filtration methods, Sewage sludge biochar, Sustainable practices

Comparative Analysis of Lab-Scale Constructed Wetlands with and without Media Using Water Hyacinth for Greywater Treatment

Chandrashekhar Parab[a*], Aakrut Vinodbhai Patel[a], Kunwar D. Yadav[a]

[a] *Department of Civil Engineering, Sardar Vallabhbhai National Institute of Technology, Surat, Gujarat, 395007, India*

Abstract: Water demand is increasing every day due to rapid population growth. Reusing greywater for purposes other than drinking is one way to meet future water needs. Constructed wetlands (CWs) utilize natural phenomena for the treatment of greywater. The use of water hyacinth plants in CWs and the effect of media on the treatment efficiency of greywater are unknown. This study presents a comparison of two different types of lab-scale constructed wetlands: one with gravel media and the other without media, for the treatment of greywater using water hyacinth plants. The study duration was 90 days with a hydraulic retention time (HRT) of 1 day. The performance of the two constructed wetlands was compared based on the analysis of different water quality parameters of greywater samples during the study. The removal efficiency of the constructed wetland with media for turbidity, COD, BOD, total solids, total dissolved solids, phosphate, and ammonia was 91.59%, 55.74%, 79.96%, 6.08%, 5.28%, 75.97%, and 30.67%, respectively. The removal efficiency of the constructed wetland without media for turbidity, COD, BOD, total solids, total dissolved solids, phosphate, and ammonia was 79.40%, 41.05%, 60.23%, 5.90%, 0.46%, 49.82%, and 16.97%, respectively. The electrical conductivity, nitrate, and nitrite concentration increased in the effluents of CWs with and without media by 2.29%, 459.62%, 138.27%, and 2.21%, 390.28%, 24.39%, respectively. From this study, it is evident that the effluent quality of CWs with media is within permissible wastewater reuse standards for non-potable purposes.

Keywords: Greywater; Constructed wetland; Gravel media; Reuse; Sustainability

$NiFe_2O_4$ Nanocomposite Exhibited as an Excellent Gas Sensor and Photocatalyst for Waste Water treatment

Ankita Malpure[a], Ganesh Dabhade[b], Ashok Borhade[a], Sanjay Wacchore[a]

[a]*Department of Chemistry, HPT Arts and RYK Science College Nashik (MS)-422013, INDIA (Affiliated to S. P. Pune University)*

[b]*Department of Applied Science, K. K. Wagh I. E. E. and R Nasik (MS)-422003, INDIA (Affiliated to S. P. Pune University)*

Abstract: The sol-gel process was utilized to produce the gas-sensing materials, $NiFe_2O_4$. It was possible to create p-type semiconductor gas-sensing materials with an inverse spinel structure. The gas sensing material is characterized by Uv-visible diffused reflectance spectroscopy (UV-DRS), X-ray diffraction (XRD), scanning electron microscopy (SEM), and transmission electron spectroscopy (TEM). It is an alternative for detecting hazardous gases that is less expensive, more environmentally friendly, and reusable nanostructure core-shell catalyst. Reducing gasses was utilized to ascertain the gas-sensing characteristics. The outcomes showed that the $NiFe_2O_4$-based sensors exhibited good sensitivity. The reaction between the gases and the absorbed oxygen, as well as the absorption of reducing gases, may be the cause of the variation in response for the different tested gases. It is also revealed that $NiFe_2O_4$ exhibits a pronounced photocatalytic activity against industrial waste water under the influence of UV–visible light exposure. The present study also reveals a possible pathway for photocatalytic degradation of IC using liquid chromatography-mass spectrometry (LC-MS).

Keywords: mixed metal oxide, sol-gel, p-type semiconductor, gas sensor, dye degradation.

Removal of Humic Acid from wastewater using ultrafiltration membrane modified with PANI-SiO_2 nanoparticles

Bharti Saini [1]*, Shirsendu Mitra [1], Syed Shahabuddin [2], Pratik Saha [1]

1 Department of Chemical Engineering, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat – 382426 INDIA

2 Department of Chemistry Engineering, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat – 382426 INDIA

Abstract: Polysulfone (PSF) is widely accepted for membranes due to its resistive property towards alkali, mineral acids, and electrolytes. Also, it is highly resistive towards surfactants, hydrocarbon oil, and oxidizing agents. Due to this, cleaning becomes easy. In recent years modified membranes have been gaining interest in wastewater treatment. The objective of this study is to study modified PSF membranes. Through literature was done on Polyaniline (PANI) as an additive along with its modification and blending methods. First, PANI was synthesized, and its characterization was done. Then PANI was blended with SiO2, and blended material was used to synthesis the PSF membrane. The composite membrane was casted by phase inversion method with the casting solution having 15 wt.% PSF, 0,1,3,5 wt.% PANI and 0,1,2,3 wt% PANI+SiO_2. The membrane's morphology and hydrophilicity were studied by FTIR-ATR, SEM, porosity, LLDP, protein adsorption, permeability, and ultrafiltration study. From the flux and fouling data, it was clear that 3 wt% of PANI and PANI + SiO_2 composite gives best result.

Keywords: Membrane processes; Polyaniline; Membranes; Ultrafiltration, Nanoparticles

Evaluation of coexisting ions on arsenic adsorption using CuO nanoparticles in aqueous solution

Indrajeet Kumar[a*], Anu Verma[b], Abdur Rahman Quaff[c]

[a] *Department of Civil Engineering, Institute of Technology, Nirma University Ahmedabad, Ahmedabad-382481, Gujarat, India*

[b] *School of Environmental Science and Engineering, Indian Institute of Technology Kharagpur, Kharagpur-721302, West Bengal, India*

[c] *Department of Civil Engineering, National Institute of Technology Patna, Patna-800005, Bihar, India*

Abstract: In this paper, the efficiency of copper oxide nanoparticles (CuO NPs) for the removal of arsenic (%R) and adsorption capacity (q, mg/g) from drinking water was studied. And, the effect of coexisting ions on arsenic adsorption was also evaluated. Synthetic water was prepared in the laboratory using arsenic trioxide (As_2O_3) in tap and DI water. The concentration of arsenic in trivalent form {As(III)} from the water sample was detected by the silver diethyldithiocarbamate (SDDC) method followed by a UV-visible spectrophotometer. The CuO NPs were synthesized by the sol-gel method and characterized by field emission scanning electron microscope (FESEM), energy dispersive x-ray (EDAX) analysis, and particle size analyser. The treatment study was performed by the batch adsorption process using CuO NPs as a nanoadsorbent. The effect of operational parameters such as pH, contact time, and adsorbent dosage on As(III) adsorption were thoroughly investigated. The optimum dosage of 0.8 g of CuO NPs at pH 7.0 showed 90% (q=11.26 mg/g) and 88% (q=11.04 mg/g) removal from DI and tap water, respectively. The maximum As(III) removal in DI and tap water at an equilibrium time of 240 min was found to be 91% (q=11.37 mg/g) and 82 % (q=10.25 mg/g), respectively. In addition, the control of pH was not required to improve the removal efficiency of As(III) because the maximum adsorption of As(III) was occurred in the neutral range (6-8). Moreover, the coexisting ions in tap water samples had no significant effect on the adsorption process compared to DI water since the values of percentage removal in both water samples were close to each other. Therefore, the optimized dosage of CuO NPs has good potential to treat arsenic-contaminated water with coexisting ions.

Keywords: *Arsenic; CuO NPs; Adsorption; Water Characteristics*

Utilization of Organic Waste for the Production of a Sustainable Adsorbent for Defluoridation: Effectiveness and Mechanism of Fluoride Elimination by Adsorption using Chinar Leaves

Firdous Ahmad Dar* and Kurella Swamy

Department of Chemical Engineering National Institute of Technology, Srinagar, Jammu and kashmir, 190006, India

Abstract: The increasing apprehension regarding elevated fluoride levels in water and their detrimental consequences on health mainly the dental and the skeletal fluorosis necessitates establishing reliable and economically viable defluoridation techniques. An environmentally appropriate alternate for activated carbon manufacturing is Chinar leaves (Platanus orientalis), a plentiful and readily accessible waste in the area. The utilization of activated carbon obtained from Platanus orientalis (PO) has been contemplated as a fluoride removal adsorbent due to its cost-effectiveness in processing and the potential for recycling waste. The effectiveness of PO activated carbon has been thoroughly assessed using batch experimentations. Findings exhibited commendable efficacy in removing fluoride, presenting the material's capability as a feasible and easily attainable remedy for water influenced with fluoride, creating opportunities for additional investigation and application within regions grappling with water quality challenges arising from fluoride. This research delves further into the topic by investigating how diverse factors (PO dosage, fluoride level, temperature, pH and the contact exposure) affect defluoridation efficiency.

Keywords: Fluorosis, Defluoridation, Activated Carbon, Platanus orientalis, Adsorbent

Density functional theory based molecular dynamics study of pharmaceutical pollutants' adsorption mechanism on iron oxide nanoparticles in wastewater

Ved Tripathi [1], Dr. Anand Tiwari*

Dharmsinh Desai University

Abstract: Wastewater generated by pharmaceutical industry may contain Chlortetracycline and Levofloxacin. The removal of these components has been a challenge. These pollutant molecules can be adsorbed, and thus removed, on nanoparticle surface at various pollutant concentrations. Langmuir and Freundlich isotherm models applied to nanoparticles of different sizes suggest Freundlich isotherm to be more appropriate for larger size of nanoparticles. The hydrogen bonding and electrostatic interactions seem to have significant impact on adsorption of pollutants on nanoparticles. Interaction of functional groups and pi-pi interactions due to presence of aromatic rings also seems to play an important role in the adsorption mechanism. In this study, Molecular Dynamic (MD) simulations were performed to investigate the adsorption mechanism of chlortetracycline and levofloxacin on iron oxide nanoparticles. Nanoparticle of size range from 0.5nm to 5 nm were modeled and equilibrated using density functional theory (DFT) approach in Quantum espresso (QE) to perform the molecular dynamics (MD) simulations using LAMMPS. The nanoparticle stability in aqueous phase was investigated by calculating radial distribution function curves of the nanoparticle clusters. The results of simulation indicated stable crystallographic structures for these nanoparticles and inverse proportionality of nanoparticle stability w.r.t. to the size.

Keywords: Density functional theory (DFT); molecular dynamics (MD); LAMMPS; Quantum espresso (QE); nanoparticles; adsorption

---

Produced Water Treatment Using Adsorption Process: A Review

Vinayak S. Wadgaonkar [a], Siraj Bhatkar [a], Muhammed Safthash[a], Rupali Sonolikar[b], Himangi Neve [b]

[a]*School of Petroleum Engineering, M.I.T.W.P.U., Pune-411038, India*

[b]*School of Chemical Engineering, M.I.T.W.P.U., Pune-411038, India*

Abstract: One of the most significant forms of wastewater created with crude oil and natural gas is generated water. Therefore, it is crucial to handle this massive quantity of produced water for subsequent reuse and recycling. Prior to treatment, it is imperative to establish the components of generated water to determine the specific method and technology required to create a water treatment process. The first part of this review paper will cover the commercial oil removal method operated in the industries to eliminate oil from produced water. As adsorption being the high credibility technology in its utilization among the water treatment sector, the second part will introduce adsorption process and general principles of adsorption. The third part will go over different regeneration methods and recent advances in adsorption method. The major purpose of this review is to inform the reader about adsorption technology, related terminology, and recent developments in the approaches. This is done to pave the way for future studies of PW adsorption and the discoveries that will inevitably result from them.

Keywords: Adsorbent; Adsorption; Produced water; Regeneration; Advanced oxidation process

---

Catalytic wet peroxidation of clindamycin using Biochar as catalyst

G vagdeep varma[a], Sourodipto Modak[a], Priyanka Katiyar[a]

[a] *Department of Chemical Engineering, Shiv Nadar Institution of Eminence, Delhi-NCR (201314)*

Abstract: The increasing presence of pharmaceutical compounds in wastewater has become a significant environmental concern, prompting the exploration of advanced treatment technologies. This study focuses on the catalytic wet peroxidation of clindamycin, a widely used antibiotic, employing biochar as a sustainable and cost-effective catalyst. Biochar, derived from renewable biomass sources such as municipal waste (food waste) and industrial waste (rice husk), offers a unique combination of porous structure, surface functionality and availability of metal sites, making it an attractive candidate for catalytic applications The catalytic wet peroxidation process is being investigated under various operating conditions, including reaction temperature, catalyst dosage, initial clindamycin concentration, and hydrogen peroxide dosage. The degradation efficiency and mineralization of clindamycin were systematically analysed using UV spectroscopy and COD analyser. The results demonstrate the efficacy of biochar as a catalyst in promoting the oxidation of clindamycin, leading to the efficient removal of the pharmaceutical compound from aqueous solutions. The influence of biochar characteristics on catalytic performance is also being explored, which will provide insights into the underlying mechanisms of the catalytic wet peroxidation process.

Keywords*: Oxidation, Bio-char, Antibiotics, Catalyst*

A Review of Adsorption for Wastewater Treatment

Parth Jani[a] and Shabiimam M A[b*]

[a]*Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

[b*]*Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382426, India*

Abstract: Water sources, over the world are facing contamination due to the release of pollutants like dyes, heavy metals, surfactants, personal care products, pesticides and medications. These contaminants find their way into water bodies through channels such as agriculture, industries and cities. The contamination of water and its subsequent treatment has become a growing concern. It's worth noting that substantial efforts have been made recently to tackle the complexity of wastewater treatment. Different methods have been approved for treating wastewater including chemical techniques like Fenton oxidation methods like adsorption and membrane filtration as well as several biological approaches. This study aims to provide insights into the advancements in these treatment methods with a specific focus on their ability to eliminate different water contaminants. To comprehend the aspects that matter in both pilot scale and large-scale systems it is crucial to identify any research gaps in this field. After examination it can be concluded that adsorption emerges as a durable cost effective and environmentally friendly method, for wastewater treatment when compared to other existing technologies. However, it's evident that further exploration and advancement fine tuning and the efficient utilization of integrated methods are crucial, for meeting the requirements of applications.

Keywords: Adsorption, Zeolite Granules, Activated Carbon, Biochar, Advanced oxidation processes.

Aniline Adsorption Behavior on Polystyrene Microplastics as a Potential Wastewater Treatment Strategy

Mohammad Iqbal Lone[a], Asma Iqbal[a]*

aDepartment of Chemical Engineering, National Institute of Technology Srinagar, Jammu and Kashmir, India - 190006

Abstract: Globally, microplastic contamination has become a serious environmental problem that calls for investigation and creative solutions. Although a lot of study has been done on microplastics and their ability to adsorb various pollutants, not much has been done regarding the adsorption capacity of the pollutant aniline. The objective of this work is to investigate the adsorption behavior of aniline, a well-known industrially produced environmental contaminant, onto the surface of polystyrene microplastics (mPS). Aniline's adsorption on mPS particles with four distinct diameters was examined. Studies were conducted on the effects of pH on aniline adsorption, ionic strength effects on aniline adsorption, adsorption kinetics under various mPS particle sizes, and adsorption thermodynamics. The findings imply that when pH rose, aniline adsorption showed an increasing tendency. The findings indicate that aniline adsorption showed an increasing trend as pH rose until it reached a value of 7, at which point it started to fall. Additionally, as mPS particle sizes reduced, aniline adsorption by mPS increased. To sum up, the results of this investigation have the potential to lay the groundwork for novel and ecologically responsible wastewater treatment technologies that can successfully tackle the problems of wastewater pollution and microplastic contamination.

Keywords: Adsorption; Aniline; Microplastics; Polystyrene; Pollutants; Wastewater

---

Study on Evaporation Characteristics of Water in Cylindrical Liquid Pool at Low Pressures

Jitendra Singh, Sarvjeet Singh*, Hardik Kothadia

Multiphase Flows and Heat Transfer Laboratory,MFHT Lab

Department of Mechanical Engineering, Indian Institute of Technology jodhpur,342030, India

Abstract: Water stands as one of the utmost indispensable resources for the survival of living organisms. The need for high-quality water is perpetually increasing due to escalating population figures, intensified agricultural activities, industrialization, and overall enhancements in living standards. The process of evaporation holds significant importance across various fields such as chemistry, medicine, agriculture, biology, engineering, and many others. Low-pressure flash evaporation represents a distinctive evaporation method, distinct from evaporation occurring from an excessively heated surface. In this technique, steam is predominantly generated at the liquid surface due to the ambient atmospheric pressure being lower than the saturation pressure corresponding to the liquid's temperature. The current investigation entails experimental examination of flash evaporation induced by sudden depressurization within a vertical cylindrical tube containing a water height ranging 100 mm. The study involves varying the initial water temperature and the back pressure of the vacuum tank within the respective ranges of 70 to 90 degrees Celsius and 11.32 to 31.32 kilopascals, respectively. The efficiency of the system is observed to be influenced by factors such as the temperature of the incoming water, the pressure of the surge tank, and the degree of superheat. This paper endeavors to examine the factors influencing the flash evaporation desalination process and to evaluate the effectiveness of various configurations in terms of performance.

Keywords: flash evaporation; phase change; desalination; low pressure; steam generation: vacuum

Exergy analysis of plate heat exchanger with varying geometry

Bandi D. Raja[a], Jaydeep Patel [b]*, Vivek K. Patel[b]

[a] *Mechanical Engineering Department, Indus University, Ahmedabad-382115, India*

[b] *Mechanical Engineering Department, Pandit Deendayal Energy University, Gandhinagar-382007, India.*

Abstract: This study presents an exergy analysis of a plate heat exchanger (PHE) to evaluate its performance and identify opportunities for improvement. The analysis focused on comparing different configurations of the PHE and assessing their exergy efficiency. The present work, explore nine distinct PHE geometries, each characterized by variations in flow arrangement and tapered cross-section. Through the application of the ε-NTU method, our analysis of entropy generation provides profound insights into the overall system performance. The results revealed that Configuration 'B' exhibited higher exergy efficiency compared to other configurations, indicating its potential for enhanced performance in industrial applications. The findings also highlighted areas for potential improvement, such as heat transfer surfaces and fluid flow enhancements for optimizing the PHE design. Moreover, the study emphasized the importance of considering not only thermal performance but also exergetic aspects in the design and operation of PHEs. This holistic approach can lead to the development of more efficient and sustainable heat transfer systems.

Keywords: Plate heat exchanger, Entropy generation, Irreversibility, Effectiveness

---

Exergy analysis of multi-stage vapour compression refrigeration system with different refrigerants

Bansi D. Raja[a], Vivek K. Patel[b*], Anurag Mudgal[b]

[a] *Mechanical Engineering Department, Indus University, Ahmedabad-382115, India*

[b] *Mechanical Engineering Department, Pandit Deendayal Energy University, Gandhinagar-382007, India*

Abstract: In the present work, low GWP refrigerants such as R600a, R290, R161 & R1233zd(E) 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.

Keywords: Vapour compression refrigeration system, Exergy efficiency, Irreversibility, coefficient of performance;

Enhancing crude oil recovery by modifying physicochemical parameters of process water utilization

Dr. Siraj Bhatkar*, Dr. Vinayak Wadgaonkar, Balraj Tavanandi, Aniket Wakle

Department of Petroleum Engineering, MIT-World Peace University, Pune 411038, India

Abstract: The water produced from oil wells is a complex blend of organic and inorganic molecules. Produced water handling plays a very important and vital role and it can't be neglected. Water cut increases in the life of an oil well as the field matures. The outcome of this research is not theoretical since the investigation is done in the field to get the produced water from the pay zone into an acceptable range. The processing of produced water from the pay zone is difficult and important in the oil and gas business. The produced water has several pollutants that are undesirable for injection into the well as process water, to delineate them into a suitable range. In this work, the physicochemical and biological parameters of raw effluent were examined experimentally, and the applicability of the physicochemical parameters for increased oil recovery applications was investigated. This work helps to understand the dosage design modification required for the treatment of petroleum-produced water for enhancing oil recovery. Enhanced oil recovery applications restrict the usage of produced water depending on their composition. Enhance oil recovery applications like chemical flooding can be applied using produced water after desired treatment.

Keywords: process water, physicochemical parameters, crude oil, oil recovery, enhance oil recovery, oil industry

Effectiveness of mixed agro waste fertilizer from bio-digester on water supply requirements

Rugved Mitelu [a], Aniket Patrikar [a], Dr. Ratnadip R Joshi [b]*

[a] *M Tech Chemical Engg., Dr. Vishwanath Karad MIT World Peace University, Pune, 411038*
[b] *Asso. Professor, Chemical Engg., Dr. Vishwanath Karad MIT World Peace University, Pune, 411038*

Abstract: In this work, Energy consumed for growing crops in a cycle majorly by Machine and Animal was determined. The paper demonstrates the water required for each crop per acre and prepares a generalized formula for water requirement using mixed agro waste feed. The feed undergoes anaerobic digestion which forms biogas and organic fertilizer. The fertilizer produced after digestion is later analyzed for its ability to gradually supply essential nutrients to the crop plants. The result shows reduced water requirement when compared against the supply of inorganic fertilizers and determined per cycle water reduction. The water solubility of the bio-fertilizer has been observed to be higher compared to the externally supplied inorganic fertilizers. Also, the bio-fertilizer presence in excess does not harm the crop hydro balance as against the synthetic fertilizer which in turn reduces reverse osmosis and increases plant life thereby providing good crop yield. The present study shows that the use of such mixed agro-waste bio-fertilizers reduces energy and water requirements thereby allowing their savings and also altering crop patterns and frequency, resulting in enhanced crop yields and income. This shall enhance the farmers' income and support a circular economy fostering a path towards Atma Nirbhar Bharar!

Keywords: crops, water requirements, inorganic fertilizers, bio-manure, bio-fertilizers

Analyzing the Abrasive Waterjet Technique for Maximum MRR, and Minimum Kerf Angle for Pure Titanium

Srivathsan Velamur[a], Jay Vora[a], Rakesh Chaudharia[a*]

[a] *Department of Mechanical Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382007, Gujarat, India*

Abstract: Titanium alloys including pure titanium has multiple advance characteristics such as excellent corrosion resistance, lightweight, biocompatible, and high strength to weight ratio. However, higher hardness of these alloys makes them difficult to machine using traditional processes. Traditional processes impose lot of challenges such as rough machining, tool failures, unfavourable chip conditions, etc. Thus, pure titanium alloys can be machined more effectively using non-traditional machining methods. Abrasive waterjet machining (AWJM) is a non-traditional method, largely preferred for machining of difficult-to-cut materials. AWJM is environmentally friendly as it utilises only water with abrasives and doesn't have any hazardous gases or chemical contamination. AWJM process possesses certain limitations on cutting rate, and increased kerf angle. Thus, it becomes essential to improve these output characteristics by selecting the proper input machining conditions for difficult-to-cut materials. Thus, the present study examined the impact of input conditions of AWJM on cutting rate and kerf taper angle of pure titanium. Taguchi's L9 array was used to conduct the experimental trials by using silicon carbide abrasives. Statistical analysis by using ANOVA has been conducted to identify the significance and contribution of individual factors on output characteristics. Main effect plots were employed to analyse the significance of machining conditions favourable for cutting rate and kerf taper angle. Authors believes that the present study will be helpful for researchers as primary point for the selection of machining conditions of pure titanium using Abrasive Waterjet technique.

Keywords: Abrasive Waterjet Machining; Pure Titanium; Taguchi; Material Removal Rate; Kerf Angle

Investigating the Effect of Nano-particle mixed Dielectric fluid on Tool Wear Rate of Inconel-718

Piyush Dixit[a], Divyesh Patel[a], Jay Vora[a], Rakesh Chaudhari[a*]

[a] *Department of Mechanical Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, 382007, Gujarat, India*

Abstract: Recently, processing of advanced materials through nano-particles mixed dielectric fluid has gained a lot of popularity. During the machining/processing, very fine metallic powder or abrasives are added to the dielectric medium which reduces the resistivity between the workpiece and the tool. This in turn increases the conductivity of dielectric fluid, improves the inter-electrode gap, and thus enhances the machining capability. Inconel 718 also referred as a superalloy is employed under the applications or conditions where operating conditions are possessing the application at extremely elevated temperatures. Inconel 718 used in several sectors including automotive parts, oil and gas industries, nuclear and chemical industries, aerospace sectors etc. Its crucial characteristics such as, high strength, high temperature resistant makes it applicable under the severe conditions by increasing their corrosion resistance and oxidation. Conventional machining technique imposes lot of challenges such as rough machining, tool failures, unfavourable chip conditions, etc. Thus, Inconel 718 can be machined more effectively using non-traditional machining methods. Electrical discharge machining (EDM) is largely suitable method in the machining difficult-to-cut material to produce intricate shape components. Thus, the present work focuses on the effect of nano-particle mixed dielectric fluid of the EDM of Inconel 718. The work has examined the impact of input conditions of EDM on tool wear rate. Taguchi's L9 array was used to conduct the experimental trials by using alumina nano-powder. Statistical analysis by using ANOVA has been conducted to identify the significance and contribution of individual factors on output characteristics. Main effect plots were employed to analyse the significance of machining conditions favourable for reduction of tool wear rate. Authors believes that the present work will be useful for machining of Inconel 718 which are largely used in various industrial applications.

Keywords: Powder-mixed Dielectric fluid; EDM; Inconel 718; Taguchi; Tool Wear Rate

Effectiveness of Various Biosorbent for Industrial Effluent Treatment – A Review

Urvee Sangani, Nancy Maheshbhai Desai, Arth Padaria, Balasubramanian Ragunathan*

Department of Petroleum Engineering, School of Energy Technology, Pandit Deendayal Energy University, Gandhinagar – 382 426, India.

Abstract: Industrial effluent treatment poses significant challenges due to the diverse and complex nature of contaminants present. Biosorption, utilizing various biosorbents, has emerged as a promising eco-friendly method for the removal of pollutants from industrial wastewater. This study evaluates the effectiveness of different biosorbents in treating industrial effluents, focusing on their capacity for adsorbing heavy metals, organic compounds, and other harmful substances. Through a comprehensive review of literature, this paper analyzes the performance of various biosorbents, including agricultural waste, microorganisms, algae and biopolymer in removing contaminants from industrial wastewater. Factors influencing biosorption efficiency, such as biosorbent characteristics, solution pH, temperature, and initial pollutant concentration, are critically assessed to understand their impact on treatment efficacy. This review reveals that biosorption offers several advantages, including high selectivity, low cost, and minimal secondary pollution, making it a promising alternative to conventional treatment methods. However, challenges remain in optimizing biosorbent performance, including scalability, regeneration and long-term stability. Future research directions aimed at enhancing biosorption efficiency and addressing operational challenges are discussed.

Keywords: Biosorption; Activated carbon; Effluent; Conventional methods

Synthesis and characterization of zeolite from fly ash for removal of water hardness

Venkata Saikumar Reddy Ravipati[a], Lakshmana Rao Jeeru[b],*

[a] *Department of Mechanical Engineering, G. Pulla Reddy Engineering College, Kurnool, Andhra Pradesh, 518007, India*

[b] *Department of Petroleum Engineering, School of Energy Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar 382426, India*

Abstract: The utilization of cost-effective materials in the synthesis of zeolites presents a promising avenue for enhancing water-softening processes. The paper presents a novel approach to preparing zeolite from coal-based fly ash through the process of alkali fusion followed by hydrothermal treatment. This method could potentially contribute to reducing the amount of industrial waste while providing a cost-effective solution for creating valuable materials. The synthesized zeolite is designed to remove calcium ions from water. The various process parameters (i.e.) fusion temperature, alkali–fly ash ratio, hydrothermal treatment time, curing time, and curing temperature have been optimized. The zeolite was characterized with XRD and SEM, and compared to commercially available 13X zeolite. The study aimed to evaluate the efficacy of the synthesized zeolites ion exchange ability by comparing it with commercially available zeolite. The thermal stability of the synthesized zeolite was analyzed to assess its potential applications.

Keywords: Adsorption, Fly ash, Zeolite, SEM, XRD

RSM-Guided Optimization of Pectin-TiO_2 Nanohydrogel for Enhanced Dye Degradation

R. Srividya[a], BVS Praveen[b], Lakshmana Rao Jeeru[c]

[a] *Department of Chemical Engineering, B V Raju Institute of Technology (A), Narsapur, Telangana 502313, India*

[b] *Department of Chemical Engineering, Chaitanya Bharathi Institute of Technology (A), Hyderabad, Telangana 500075, India*

[c] *Department of Petroleum Engineering, School of Energy Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar 382426, India*

Abstract: This study introduces an innovative method for developing a hydrogel made of pectin that includes titanium dioxide (TiO_2) nanoparticles. The purpose is to enhance the effectiveness of dye degradation and determine the ideal composition needed for this process. The hydrogel is synthesized using a simple and eco-friendly technique, utilizing the biocompatibility of pectin and the photocatalytic characteristics of TiO_2. To confirm the successful incorporation of TiO_2 nanoparticles, the structure and morphology of the hydrogel is meticulously analyzed using scanning electron microscopy (SEM), Fourier-transform infrared spectroscopy (FTIR), and X-ray diffraction (XRD). The study centers on the deterioration of BG (BG) dye and methodically investigates the absorption efficiency of the Pectin-based TiO_2 nano hydrogel under different operational circumstances. The adsorption data strongly correlates with the pseudo-second-order kinetics and the Redlich Pearson isotherm. Furthermore, response surface modeling is used to optimize adsorbing BG dye statistically. The maximum recorded elimination effectiveness for BG dye is 89.9%, which was reached by subjecting an initial BG concentration of 30 mg/L to a treatment duration of 180 minutes at room temperature with a compelling composition of 3wt% of Pectin and 1wt% of Carboxymethyl cellulose.

Keywords: Hydrogel; Nanoparticle; degradation; response surface methodology; biocompatibility; reusability

Fabrication of Nano-adsorbent and its application in Fluoride removal

Tanushree Gupta[a], Rina Kumari[b] *, Yogesh Kumar[c]

[a,b] *Central University of Gujarat, Gandhinagar-382030*

[c] *Ministry of Environment, Forest and Climate Change, Gandhinagar-382010*

Abstract: Exceeding the permissible limit of fluoride in water can lead to various health issues such as dental and skeletal fluorosis, particularly affecting arid and semi-arid regions where fluoride contamination in aquifers is prevalent. Elevated levels of fluoride in groundwater stem from both natural processes, like the gradual dissolution of fluoride-rich minerals, and human activities such as the discharge of wastewater containing fluoride pollutants. Despite complaints from villagers about groundwater salinity in North Gujarat, many remain unaware of the presence of fluoride in their drinking water. To address this concern, this study focuses on developing an effective nano-adsorbent and characterizing it using advanced instrumentation. The nano-adsorbent's efficacy is evaluated by testing its ability to adsorb fluoride at different concentrations, thereby removing the contaminant from water. Specifically, clay nano-composites are synthesized and characterized using techniques like FTIR, SEM, and XRD. Acidifying bentonite clay enhances its cation exchange capacity, thereby improving its adsorptive properties. This modification results in a fluoride removal capacity of 2.05mg/g at a fluoride ion concentration of 20mg/L in water. Further enhancement is achieved by incorporating MgO into the clay at a 1:1 ratio, significantly increasing the adsorption capacity to 3.24mg/g at the same fluoride concentration. This improvement raises the removal percentage from 92% to 99% at a fluoride concentration of 5mg/L in water. Notably, this composite exhibits effectiveness under near neutral pH conditions, across a wider concentration range, and with a smaller amount of adsorbent needed. Moreover, it demonstrates superior performance in the presence of competing ions in groundwater compared to acidified bentonite. Given the low cost of both bentonite clay and magnesium, this composite material emerges as a promising adsorbent for defluorination of water, even under natural conditions.

Keywords: Nanoadsorption; Fluoride Chemistry; Bentonite Clay; Magnesium oxide; Nanocomposite

Application of Mixed Metal Oxide Electrodes in Wastewater Treatment using Electrochemical Method

Nidhi Mehta[a], Priya Saxena[b], Sandip Sharma[c]

[a,b] *Central University of Gujarat, Gandhinagar-382030*

[a] *Assistant professor, Chemical Engineering Department, L. J. University Ahmedabad 382210 India*

[b] *Associate professor, Chemical Engineering Department, Parul University Baroda 391760 India.*

[c] *Assistant professor, Chemical Engineering Department, Nirma University Ahmedabad 382481 India.*

Abstract: The treatment of persistent organic compounds in wastewater presents a significant challenge for conventional methods. Recent advancements highlight the effectiveness of electrochemical oxidation processes utilizing mixed metal oxides in degrading these compounds. This technique involves applying electrical current to facilitate the oxidation of pollutants. Mixed metal oxides, such as TiO_2 /RuO_2 or Fe_2O_3 /NiO, demonstrate improved catalytic activity and stability compared to single-metal oxide electrodes. Key parameters influencing the efficiency of electrochemical oxidation includes electrode composition, surface area, current density, pH, and temperature. Optimization of these parameters allows for tailored treatment of specific pollutants. Techniques like UV- Spectroscopy, SEM, XRD, and EIS help analyze electrode properties, aiding in process design. These processes effectively address challenges posed by persistent organic pollutants and pharmaceutical residues in industrial wastewater. In summary, integrating electrochemical oxidation with mixed metal oxides presents a promising solution for treating stubborn organic compounds in wastewater. Ongoing research aims to provide scalable, cost- effective, and environmentally sustainable solutions to combat water pollution and environmental degradation.

Keywords: Electrochemical Treatment; Mixed metal oxides; Dye wastewater; Electrodes

Microwave-assisted advanced oxidation process for dye wastewater treatment

[1] Sandip Sharma *, [2] Nidhi Mehta, [3] Jayesh Ruparelia

[a,b] *Central University of Gujarat, Gandhinagar-382030*

1 Assistant professor, Nirma University, Institute of Technology. Ahmedabad India.

2 Assistant professor, Chemical Engineering Department, L. J. University Ahmedabad India.

3 Professor, Chemical Engineering Department, Nirma University Ahmedabad India

Abstract: Treatment of dye wastewater is becoming more cumbersome due to less effectiveness of the conventional treatment towards recalcitrant pollutants. Further, incomplete treatment releases toxic and carcinogenic compounds. Thus, need for complete treatment of dye wastewater drives researchers to hunt for innovations and research. The microwave assisted treatments are gaining researchers attention due to it enhancing the active radicals which shows stronger synergetic effect with advanced oxidation processes. The present study focuses on the impact of the process parameters on the performance of the microwave assisted wastewater treatment. Reactive black 5 containing synthetic wastewater was treated using persulfate activated by microwave. The Taguchi's L27 was used to identify the minimum experiments to perform. The color, chemical oxygen demand (COD) and Total organic carbon (TOC) removal rare at different combination of pH, Persulfate (PS) dosage, Initial dye concentration and microwave power are optimised using preference selection index (PSI) method. The result of PSI concluded that the initial pH at 12.0, PS dosage at 1.5 g/L, initial dye concentration at 500 mgL^{-1} and power at 350 W are the optimum combination for achieving the higher color, COD and TOC removal.

Keywords: Dye Wastewater, Microwave, Persulfate, Sulphate radical, Preference selection Index (PSI) method

Cost-Effective Wastewater Treatment Strategies by Predictive Energy Management with Machine Learning Techniques

Manish Kumar[a], Debabrata Swain[b], Abhishek Kumar[c], Paawan Sharma[c]

[a,b] *Central University of Gujarat, Gandhinagar-382030*

[a] *Department of Electronics and communication Engineering, Pandit Deendayal Energy University, Raisan, Gandhinagar-382421, India*

[b] *Department of Computer Science and Engineering, Pandit Deendayal Energy University, Raisan, Gandhinagar-382421, India*

[c] *Department of Information and Communication Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar-382421, India*

Abstract: Wastewater treatment plants (WWTPs) are pivotal infrastructures ensuring stringent effluent quality standards while grappling with substantial energy demands. Accurate prediction of energy consumption holds paramount importance for cost-effectiveness, operational optimization, regulatory compliance, and environmental sustainability. This paper presents an extensive evaluation of energy consumption prediction using different machine-learning models. Optimization techniques is employed to enhancing their predictive capabilities. Notably, the study focuses on assessing the impact of incorporated features on energy consumption prediction, with specific emphasis on the Random Forest algorithms. Moreover, the research explores the potential benefits of incorporating historical data through time-lagged measurements to improve prediction accuracy. The inclusion of lagged measurements notably enhances prediction accuracy, underscoring the importance of leveraging temporal dynamics in energy consumption forecasting for WWTPs. This underscores the efficacy of leveraging advanced machine learning techniques, coupled with temporal information, to achieve more precise energy consumption forecasts in WWTP operations. The implications of these findings are substantial. By accurately predicting energy demands, WWTP operators can implement proactive strategies to optimize resource allocation, minimize operational costs, and reduce the overall carbon footprint. Furthermore, adherence to regulatory standards is facilitated, ensuring continued compliance with effluent quality norms. This study contributes valuable insights into evaluating a diverse set of models and emphasizing the importance of incorporating historical data through time-lagged measurements, the research provides a robust framework for enhancing operational efficiency and sustainability in WWTPs. The demonstrated superiority of dynamic models, particularly the dynamic KNN approach, highlights promising avenues for practical implementation, driving towards greater efficiency and environmental stewardship in wastewater treatment processes.

Keywords: Ensemble Learning; Energy consumption; Machine Learning; Predictive analysis; Waste water treatment

AI-based Predictive Image Classification Model for Detection of Soluble Salt Concentration in Water

Panchal Truptiben Dlilpbhai, Bhasuru Abhinaya Srinivas and Vivek Jaiswal

Department of Mechanical Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar 38242, India

Abstract: The quality of water is a question that millions of people consider daily. Water quality can be tested using sophisticated methods such as spectrophotometry, ion-selective electrodes, and titration. But none of these techniques has a cost or time advantage. Also, a few studies have used machine learning to predict the Water Quality Index (WQI) by combining different salt concentrations and other readings. In the present paper, we propose a convolutional neural network (CNN)- based image classification model that can distinguish between different classes upon training and validation. We tested with varying concentrations of chlorine, fluorine, and arsenic-based salts in deionized water. The solutions were drop-cast on a cleaned glass slide and left to dry. Later on, the samples will be imaged with an upright microscope. We will use the resultant images to generate different classes of tested salts. A CNN-based machine learning (ML) algorithm was deployed for image classification, resulting in 84% accuracy. The accuracy value shows that the model can judge the images 84% of the time accurately; the remaining is attributed to the fact that there could be false positive and true negative values in the dataset. Although the work on improving accuracy is ongoing, it could still serve as a screening test before undergoing in-depth analysis. All the user has to do is collect the sample of contaminated water, send it to the nearest center with a microscope facility, get the image, and upload it to the server. In significantly less time, the assessment can be completed by the user.

Keywords: CNN; AI; ML; water; Image classification

Techno-economic analysis of hybrid forward osmosis-reverse osmosis process for water recovery from dairy effluent

Dipak Ankoliya[a], Anurag Mudgal[a]*, Manish Kumar Sinha[b], Vivek Patel[a], Jatin Patel[a], Varsha Mudgal[a], Dhaval Patel[a], Milan Raninga[a], Himanshu Choksi[b]

[a] *Department of Mechanical Engineering, Pandit Deendayal Energy University, Gandhinagar-382426, Gujarat, India*

[b] *Department of Chemical Engineering, Pandit Deendayal Energy University, Gandhinagar-382426, Gujarat, India*

Abstract: The forward osmosis (FO) membrane with biomimetic channel is used to extract water from dairy wastewater which would otherwise discharge in natural water bodies. Conventionally, dairy industries are using biological processes in the effluent treatment plant (ETP) to treat the wastewater generated from dairy processes to achieve the water discharge norms of local governing bodies. This treated effluent would not be recycled or repurposed so results into the water wastage. To reduce this water wastage and to ease the water stretch on natural water resources (ground or surface water) near to industrial zone, the water recovery from this dairy effluent, primary treated, would be recommended using hollow fibre forward osmosis membrane. The water can be extracted from FO process using natural osmotic pressure gradient using highly saline water as draw solution. The water molecules flow from feed side to the draw side in FO process and diluted draw solution will be regenerated by using reverse osmosis (RO) process. Finally, RO process generates pure water with total dissolved solids (TDS) concentration less than 300 mg/L. Here, Aquaporin HFFO14 membrane is used in FO process and RO process is simulated for the draw water regeneration. The overall water flux from FO process obtained 4.9 litres per square meter membrane area per hour time and overall recovery of 89.4% is achievable in experiment with Aquaporin HFFO14 FO membrane module. The optimization of draw solution concentration is carried out by techno-economic analysis of hybrid FO-RO system simulation.

Keywords: forward osmosis; reverse osmosis; hybrid process; techno-economic; dairy wastewater; reuse and recycle;

Life Cycle Assessment and Exergoenvironmental Analysis of solar assisted Cascade Rankine Cycle coupled with Reverse Osmosis

Milan Raninga, Vivek Patel, Anurag Mudgal, Jatin Patel, Himanshu Chokshi, Varsha Mudgal, Dhaval Patel, Dipak Ankoliya

Pandit Deendayal Energy University, Gandhinagar, Gujarat, INDIA

Abstract: In this paper, a solar assisted cascade Rankine cycle based reverse osmosis system is studied. The exergy analysis and environmental examination are applied to achieve better insight into the thermal RO system. In this work, various systems such as steam Rankine cycle (SRC), organic Rankine cycle (ORC), and a reverse osmosis (RO) are combined to achieve a new system design. In this study, Engineering Equation Solver is used to simulate the proposed system. Overall objective is to determine the environmental impact points when the system will be implemented to the particular location. The environmental points of the systems component and its material is determined using ECO99 database. Overall, the environmental points by the system are 66 mPts/h, in which 10 % is due to exergy. Component wise the highest point is determined from Solar collector, followed by the RO units. Mainly, the environmental impact due to Fabrication, transportation and installation is identified.

Keywords: Exergy analysis, Life Cycle Assessment, Exergoenvironmental Analysis, Reverse Osmosis

Design methodology for forward osmosis system

Dhaval Patel[a], Jatin Patel[a], Dipak Ankoliya[a], Milan Raninga[a], Anurag Mudgal[a], Vivek Patel[a], Varsha Mudgal[a], Himanshu Choksi[b]

[a] *Mechanical Engineering Department, School of Technology, Pandit Deendayal Energy University, Gandhinagar – 382426, India*

[b] *Chemical Engineering Department, School of Technology, Pandit Deendayal Energy University, Gandhinagar – 382426, India*

Abstract: Forward osmosis (FO) is an emerging process in the field of water treatment. Water treatment using the FO process will address the ongoing problem of water scarcity. The commercial application of the FO system is very limited due to several issues like low water flux, concentration polarisation, draw solution availability and regeneration, and membrane fouling. The present study focuses on the FO system's design methodology for water and wastewater treatment applications. This will focus on the process design (system application), draw solution/feed solution selection, membrane selection, mode of operation, desired recovery and output, and pump and flow rate selection. The function design methodology will accelerate the application of the FO system at the pilot level and commercial level. The study also focuses on mitigating technology's challenges and problems, like membrane fouling, concentration polarization, lower water flux, and recovery. The study will recommend the design methodology for the large-scale FO for water and wastewater treatment.

Attribute based assessment of Wastewater treatment using VIKOR's Method

Vatsal Pandya*, Abhishek Kumar*, Abhinaya B Srinivas*

Pandit Deendayal Energy University, Gandhinagar, Gujarat, INDIA

Abstract: Water is essential to the sustainable growth of society and is one of the most important resources in the near future. The treatment of wastewater is an essential component of the circular water management system, providing a range of technological options. Therefore, making the right choice when it comes to technology is crucial from a long-term standpoint. The sustainable wastewater treatment process selection is a challenging but necessary procedure. This introduction sets the stage for a comprehensive exploration of wastewater management, encompassing the diverse array of practices, technologies, and policies that collectively contribute to the sustainable handling of this valuable resource. The VIKOR's approach for evaluating the sustainability of wastewater treatment systems will be covered in this paper. This method may be particularly pertinent to the expanding industry with its plethora of new possibilities. The VIKOR method was developed for multi-criteria optimization of complex systems. It determines the compromise ranking list and the compromise solution obtained with the initial (given) weights. This method focuses on ranking and selecting from a set of alternatives in the presence of conflicting criteria. Based on those ranking we can Identify which problem needs to be our priority.

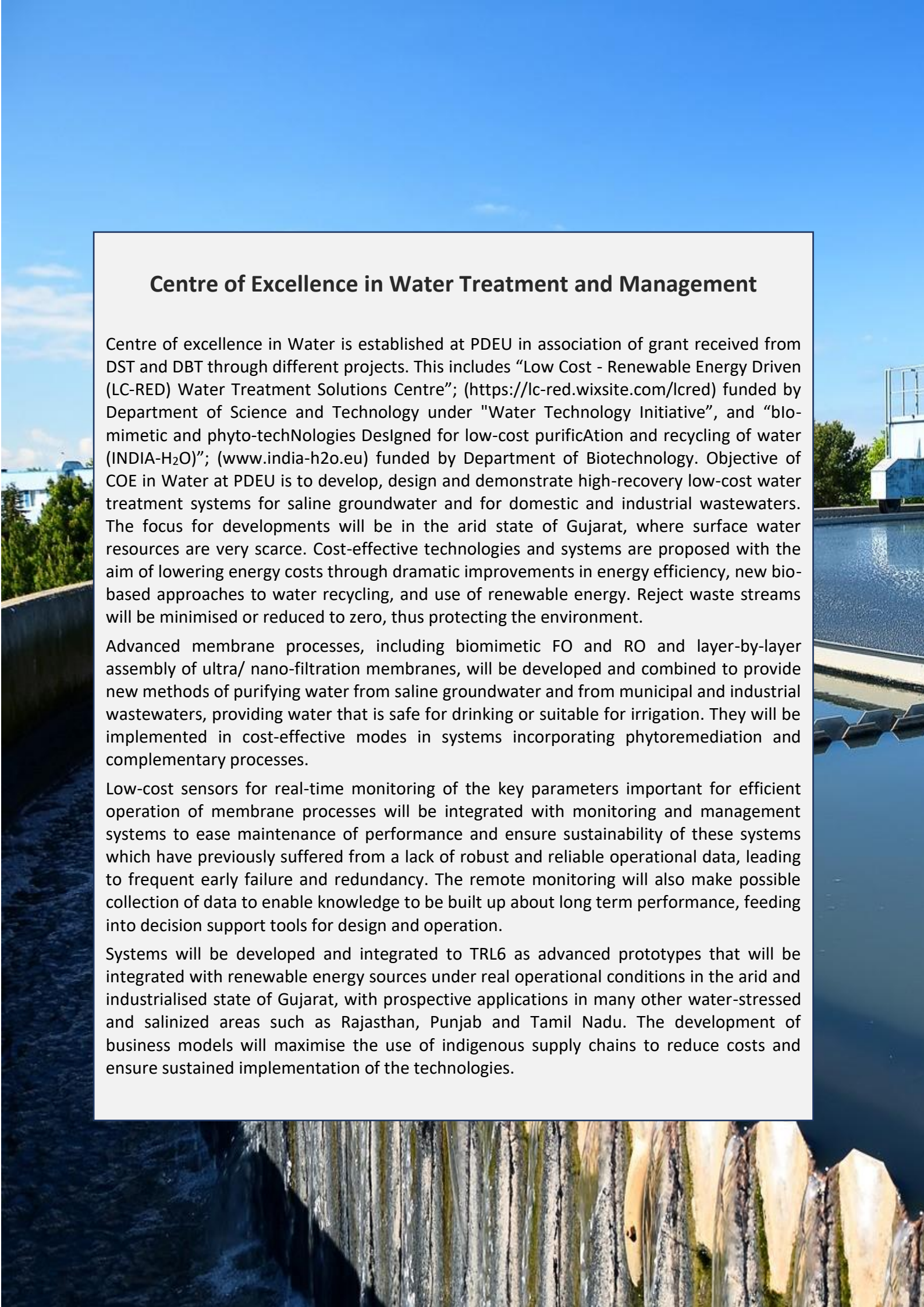
Domestic Wastewater Treatment with Hybrid Constructed Wetland

Varsha Mudgal, Milan Raninga, Dhaval Patel, Dipak Ankoliya, Anurag Mudgal *, Jatin Patel, Vivek Patel

Pandit Deendayal Energy University, Gandhinagar, Gujarat, INDIA

Abstract: Hybrid mesocosm constructed wetland (CW) designed to analyse effect of plants on pollutant removing efficiency (PRE) of the system. Supernatant of settled domestic wastewater (DWW) treated in CW at four different (.5 d, 1 d, 2, and 3 day) hydraulic resident time (HRT). CW1 was unplanted and CW2 planted with Canna and lemon grass. Each Hybrid CW has four units, water passes from up to down in first unit (U1) and down to up in 2nd (U2), 3rd (U3), and 4th (U4) unit. In CW2, U1 and U2 planted with Canna while U3 and U4 with lemon grass. Maximum reduction of electrical conductivity (28%), biochemical oxygen demand (80%), chemical oxygen demand (78%), Nitrate (74%) and Phosphate (60%) observed in CW2 at 3 days HRT. Pollutant removing efficiency of CW2 was higher than CW1 even at .5-day HRT. Both Canna and lemon grass shows good growth and covers more than 50% surface area. Treated water is good enough to reuse for irrigation, industrial cooling and controlled disposal in surface water.

Keywords: Biochemical Oxygen Demand (BOD); Chemical Oxygen Demand (COD); Hydraulic Resident Time (HRT); Pollutant Removing Efficiency (PRE)



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.

Contact Details

Pandit Deendayal Energy University
Knowledge Corridor, Raisan Village,
Gandhinagar – 382 426,
Gujarat (State), INDIA

email: water@pdpu.ac.in

Website: www.pdpu.ac.in

www.pdeu-h2o.com

9 789334 019520

PANDIT DEENDAYAL ENERGY UNIVERSITY
PDEU
PANDIT DEENDAYAL ENERGY UNIVERSITY
Formerly Pandit Deendayal Petroleum University (PDPU)