1st International Conference on

"Advances in Water Treatment and Management"

(ICAWTM-22)

25-26 March 2022, Gandhinagar, Gujarat, India

Editor's Name

Dr. Anurag Mudgal

Publisher's Address

Pandit Deendayal Energy University
Gandhinagar, Gujarat, India

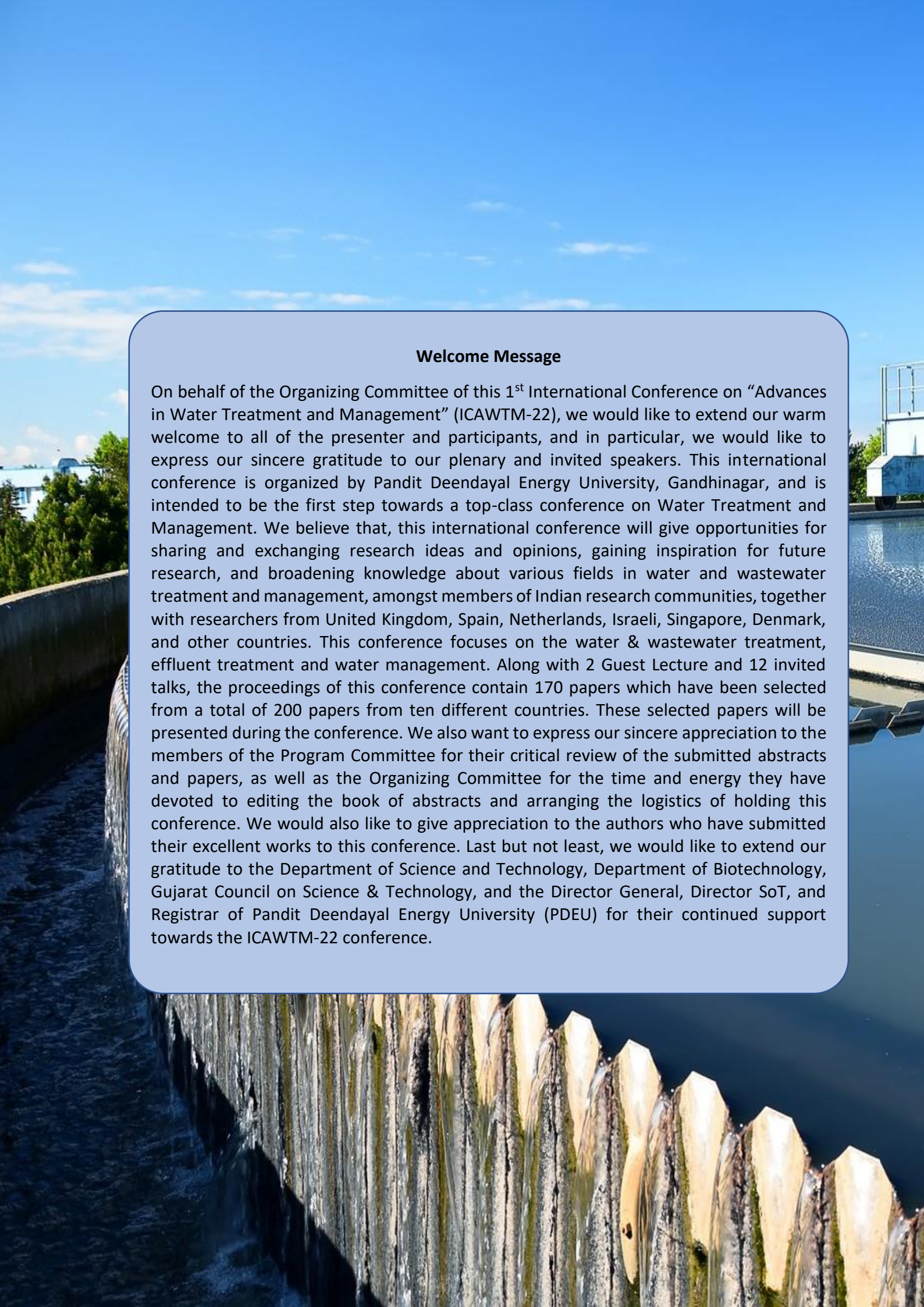
ISBN: 9789356206182

Organized by

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

In Associated with

GUJARAT COUNCIL ON SCIENCE & TECHNOLOGY
DEPARTMENT OF SCIENCE & TECHNOLOGY
GOVERNMENT OF GUJARAT



Welcome Message

On behalf of the Organizing Committee of this 1st International Conference on "Advances in Water Treatment and Management" (ICAWTM-22), 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, and is intended to be the first step towards a top-class conference on Water Treatment and Management. We believe that, this international conference will give opportunities for sharing and exchanging research ideas and opinions, gaining inspiration for future research, and broadening knowledge about various fields in water and wastewater treatment and management, amongst 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 & wastewater treatment, effluent treatment and water management. Along with 2 Guest Lecture and 12 invited talks, the proceedings of this conference contain 170 papers which have been selected from a total of 200 papers from ten different countries. These selected papers 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. Last but not least, we would like to extend our gratitude to the Department of Science and Technology, Department of Biotechnology, Gujarat Council on Science & Technology, and the Director General, Director SoT, and Registrar of Pandit Deendayal Energy University (PDEU) for their continued support towards the ICAWTM-22 conference.

1st International Conference
on

Advances in Water Treatment and Management (ICAWTM-22)

25-26 March, 2022

Pandit Deendayal Energy University

Knowledge Corridor, Raisan Village, Gandhinagar

Gujarat 382 426, INDIA

Book of Abstrats

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 invited lectures by eminent resource persons from reputed University and Institutions, 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 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
- Low-cost solutions for water treatment
- Renewable energy-based water treatment technologies
- Novel hybrid systems and module design
- Emerging desalination technologies
- Pre-treatment and post-treatment processes
- Membrane fouling and control
- Brine/concentrate management
- Resources recovery from brine
- Water recycling and reuse
- Wastewater treatment
- Wastewater treatment using immobilized microorganism technology
- Sustainability and water management
- Cost effective methods for removal of heavy metals
- Phytoremediation technologies for contamination of organic pollutants
- Bioremediation of contaminated water or wastewater
- 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
- Covid-19 impact in desalination

Our Team

Chief Patron

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

Patrons

Prof. Sunil Khanna
Director, School of Technology
Pandit Deendayal Energy University

Prof. Tarun Shah
Registrar
Pandit Deendayal Energy University

Convener

Dr. 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. Abhishek Kumar
Pandit Deendayal Energy University

Dr. Surendra Sasikumar Jampa
Pandit Deendayal Energy University

Dr. Daya Shankar Kaul
Pandit Deendayal Energy University

Dr Manoj Kumar Pandey
Pandit Deendayal Energy University

Dr. Achinta Bera
Pandit Deendayal Energy University

Dr. Anurag Kandya
Pandit Deendayal Energy University

Dr. Rajat Saxena
Pandit Deendayal Energy University

Dr. Madhavan N
Pandit Deendayal Energy University

Dr. Lakshmana Rao Jeeru
Pandit Deendayal Energy University

Manish Kumar
Pandit Deendayal Energy University

Rahul Deharkar
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. Chaitanyamoy Ganguly	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. Surendra Singh Kachhwaha	Pandit Deendayal Energy University, Gujarat, India
Prof. Vishvesh Badheka	Pandit Deendayal Energy University, Gujarat, India
Prof. R.K. Srivastava	G.B. Pant University of Agriculture and Technology, Pantnagar, India
Prof. Anurag Gupta	Pandit Deendayal Energy University, Gujarat, India
Dr. Guillermo Zaragoza	Centre for Energy, Environment & Technology Research, Spain
Dr. Cristina Yacoub Lopez	LEITAT Technological Center, Spain
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. Guofei Sun	Aquaporin, Singapore
Dr. Ravi Saini	CSIR-Central Electronics Engineering Research Institute, Rajasthan, India
Dr. Nirajan Dhakal	IHE Delft Institute for Water Education, Netherlands
Dr. Isaac Fernández Rodríguez	Fundacio Centro Technologico de Investigation Multisectorial (CETIM), Spain
Dr. Bhausaheb Botre	CSIR-Central Electronics Engineering Research Institute, Rajasthan, India
Dr. Satyam Srivastava	CSIR-Central Electronics Engineering Research Institute, Rajasthan, India
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. Francesca Audino	LEITAT Technological Center, Spain
Xuan Tung Nguyen	Aquaporin, Singapore
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. S Venkata Mohan
Senior Principal Scientist
CSIR-IICT, Hydrabad

Dr. Vinod Kumar Shahi
Senior Principal Scientist
CSIR-CSMCRI, Bhavnagar

Invited Speakers

Prof. Maria Kennedy
IHE Delft Institute for Water Education, Netherlands

Dr. Suphiya Khan
Banasthali University, Rajasthan, India

Prof. R.K. Srivastava
G.B. Pant University of Agriculture and Technology, Pantnagar, India

Dr. Jaichander Swaminathan
Indian Institute of Technology Gandhinagar, Gujarat, India

Dr. Guillermo Zaragoza
Centre for Energy, Environment & Technology Research, Spain

Prof Dinesh Kumar
Central University of Gujarat, Gandhinagar, India

Dr. Xialei You
LEITAT Technological Center, Spain

Prof. Philip Davies
University of Birmingham, UK

Rubén Rodríguez-Alegre
LEITAT Technological Center, Spain

Dr. Neil Stewart
Modus Research and Innovation, UK

Dr. Datta Madamwar
Charotar University of Science and Technology, Gujarat, India

Dr. Gabriela Cuadrado Quesada
IHE Delft Institute for Water Education, Netherlands

Program at Glance

Day-1

9:30 to 10:15	Inauguration of the Conference
10:15 to 11: 30	Inauguration of Centre of Excellence in Water Treatment and Management
11:30 to 12:00	Keynote Lecture by Dr. Vinod Kumar Shahi, CSIR-CSMCRI
12:00 to 12:30	Keynote Lecture by Dr. S Venkata Mohan, CSIR-IICT
14:00 to 14:30	Invited Talk by Prof. Maria Kennedy Invited Talk by Dr. Suphiya Khan Invited Talk by Prof. R.K. Srivastava Invited Talk by Dr. Jaichander Swaminathan
14:45 to 18:00	Paper Presentation WATER-001-WATER-051 (Track 1-4)
20:00	Network Dinner

Day-2

9:45 to 10:15	Invited Talk by Dr. Guillermo Zaragoza Invited Talk by Prof Dinesh Kumar Invited Talk by Dr. Xialei You Invited Talk by Prof. Philip Davies
10:15 to 13:15	Paper Presentation WATER-052-WATER-100 (Track 5-8)
14:30 to 15:00	Invited Talk by Rubén Rodríguez-Alegre Invited Talk by Dr. Neil Stewart Invited Talk by Dr. Datta Madamwar Invited Talk by Dr. Gabriela Cuadrado Quesada
15:15 to 18:15	Paper Presentation WATER-101-WATER-155 (Track 9-12)
18:15 to 18:45	Valedictory Function

Day-3

Visit to Statue of Unity (one day visit)

Paper Presentation

Track – 1 Pre-treatment and Removal of contamination from the water			
Track ID	**Authors Name**	**Paper Title**	**Page No.**
WATER-001	Juhi Rani and Biswajit Paul	Challenges in Arid Region Reclamation with special reference to Indian Thar desert and its conservation and remediation techniques	16
WATER-002	Maulik Arvindbhai Modi and Dr. Tushar M Patel	Determination of Plastic Pyrolysis Oil by high performance liquid chromatography (HPCL)	16
WATER-003	Madala Naga Rajani, Dasari Kiran Kumar and Vuruti Nageswar Rao	Biosorption of Parthenium Stem Powder for Removal of Lead and Optimized by using Box -Behnken Design	17
WATER-004	Mumtaz Gulamhussein, Bharti Saini and Anirban Dey	Removal of Pharmaceutical Contaminants through Membrane Bioreactor	17
WATER-005	Vaishali Umrigar and Divyesh Kakadiya	Removal of Toxic Metals from Wastewater by Using Dendritic Fibrous Nanosilica (DFNS)	17
WATER-006	Shruti Chaudhari and Dr. Prakash Samnani	Determination of Microplastics in Pond water	18
WATER-007	Vinayak Wadgaonkar and Niraj Topare	Removal of Cu (II) from Aqueous Solutions in Fixed-Bed Column Using Red Gram Husk Powder	18
WATER-008	Mistry Mitali, Valia Nihar, M A Shabiimam and Kandya Anurag	Advance Oxidation Techniques for Treatment of Oil Refinery Effluent: A Review	18
WATER-009	Shailee Gaur, Aditya Sahani, Pradipta Chattopadhyay and Amit Jain	Remediation of Waste Engine Oil Contaminated Soil Using Biosurfactant Based Detergent Formulation	19
WATER-010	Vamshi Krishna Mukkera, Srivani Katuri and Usha Sri Musham	Biodegradation of Chrysophenine GX using Candida Albicans (NCIM 3665)	19
WATER-011	R.V. Saikumar Reddy, B.V.S. Praveen, Narayan Chandra Pradhan and Lakshmana Rao Jeeru	Removal of Water Hardness Using Zeolite Synthesised From Fly Ash	19
WATER-012	Reema Mandal and Anirban Das	Fluoride in Groundwater: Approach to Health Perspectives	20
WATER-013	Janhavi Ingle and Upendra Patel	Catalytic Electrochemical reduction of nitrate in the presence of Ag-PVA beads	20
WATER-156	Mahak Kushwaha, Sonu Kumari, Neha Singh and Suphiya Khan	Effective Remediation of Acid Blue-113 Dye through Al/GO cellulose based 3D-hydrogel	20

Track – 2 Pre-treatment – Adsorption			
Track ID	**Authors Name**	**Paper Title**	**Page No.**
WATER-014	Mohd Danish, Khursheed B. Ansari and Mohammad Danish	Pore volume and surface diffusion model to characterize batch adsorption of Cu (II) over chemically modified Cucurbita moschata biosorbent: Simulation using gPROMS	21
WATER-015	Prajakta Ramteke, Asmita Jadhav, Sunit Kumar Singh, Petra Ecorchard and Nitin Labhasetwar	Efficient Selenium Removal from Water using Iron-based Mixed Oxide Adsorbents	22
WATER-016	Kirtee Dalve,Anuja Patil, Foram Malde, Harsh Murali, Aayush Iyer, Safina Saradar, Niraj Topare, Shantini Bokil, Vishnu Choudhari and Anish Khan	Applicability of Various Adsorbents for Removal of Dyes from Wastewater: A Review	22

Track – 3 Challenges and Opportunities: Wastewater Treatment

WATER-035	Krishna Neeti, Reena Singh and Shaz Ahmad	The role of green nanomaterials as effective adsorbents and applications in wastewater treatment	27
WATER-036	Brian Mwigo, Disha Suthar, Mumtaz Aliraza, Manish Kumar Sinha, Surendra Sasikumar Jampa and Smit Vala	Implementation and utilization of Zeolitic imidazolate frameworks (ZIFs) based membranes in waste water treatment: A review	29
WATER-037	Anupam Mukherjee, Birupakshya Mishra, Aditi Mullick, Subhankar Roy and Siddhartha Moulik	Study on Hydrodynamic Cavitation induced Degradation of Norfloxacin: Synergistic Effects of Integrated Advanced Oxidation Processes	28
WATER-038	Anuradha Awasthi, Kavita Gandhi and Sadhana Rayalu	Carbon nanomaterials for facilitated solar-powered wastewater treatment	30
WATER-125	Rajesh Kumar Jain, Rajesh Goyal and Dulal Goldar	Socio-economic impact of interlinking of rivers (ILR) using social accounting matrix (SAM) based model	30

Track – 4 Desalination technologies			
Track ID	**Authors Name**	**Paper Title**	**Page No.**
WATER-039	Krunalkumar B Patel and Tushar Patel	Comparative analysis of single basin stepped and conventional solar desalination system	31
WATER-040	Nipu Kumar Das, Dr. Papu Kumar Naik, Prof. Tamal Banerjee and Prof. Surya Sarathi Bose	Thermophysical properties for MWCNT based Phosphonium Eutectic Nanofluid: An Emerging Heat Transfer Media for Solar Desalination System	31
WATER-041	Tunuguntla Arun Sri Sai Krishna, Sumit Tiwari and Rajat Saxena	Performance comparison between double slope passive and active solar still based on energy matrices	32
WATER-042	Bandana Swain and Jatin Patel	Exergetic efficiency of single slope passive solar still: an experimental analysis	32
WATER-043	Pravesh Chandra, Anurag Mudgal and Jatin Patel	Design and Modeling of Vertical Tube Evaporator in a Thermal Driven Multiple Effect Distillation System	32
WATER-044	Sumata Das, Pritam Dey and Srimanta Ray	Mechanistic study on adsorption of aqueous pollutants on waste biomass derived activated carbon	33
WATER-045	Darshan Savaliya and Jatin Patel	A Review on Atmospheric Air Water Generation Technologies	33
WATER-046	Niyant Thakkar, Dr. Jatin Patel and Dr. Anurag Mudgal	Solar Still Water Desalination Sustainable Energy Solutions by Energy-Exergy-Environ Analysis	33
WATER-047	Hitesh N Panchal Panchal and Dr. Akhilesh Kumar Choudhary	Performance analysis of Atmospheric water generator to generate water from Atmosphere: A case study of Patan district	34
WATER-049	Dr. Williams Joy Koshy	Modified Route For Industrial Effluent Treatment Using Adsorption And Performance Comparison Of Activated Carbon And Lignite	34
WATER-050	Sivakumar Pandian and Harit Tarsariya	Production Water Treatment by Adsorption Produced From Waste Casting Sand	34
WATER-051	Vaishali Chauhan and Dr. Kalisadhan Mukherjee	Fe (III) Impregnated activated alumina for cationic and anionic dye adsorption in water	35
WATER-153	Karthik M and Suresh A.K	Improvement of Reverse Osmosis Performance of Polyamide Thin-Film Composite Membranes using Nanoparticles	35

Track – 5 Water Treatment			
Track ID	**Authors Name**	**Paper Title**	**Page No.**
WATER-052	Sireesha Mantena and Nageswara Rao Kunjam	Feasibility study on application of soft computing methods in groundwater potential mapping: A review	35
WATER-053	Helly Mehta, Dr. Manoj Gundalia and Kartik Sharma	Determination of appropriate Proportion of Mg and P addition in Human Urine to get Optimum Quantity of Struvite using MAP Crystallization Process	36
WATER-054	Mukesh A Modi and Dr Narendra J Shrimali	Remedial strategies to minimize the risk on public health due to high Nitrate concentrations in groundwater	36
WATER-055	Divyarajsinh Solanki, Prabhav Vakharia, Neel Suryawanshi, Parth Dabhole, Sweeti Sawant, Shivam Bhise, Shantini Bokil, Niraj Topare and Vishnu Choudhari	A Review on Adsorption of Dyes in Batch and Column Mode: Effects of Operating Parameters	36
WATER-056	Anjali Bibin Suja, Sowmya Dawalapuram, Vamshi Polagoni, Mosha Jeddi and A.V.Raghavendra Rao	Recent advances in Synthesis, Characterization and Applications of Activated Carbons from Coconut shell for water purification: A Review	37
WATER-057	Sarika Vithalkar and Dr.Ravin Jugade	Adsorption of Brilliant Green Dye by Used-Tea-Powder: Equilibrium, Kinetics and Thermodynamics Studies	37
WATER-058	Bandi Sumanth Kishore, Prasad Ksnv, Giri Raja Rohith, G Romie, S Ashok and Sara Harinath Goud	Biosorption of Dyes onto Cocoa Shell Powder in Batch Studies	37
WATER-059	Gudendra Negi, Anirbid Sircar and Sivakumar Pandian	Engineering the rheology and Interfacial tension behavior of mixed formulation of anionic and non-ionic surfactant with added nanoparticles	38
WATER-060	Yogendra Singh Solanki, Soumen Maity, Debojyoti Basuroy, Madhu Agarwal and Ab Gupta	Performance analysis to find the distribution of TDS, Fluoride, Alkalinity and Hardness in the groundwater of Rajasthan India- A Case study	38
WATER-061	Dhamsaniya Meet, Sojitra Dhruvin, Modi Harshul, M. A. Shabiimam and Kandya Anurag	Issues of Landfill Leachate and its Treatment Techniques: A Review	39
WATER-062	Borlon Daniel, Shah Meet, M. A. Shabimam and Kandya Anurag	Treatment of Water Using Natural Materials: A Review	39
WATER-063	Asim Fulzele, Saptarshi Dutta Purkayastha, Pandurang Balwant, Divya Kalra, Paras Pujari, Nitin Labhsetwar and Atya Kapley	Hydro-geochemical approach to study Sea water intrusion at Lodhva in Gujarat Coast-A case study	39
WATER-152	Pawan Gupta, Issac Wilson	Seawater Desalination Using Hydrate Technology	40

Track – 6 Heavy metals removal			
Track ID	**Authors Name**	**Paper Title**	**Page No.**
WATER-064	Aditya Kumar Jha and Sukalyan Chakraborty	UV Assisted Photocatalytic Degradation of Tetracycline and Ciprofloxacin Antibiotics using Biosynthesized nZVI from Shorea robusta leaf extract.	40
WATER-065	Jahanvi and Jaigopal Sharma	Encapsulation of bacterial cells in hydrogel to degrade microplastics	41
WATER-066	Vinayak Wadgaonkar and Niraj Topare	A Review on Application of Low-Cost Adsorbents for Heavy Metals Removal from Wastewater	41

Track – 7 Industrial Wastewater treatment			
Track ID	**Authors Name**	**Paper Title**	**Page No.**

WATER-085	Ganesh Dabhade, Gaurav Daware, Yennam Rajesh and Lakshmana Rao Jeeru	An Efficient Removal of Indigo Carmine Dye (IC) From Aqueous Medium Using Environmental Friendly Synthesized ZnAl2O4	48
WATER-086	Chaina Ram, Dr Anirudh Kulkarni and Dr Surendra Singh Kachhwaha	Application of Hydrodynamic Cavitation Devices in Industrial Wastewater Treatment: A brief review	49
WATER-087	Dr. Ravi Tejasvi and Setu Visavadia	g-C3N4@charred wood-sawdust as buoyant biodegradable photocatalysts for enhanced photocatalytic oxidation of organic wastewater pollutants	49
WATER-088	Dr. Ravi Tejasvi	Plastic circuit boards from computer e-waste as the cost-effective and flexible electrodes in electrolytic wastewater treatment	49
WATER-154	Harsh Patni and Balasubramanian Ragunathan	A Comprehensive Review on Recycling and Reusage of Oil-field Waste Water	47

Track – 8 Membrane Technology			
Track ID	**Authors Name**	**Paper Title**	**Page No.**
WATER-089	Smit Vala, Surendra Sasikumar Jampa and Manish Kumar Sinha	Ultrafiltration study of polysulfone (PSF) membrane modified with branched polyethyleneimine (PEI) .	48
WATER-090	Dixita Prajapati and Prof. Chivukula Murthy	Salt rejection study of reduced graphene oxide-polysulfone mixed matrix membrane	50
WATER-091	Priyanka Mistry and Chivukula Narayan Murthy	Surface Modification of Polysulfone/Azide-functionalized MWCNT Mixed Matrix Membrane using Click Reaction	50
WATER-092	Ajay V Gawali, Sapna A Gawali, Dr. Manish Kumar Sinha and Surendra Sasi Kumar Jampa	Study on water and gas permeation characteristics with ZIF-8 mixed matrix membranes	50
WATER-093	Dr. Km Nikita, Mr. V.K. Aswal and Prof. C.N. Murthy	Modification of functionalized MWCNT incorporated polyether sulfone mixed matrix membranes using click chemistry	51
WATER-094	Hiralkumar Morker, Bharti Saini and Anirban Dey	Role of Membrane Technology in Food Industry Effluent Treatment	51
WATER-095	Surendra Sasikumar Jampa, Manish Kumar Sinha, Ashish Prabhudas Unnarkat, Sapna Ajay Gawali, Smit Vala, Nagarjuna Reddy Paluvai and Ajay Gawali	Structured Nano Materials Derived From MOF	52
WATER-096	Pratik Saha, Manish Kumar Sinha and Surendra Sasikumar Jampa	Hybrid Membrane Process for water treatment	51
WATER-097	D. Dsilva Winfred Rufuss, Yawen Wu and P. A. Davies	Effects of feed and draw solutions temperature on the performance of Aquaporin HFFO.6 membrane in forward osmosis	52
WATER-098	Rubén Rodríguez-Alegre, Abel Lara, Xialei You, Natalia Rey-Martínez, Montserrat Pérez-Moya and Julia García-Montaño	Assessment of ultrafiltration membranes for domestic food waste and blackwater treatment with AnMBR	53
WATER-099	Anwesha Mohanty, Hrishikesh Saikia, Nitya Tailwani, Tushar Patil and Swapnil Dharaskar	ENERGY EFFICIENT CO2 SEPERATION USING NANOPARTICLES SUPPORTED MEMBRANE: A REVIEW	53
WATER-100	Philip Davies, Ebrahim Hosseinipour, Somayeh Karimi, Anurag Mudgal and Dhaval Patel	Practical brackish water desalination with 94% recovery and specific energy consumption below 0.6 kWh/m3	54

Track – 9 Modelling and Optimisation			
Track ID	**Authors Name**	**Paper Title**	**Page No.**
WATER-101	Padma Parija, Sudarsan J.S and Suribabu C.R	Usage Of Flap Gate For Optimisation Of Discharge: A Sustainable Water Management Approach	54
WATER-102	Siraj Bhatkar, Lalitkumar Kshirsagar, Niraj Topare, Vinayak Wadgaonkar and Yash Chavan	Dose Optimization of Oil Field Produced Water and Advanced Water Treatment for Heavy Viscous oil	55
WATER-103	Siraj Bhatkar, Nishank Badhe and Avishkar Adhatrao	Optimizing produced water quality for enhancing oil recovery	55
WATER-104	Jerripotu Gopala Rao, Gunwant Sharma and Sudhir Kumar	Optimal Operation of the KLRao Sagar Pulichintala Reservoir using Genetic Algorithm under RCP4.5 Climate Change Scenario	56
WATER-105	Vishal Dhakane, Dharmik Gohil, Manish Kumar and Paawan Sharma	Modelling and simulation of Bubble column Integration with HEIR Technology for Water Purification	56
WATER-106	Harsha Sahu, Soumyadeep Dutta, Tilottama Chakraborty and Mrinmoy Majumder	Feature Selection for Decision Making in Water Treatment Plant: A Modified AHP Approach	54
WATER-107	Chintavi Patel, Abhilash Nair and Abhipsa Makwana	Electrooxidation of leachate: Understanding effect of cathode material and process optimization using Response Surface Methodology	56
WATER-108	Reshma Malan and Narendrasinh Desai	Contaminate transportation modeling with time dependent dispersion	57
WATER-109	Jigar Modi and Vivek Patel	Thermo-Ecological Optimization of Shell and Tube Heat Exchanger	57
WATER-110	Trushil Patel and Dr. Vivek Patel	Multi-objective optimization of offset Plate-Fin Heat Exchanger	57
WATER-111	Harshil Pancholi and Vivek Patel	Optimization of Cooling System	58
WATER-112	Praharsh Patel, D.M. Pandya and Manan Shah	A Review on Various Mathematical Techniques for Groundwater Quality Analysis and Assessment	58
WATER-113	Parthiv Pal, Anurag Mudgal and Manish Kumar	Design and Analysis of Heat Exchanger for Safety of Tubes by Radiated Water	58

Track – 10 Water Management			
Track ID	**Authors Name**	**Paper Title**	**Page No.**
WATER-114	Divya Rameshkumar Patel and Sandesh Chibber	A Study Of Physico Chemical Parameters of Sabarmati River in Ahmedabad District, Gujarat, India	59
WATER-115	Karthik Raghunathan, Deepak Marathe, Umakant Thawale, Seshpal Rathod and Prashant Thawale	Phyto hydraulic management of wastewater from Automobile industry using High Rate Transpiration System	59
WATER-116	Dattatray Kumbhar, Ashok More and Sachin Mane	Curb Pollution of River -Dealing with Dry Weather Flow Interception	58
WATER-117	Gopal Prasad Patel	Environmental Effects of River Sand Mining: A study on the Mahanadi River Basin of Mahasamund District, Chhattisgarh, India	60
WATER-118	Ajmal Koya Pulikkal and Sajeesh Adangampurath Kolothumthodi	Water quality assessment of open wells in Malappurm district, Kerala	60
WATER-119	Dipesh Dalal	A review on methods for effective management of water losses an effort made by Indian Authors	60
WATER-120	Dipesh Dalal and Dr Rupesh Vasani	Leakage Detection in Water Distribution Systems using WSN for Smart Cities	61

Poster-6	Nikhil Savio and Rajeev Kumar Srivastava	Potentialities of Plant based hybrid wetland systems for the treatment of Household grey water using Canna indica, Agave americana and Tagetes sp.	73
Poster-7	Varsha Mudgal, Milan Raninga, Dhaval Patel, Dipak Ankoliya and Anurag Mudgal	Sustainable method for removal of heavy metals: Phytoremediation	74
Poster-8	Nikunjkumar Vagadiya, Mohil Odedara, Dhrutikumari Patel, Sudhanshu Sharma and Nandini Mukherjee	Anion detection employing synthetic chemosensors in aqueous media	74
Poster-9	Milan Raninga, Anurag Mudgal, Vivek Patel and Jatin Patel	Design of ORC-RO System for Utilizing Waste Heat from Flue Gases of Coal-Fired Thermal Power Plant	74
Poster-10	Dipak Ankoliya, Anurag Mudgal, Manish Kumar Sinha, Vivek Patel and Jatin Patel	Techno-economic analysis of hybrid electrodialysis-batch reverse osmosis process for brackish water desalination	75
Poster-11	Dipak Ankoliya, Anurag Mudgal, Manish Sinha, Vivek Patel and Jatinkumar Patel	Application of electrocoagulation process for the treatment of dairy wastewater: a mini review	40
Poster-12	Milan Raninga, Anurag Mudgal, Vivek Patel, Jatin Patel and Manish Kumar Sinha	A mini review on adsorption of industrial dyes and removal of heavy metals	52
Poster-13	Dhaval Patel, Anurag Mudgal, Vivek Patel and Jatin Patel	Mathematical approach for better performance of flat-sheet forward osmosis membrane	59
Poster-14	Anu Manhas, Siddhi Kediya and Mohil Odedara	The DFT/TD-DFT study on benzothiazole based chemosensor to decipher anion sensing mechanism	75
WATER-048	Rubén Rodríguez-Alegre, Abel Lara, Xialei You, Montserrat Perez-Moya and Julia García-Montaño	Reuse of domestic grey water with green wall and alternative post-treatments	75

Challenges in Arid Region Reclamation with special reference to Indian Thar desert and its conservation and remediation techniques

Juhi Rani[1*] and Biswajit paul[2*]

[1,2] *Department of Environmental Science and Engineering, Indian Institute of Technology (Indian School of Mines), Dhanbad -826004, Jharkhand, India.*

Abstract: The present paper systematically and inclusively reviewed about the arid zone and its major challenges with respect to environmental condition for the healthy growth of plant. Arid zone suffers from various problems like low and erratic rainfall, high temperature, salinity/ alkalinity and low nutrients status of soil. Presence of irrigation water with high salinity, Electrical conductivity and total dissolved solute (TDS) and some geological related constraints also poses amajor problem in arid land. This paper also critically reviews about the remediation process for the improvement of soil and water quality in the arid and semi-arid region. It can be done by various ways but in this review, article focus on green remediation techniques, phytoremediation and biochar application are given for soil treatment and for water treatment use of methods like treatment with herbal plants, biochar addition and use of mangroves. This process proved to be fruitful for desalination and TDS reduction of water. Apart from these techniques some managementtechniques for the conservation of soil and water in arid parts are also given light. These techniquesinclude shelterbelt plantation, fixation of sand dunes, water harvesting by khadin system and Negarim system, implication of Bhungroo technology, Dew and rain ridge collection system, useof micro irrigation system consisting of Drip and Sprinkler method. These are used for the protection of soil, crops, environment and for the conservation of water which helps in doing sustainable and healthy agriculture practice. This system also helps the small and marginal farmersby increasing their productivity of crops and hence their income because in arid land major dependency of farmers is on rain and in some years, it is too low for the growth of crops. In additionto this some barrier techniques like bunding, vegetative barriers, subsurface moisture barriers anduse of antitranspirants are also mentioned. These can be helpful in reducing runoff, transpiration rate and improving moisture storage capacity in soil. This study also reviewed about the role of Plant Growth Promoting Bacteria (PGPR) and its advantages in arid land and also about the Integrated farm management (IFM). The role of PGPR is to induce growth in plant directly or indirectly. It contributes in the progression of sustainable agriculture practice by production of vital enzymes that helps in the growth of root, prevention of plant disease by the production of siderophores and by symbiotic and asymbiotic nitrogen fixation. Some PGPR strains in the arid land had also been reported to implicate in the metabolism and growth of plant by withstanding the unfavorable condition of the arid land. IFM is cost effective, waste recycling process and economical process. It is an ideal way to cope up with the arid region problems. In this system techniques like intercropping, horticulture, agrisilviculture, agri horti system and silvi pastoral. It is a combined way of growing trees, crops, grasses and fruits. It efficiently utilizes all the inputs andismore fruitful and profitable than single cropping.

Determination of Plastic Pyrolysis Oil by high performance liquid chromatography (HPCL)

Maulik A Modi[a], Dr.Tushar M Patel[b]

[a]*KSV University, Sector-15, Gandhinagar-382015, India*

[b]*LDRP-ITR, KSV University, Sector-15, Gandhinagar-382015, India*

Abstract: This study reports a basic and helpful insightful interaction for the simultaneous assurance of Plastic Pyrolysis Oilby HPLC (high performance liquid chromatography). This approach is based on normal-phase high performance liquid chromatography with refractive index detection. It employed silica stationary phase, n-hexane mobile phase. From the chromatography library, we can find the standard chemical compound based on their Retention time. Mass spectrometry result of LDPE, HDPE & PP for low, medium & high carbon content, got the different chemical compound with its molecular weight and chemical compound contain carbon in the range of C_7 to C_{34} which is very similar carbon content in diesel fuel (C_9 to C_{26}) as shown in diesel chromatogram. Diesel Carbon content C_9 to C_{21} with 7 to 33 minutes retention time. LDPE Carbon content C_7 to C_{16} with 2 to 36 minutes retention time. HDPE Carbon content C_9 to C_{34} with 2 to 30 minutes retention time. PP Carbon content C_7 to C_{18} with 2 to 28 minutes retention time. From the result it can be conclude that carbon contain of LDPE, HDPE & PP found similar result as Diesel. By performing chemical composition analysis using chromatography and mass spectrometry, it can be conclude that plastic fuel having similar chemical composition as diesel fuel; Plastic fuel is another option as an alternative fuel of Diesel. By performing HPLC chemical composition analysis of unknown fuel, we can conclude unknown fuel can be useful as an alternative fuel or/not before doing direct experimental work on engine.

Keywords*: HPLC Instrument; Diesel; LDPE; HDPE; PP.*

Biosorption of Parthenium Stem Powder for Removal of Lead and Optimized by using Box -Behnken Design

M Naga Rajani [a]*, D Kiran Kumar [b], V Nageswara Rao [a]

[a] * *Department of Chemical Engineering, Andhra University College of Engineering, Andhra University,Visakhapatnam-530 003, Andhra Pradesh, India.*

[b] *Department of Pharmaceutical Engineering, B.V. Raju Institute of Technology, Narsapur, Medak, 502313,Telangana, India.*

Abstract: Products obtained from cheap adsorbent sources such as agricultural wastes; various leaves were used in the removal of Pb (II) ions from aqueous solutions. This thesis determines Kinetic studies on adsorption of Pbions from an aqueous solution using an adsorbent from plant source, low-cost called as "**Parthenium Stem powder**" leaves, they have a common name as "Parthenium". From the experimentation it is determined that 0.5g of "Parthenium" stem powder of 53µm size was obtained to be enough to remove 60.08% of 100mg/L concentration of Pb from 50mL of aqueous solution in 50min. Results showed that adsorption of Pb increased with increase in adsorbent dosage. The Freundlich and Langmuir models were applied to describe the equilibriumisotherms and isotherm constants were determined. The Kinetic studies show that the adsorption of Pb on the "Parthenium" stem powder follows pseudo-second-order kinetics. Various thermodynamic parameters such as enthalpy, Gibbs free energy and entropy of adsorption were also determined and the above parameters were optimized by using '**BOX -BEHNKEN DESIGN'** Hence' the results show that "Parthenium" stem powder is effective in Pb removal and can be appreciably considered as most versatile, economical and feasible adsorbent for reclamation of Pb from aqueous solutions.

Keywords*: Gibbs free energy, Kinetic studies, Parthenium Stem powder, Pb (II) ions.*

Removal of Pharmaceutical Contaminants through Membrane Bioreactor

Mumtaz Aliraza[a], Bharti Saini[a*], Anirban Dey[a]

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

Abstract: One of the most basic need for life is water, being utilized in our consistently daily needs for example; drinking, washing, cooking and so forth. The rapid growth of the population and economy around the world gives rise to the demand of sanitary water. Water is polluted by the industry, residential and agricultural waste streams. Pharmaceutical contaminants have been emerging in the water bodies with different types of groups. This contaminant can be treated by conventional techniques such as; chlorination, activated carbon etc. A membrane bioreactor, which is a combination of a membrane process like ultra-filtration or Nano-filtration with activated sludge process can also be used. In this article, I am going to review some methods used to remove pharmaceuticalcontaminants from waste water using a membrane bioreactor.

Keywords*: Membrane bioreactor; Pharmaceutical contaminants; Nano-filtration; Reverse osmosis; Sludge retention time; Hydraulic retention time.*

Removal of Toxic Metals from Wastewater by Using Dendritic Fibrous Nanosilica (DFNS)

Vaishali Umrigar[1*], Kushal Gandhi, Kakadiya Divyesh, Naik Priyanka

[1] Chemical Engineering Department, Sarvajanik College of Engineering and Technology, Surat 395001, India.

Abstract: Dendritic fibrous nanosilica (DFNS) is a notable invention in recent years. Due to the fibrous morphology; DFNS behaves differently for various applications. This morphology enhances the molecular loading on active sites of silica surface by avoiding blockage of the pores and due to high surface area of silica material gets better internal surface accessibility with controlled particle sizes, tunable pore size and pore volumes which improves stability of DFNS. In line with the research in the field of atom economy of the molecules to achieve maximum efficiency in various applications in the area of catalyst, energy storage, solar energy harvesting, biomedical applications, the use of DFNS as vast or global material is very keenly required. For the current study the target is to synthesize DFNS with the wide adoptability by improving different properties and apply it for the removal of pollutants such as toxic metal ions specifically chromium (Cr+2) and mercury (Hg+2). Characterization of DFNS morphology have been detected by Scanning electron microscope (SEM) to apply for the current water treatment processes.

Keywords*: wastewater, nanosilica, SEM analysis, toxic metals*

Determination of Microplastics in Pond water

Shruti Chaudhari [a], Prakash Samnani [b]

[a] *Shruti Chaudhari, Department of Environmental Studies, The Maharaja Sayajirao University of Baroda, Vadodara-390002, India*

[b] *Prakash Samnani, Department of Chemistry, The Maharaja Sayajirao University of Baroda, Vadodara-390002, India*

Abstract: Plastics in the form of the fibers, fragments or beads, smaller than 5 mm in size, are of increasing concern. These are called as the microplastics. Microplastics is considered generalized pollutant that is present in practically all environmental compartments, especially in the marine and freshwater environment. Microplastics pollution has not been studied much for Indian aquatic systemslike ponds in urban areas. In this study, we present the assessment of microplastics pollution in Vadodara's Gotri pond water. Furthermore, several techniques exist for assessing microplastics extracted from water samples, standardization of the techniques is still not achieved. Using more common methods of density separation, we have isolated and characterized microplastics in watersamples collected from the pond. The study shows for the first time presence of microplastics pollution in ponds in the city, with the amount ranging from 0.010 mg to 0.039 mg per liter. In this study we show presence of the microplastic in various shapes - fragment, fibers, film, foam and many irregular particles - with the help of almicro light compound binocular microscope. The isolated microplastics were characterized using FTIR spectroscopy, based on the identification of functional groups in the material.With the help of the literature data, we conclude that PVC (polyvinyl chloride), PP (polypropylene), PET (polyethylene Terephthalate), PS (polystyrene), HDPE (High density polyethylene) and LDPE (Low density polyethylene) are present in these samples.

Keywords*: Microplastics pollution, pond water, sample collection, microscope, FTIR spectroscopy*

Removal of Cu (II) from Aqueous Solutions in Fixed-Bed Column Using Red Gram Husk Powder

Vinayak S. Wadgaonkar[1*], Niraj S. Topare[2], Siraj A. Bhatkar[1], Dinesh S. Bhutada[2]

[1*] *School of Petroleum Engineering, Dr. Vishwanath Karad MIT World Peace University, Pune-411038, India*

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

Abstract: The adsorption capacity of red gram husk powder (RGHP) in a fixed-bed adsorption column was determined by studying the removal of Cu (II) from an aqueous solution. Different process parameters were used to determine the breakthrough characteristics of the adsorption system, including initial Cu (II) concentrations of (6, 8, 10 ppm), bed heights of (20, 30, 40 mm, and flow rates of (3, 5, 7 mL/min). The bed height and flow rate were shown to influencethe breakthrough point. Breakthrough and exhaustion times were shown to rise favorably as bed height was increasedwhile flow rate and concentration were reduced. When a 30 mm bed depth was employed with a concentration of 8 ppm and a flow rate of 5 mL/min., the highest absorption capacity was attained. The adsorption data were analyzed using the Adam-Bohart, bed depth service time, and Yoon-Nelson models. The RGHP was shown to have a good potential for Cu (II) removal and might be used as a low-cost adsorbent alternative.

Keywords*: fixed-bed column, red gram husk powder, adsorption, breakthrough, Cu (II)*

Advance Oxidation Techniques for Treatment of oil Refinery Effluent: A Review

Mitali Mistry [a], Nihar Valia [b], Shabiimam M A [cd] Anurag Kandy [ae]

[abce] *Civil Engineering, SOT, Pandit Deendayal Energy University, Gandhinagar, 382007*

[d] *Gujarat Energy Research Management and Institute, Gandhinagar, 382007*

Abstract: India being an emerging country the consumption of oil and its products like diesel fuel, gasoline, kerosene, liquified petroleum gas and various more, generating more waste in which wastewater is a major component. Indian refinery generates 28,220 tons of wastewater per annum. Refinery effluent contains high amount of organic load, color and refractants. There are several treatments techniques are available. However, the selection of suitable treatment techniques is a challenge. Advanced oxidation Processes are highly efficient for domestic wastewater treatment. In this review study discussed about the various and Advanced Oxidation Process like Fenton and Photo Fenton process, H2O2 process, Photocatalysis, Ozonation techniques with respect to BOD, TOC and COD Removal. It presented overview that the photolytic and degradation proven more efficient organic removal. This study is to look at how advanced oxidation technologies are currently use to treat waste water from oil refinery. This data exposes the scientific literature as well as prospective research directions for analyzing the impact of various technologies on oil refinery treatment.

Keywords: Advance Oxidation, Fenton, Photo-Fenton, Degradation, Pollutant Removal

Remediation of Waste Engine Oil Contaminated Soil Using Biosurfactant Based Detergent Formulation

Shailee Gaur [1], Aditya Sahani [2], Pradipta Chattopadhyay [3], Amit Jain [4*]

[1,2,3,4]*Department of Chemical Engineering, Birla Institute of Technology and Science, Pilani – Pilani Campus, Pilani-333031, India*

Abstract: The development of a suitable technology for the remediation of waste engine oil contaminated soil is the need of thehour. With no proper measures to recycle or dispose of the waste engine oil, it is often dumped on the land or spilled into waterways. This constitutes a significant hazard to the environment, humans, animals, microbial community, and freshwater sources. The application of rhamnolipid biosurfactant based detergent formulation for remediation of wasteengine oil contaminated desert soil using soil washing technique was studied. At a biosurfactant concentration of 0.02% (w/v), the rhamnolipid based biosurfactant obtained a high percentage of oil removal efficiency/detergency. The commercial rhamnolipid biosurfactant R90 based detergent formulation gave percentage detergency of about 91%, whereas the other four rhamnolipid produced in-house from waste engine oil as substrate gave percentage detergency between 79-85%. The surface tension reduction property, emulsifying potential, foamability, and foam stability of the biosurfactants and detergent formulations are also described. The important feature is that these soil washing studies were done at a temperature of 25°C (room temperature), thus giving excellent oil recovery potential using biosurfactants without the need for high temperature treatments unlike heavy oil-contaminated sediments recovery.

Keywords*: Waste Engine Oil; Soil Washing; Biosurfactant; Detergency; Rhamnolipid; Oil recovery*

Biodegradation of Chrysophenine GX using Candida Albicans (NCIM 3665)

Vamshi Krishna Mukkera*, Srivani Katuri, Usha Sri Musham

Department of Chemical Engineering, National Institute of Technology Warangal-506004, Telangana, India.

Abstract: The present study refers to the bioremediation of the dye Chrysophenine GX contaminated water using the microbe yeast *Candida Albicans* (NCIM 3665). The bioremediation experiments at various pH levels and Temperatures weredone in 250ml glass flasks at a dye concentration of 50 mg/L in an incubating shaker at 80rpm. *Candida Albicans* uses the dye-containing nutrient medium as a carbon and energy source. By finding the absorbance values of the supernatants using UV-Vis spectrometer, decolorization was found and its maximum value obtained is 86.25% whichwas found at the optimum conditions of pH 8, 50mg/L dye concentration, temperature maintained at 28^{o}C, and for 72hours of incubation at 80 rpm. Under the same conditions, the experiments were also done in the control flasks whosedecolorization of 1.318 % was obtained. It can be observed that the amount of decolorization of the simulated wastewater by the microbial process is significantly higher than that of the control flask. The Kinetics of the biodecolorization process deduced the value of Michaelis constant (K_m) to be 0.851 mol/l and the maximum rate of reaction (V_{max}) to be 0.11383 moles/h. Hanes Woolf plot shown greater applicability of the experimental runs with R^2=0.9762

Keywords: *Candida Albicans*; Chrysophenine GX**;** Biodegradation; Optimum; Kinetics; Hanes Woolf

---

Removal of Water Hardness Using Zeolite Synthesised from Fly Ash

R.V. Saikumar Reddy [a], B.V.S.Praveen [b], N.C. Pradhan [c], Lakshmana Rao Jeeru [d,*]

[a] *Department of Mechanical Engineering, G. Pulla Reddy Engineering College, Kurnool, A.P. 518007, INDIA*

[b] *Department of Chemical Engineering, B V Raju Institute of Technology, Vishnupur, Narsapur, Medak 502 313, INDIA*

[c] *Department of Chemical Engineering, IIT Kharagpur, Kharagpur, West Bengal 721302, INDIA*

[d] *School of Petroleum Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat 382 426, INDIA*

Abstract: The usage of economical materials in zeolite synthesis has a broad interest in water softening. The paper deals with coal-based fly ash into zeolite via fusion with alkali followed by hydrothermal treatment. The zeolite thus synthesized is basically aimed at the removal of calcium ions from the 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 thus prepared has been characterized with XRD and SEM analysis and also compared with the commercially available 13 X zeolite. The batch study has been carried out in order to compare the ion exchangeability of the synthesized zeolite with that of commercially available zeolite. The thermal stability of the synthesized zeolite has been determined.

Keywords: *Fly ash; 13X zeolite; characterization; Calcium; Adsorption*

Fluoride in Groundwater: Approach to Health Perspectives

Reema Mandal, Anirban Das*

Pandit Deendayal Energy University

Abstract: The problem of high Fluoride (F > 1.5 mg/L) in groundwater (GW) is widespread and has deleterious effect on humans. In Gujarat residents of eighteen districts are prone to problem of groundwater fluoride. An extensive study is carried out in the semi-arid regions of Banaskantha (23°33 N- 24°25 N; 71°07E- 73°02 E) and Patan (23°24 N - 24°09 N; 71°01E - 72°30 E) districts, North Gujarat, India which has a combined geographical area of ~16000 km2 and host a population of ~4.46 million as per 2011 census. The study primarily aims to: (i) determine non-carcinogenic health risk, its severity and total population at risk due to exposure of fluoride, and (ii) suggest effective remedial measures and better groundwater management practices to ensure public health safety of the local residents from fluorosis. Our results suggest 44% and 42% of the samples in Banaskantha and Patan districts respectively have F above WHO permissible limit of 1.5 mg L−1. Human Health Risk was quantified by Hazard Quotient (HQ) index for the oral pathway following USEPA protocols. HQ values ranged from (0.06 to 4.11) for adult and (0.1 to 8.55) for children. Conservative estimates suggest 0.45 million child and 1.06 million adult population of these districts are potentially at high risk from fluorosis. GIS maps based on Empirical Bayesian Kriging model show Danta, Dantiwada, Dhanera, Vadgam, Sidhpur and Patan sub-districts are the high-risk zones in the studied region for which we require GW treatment and better management practices of this resource. We suggest that local administration and stakeholders should install at the least low-cost fluoride treatment plants in these hot-spots areas, and only the treated water should be used for drinking; (ii) use and harvesting of rainwater should be given a top-priority-approach by all stakeholders in these overexploited-groundwater, semi-arid-and-surface-water-scarce region.

Keywords*: Semi-arid region, Fluoride, Hazard quotient, Health Risk Assessment, Geostatistical modeling*

Catalytic Electrochemical reduction of nitrate in the presence of Ag-PVA beads

Janhavi Ingle, Upendra D. Patel*

Civil Engineering Department, Faculty of Technology & Engineering, The Maharaja Sayajirao University of Baroda, Gujarat, India

**Corresponding author. E-mail: ingle_janhavi@yahoo.com, patelupendra@gmail.com, udpatel-ced@msubaroda.ac.in*

Abstract: Increasing concentrations of nitrate in water sources is a growing concern, necessitating the development of techniques to remove it. In the present study, the removal of nitrate was studied in a divided and undivided electrolytic cell in the absence and presence of metallic silver coated polyvinyl alcohol beads (Ag-PVA beads). In the undivided cell using graphite (Gr) as anode & iron (Fe) as cathode, nitrate removal was limited to 13% and 28%, respectively in the absence and the presence of Ag-PVA beads, while there was no TN removal in either case. In a divided cell, nitrate reduction & TN removal was 65% & 12%, respectively in the absence of Ag-PVA beads which increased to 85% & 52% respectively in the presence of 6.67 mM Ag-PVA beads. The influence of various types of cathodes (SS, Fe, Fe coated Sn, Cu, Ti) was studied using a divided cell. The nitrate removal followed an order: Fe > Ti ≈ Cu > SS > Fe/Sn at the current density of 15 mA/cm2 in 90 min in the presence of 6.67 mM Ag-PVA beads. The selectivity towards nitrogen gas was maximum with Fe cathode which was 52%. Ammonia was the major product obtained with all the cathodes (except Fe). It appears that the intercalation of nascent hydrogen on metallic silver results in the formation of AgHx, which causes catalytic reduction of nitrate. Ag-PVA beads could be reused up to 8 times. The influence of current density (5mA/cm2, 10mA/cm2, 15mA/cm2 and 20mA/cm2) for nitrate reduction was also studied.

Keywords: *Electrochemical reduction (ECR), Ag-PVA beads, Nitrate reduction, TN removal*

Effective Remediation of Acid Blue-113 Dye through Al/GO cellulose based 3D-hydrogel

Mahak Kushwaha, Sonu Kumari, Neha Singh and Suphiya Khan

Banasthali Vidyapith, Rajshatan

Abstarct: Clean water has become increasingly difficult to access due to the environmental discharge of pollutants. Azo dyes have led to severe water pollution and continues to cause serious health problems. Adsorptive removal of dyes from water has attracted intensive interest in the treatment of water pollution. Present study focuses on development of Al/GO cellulose based 3D-hydrogel for acid blue-113 dye remediation. The characterization of green synthesized Al nanoparticles (NPs) and GO has been carried out by using various analytical techniques such as XRD, FESEM and EDX. The parameters such as adsorbent dose and pH of dye solution in adsorption process were optimized. The maximum percentage dye removal was reported upto 97.23% at a contact time of 16 min. Moreover, the study of the adsorption kinetics and isotherm indicate that the pseudo-second-order kinetics and Langmuir isotherm model is more suitable for describing the experimental adsorption data having maximum adsorption capacity of 5.34 mg g−1. Overall, these hydrogel-based materials have demonstrated outstanding removal capabilities for dyes and might be promising for environmental purposes.

Pore volume and surface diffusion model to characterize batch adsorption of Cu (II) over chemically modified Cucurbita moschata biosorbent: Simulation using gPROMS

Mohd Danish, Khursheed B. Ansari, Mohammad Danish*

Department of Chemical Engineering, Zakir Hussain College of Engineering and Technology, Aligarh Muslim University, Uttar Pradesh, India

Abstract: This work describes the successful simulation of the pore volume and surface diffusion (PVSD) model for Cu (II) batch adsorption on a chemically modified Cucurbita moschata biosorbent. The model captures the convective transport of Cu (II) from the bulk solution to biosorbent surface followed by surface and pore diffusion inside the biosorbent. The adsorption physics is mimicked using Langmuir isotherm. The developed model comprises of coupled algebraic, ordinary, and partial differential equations solved by using gPROMS. The results have been depicted by Cu (II) concentration decay curve, which excellently matches the experimental data, thereby validating the adopted PVSD model. The statistical analysis of the PVSD model has been done by calculating R2 and Root mean square error. The external mass transfer coefficient, pore volume diffusion coefficient, and surface diffusion coefficient have been estimated. In addition, the relative contribution of the pore volume diffusion and surface diffusion for Cu (II) adsorption has been calculated. The parameters estimated in the present work could be the benefit of other heavy metal removal using biosorbent.

***Keywords**: Adsorption, Diffusional models, Heavy metals, gPROMS, Wastewater Treatment*

Orange Peel Activated Carbon Produced from Waste Orange Peels for Adsorption of Methyl Red

Niraj S. Topare[1,2*], Sunita Raut-Jadhav[2], Shantini A. Bokil[3], Anish Khan[4,5]

[1,2]School of Chemical Engineering, Dr. Vishwanath Karad MIT World Peace University, Pune-411038, India*

[2]Department Chemical Engineering, Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune, 411043, India

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

[4]Chemistry Department, Faculty of Science, King Abdulaziz University Jeddah, 21589, Saudi Arabia

[5]Center of Excellence for Advanced Materials Research, King Abdulaziz University, Jeddah 21589, Saudi Arabia

Abstract: The presence of contaminants in the water is a very serious environmental issue. To overcome this problem, the present paper presents the development and evaluation of the efficiency of activated carbon produced from orange peels for the removal of methyl red (MR) from aqueous solutions. The bulk density, particle size, surface area, and proximate analysis of produced adsorbents can be employed for characterization. The specific surface area of the prepared adsorbent was 512.2 m2/g. Adsorbent concentration (0.25 to 1.25g/L), MR concentration (100 to 400 mg/L), temperature (40 to 60°C), contact time (10 to 60 minutes), and pH (3 to 11) were all examined in this experiment. At an amount of adsorbent of 1g/L adsorbent, MB concentration of 100 mg/L, and a pH of 11, maximum adsorption has been observed. Adsorption models such as Langmuir and Freundlich were used to examine the results. At 60°C, the adsorption isotherm was found to fit the Langmuir model with 111.11 mg/g. The linear regression correlation coefficient, R2 value 0.966. Analytical results showed that MR could be effectively removed from water by using activated carbon made from waste orange peels as an adsorbent.

***Keywords**: Adsorption, Activated carbon, Isotherms, Orange peels, Process Parameters*

Nano-Metal Oxides-Activated Carbons for Dye Removal: A Review

Mugdha Bichave [1], Akshta Kature [1], Shreya Koranne [1], Rutuja Shinde [1], Akhila Gongle [1], Vishnu Choudhari [1*], Niraj S. Topare [2], Shantini A. Bokil [3]

[1] School of Pharmacy, Dr. Vishwanath Karad MIT World Peace University, Pune-411038, India*

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

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

Abstract: It is common for dyes to be utilized in a wide range of industries such as leather and textiles as well as the printing, paper, and packaging industry. Most dyes fall into a dangerous category of water toxins that have had a significant impact on the ecosystem. Dye removal from wastewater can be done in a variety of methods. It is now necessary to develop advanced and cost-effective methods. Organic dyes may be removed from textiles using adsorption, which isa more effective and environmentally beneficial process. Nanomaterials are a more attractive option for dye removalbecause of their unique characteristics. An overview of the synthesis, characterization, and dye removal capabilities of nano-metal oxides-activated carbons is presented. This review also includes a discussion of several operating parameters associated with the adsorption process, adsorption isotherms, kinetics, thermodynamic behavior, and reusability of the adsorbent.

***Keywords**: Nanomaterial, Metal oxide, Activated carbon, Adsorption, Dyes*

Applicability of Various Adsorbents for Removal of Dyes from Wastewater: A Review

Kirtee Dalve [1], Anuja Patil [1], Foram Malde [1], Harsh Murali [1], Aayush Iyer [1], Safina Saradar [1], Niraj S. Topare [1]*, Sunita Raut-Jadhav [2], Shantini A. Bokil [3], Vishnu Choudhari [4], Anish Khan [5]

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

[2] *Department Chemical Engineering, Bharati Vidyapeeth (Deemed to be University) College of Engineering, Pune, 411043, India*

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

[4] *School of Pharmacy, Dr. Vishwanath Karad MIT World Peace University, Pune-411038, India*

[5] *Chemistry Department, Faculty of Science, King Abdulaziz University Jeddah, 21589, Saudi Arabia*

Abstract: Water contamination has risen to become one of the world's most critical problems. But the problem continues, as seen by the massive amounts of wastewater that are generated and dumped into the environment on a yearly basis. Dyeing wastewater is one of the many different types of wastewaters that should be taken into consideration. There are a number of dye-using industries that release toxic effluents into the environment. As a result of their adverse effects on both the environment and human health, dyes are one of the most serious water pollution environmental concerns. An effective and long-term dye effluent treatment system must be developed in order to eliminate this problem. High operation expenses and energy consumption, as well as long residence times, and low efficiency are the main drawbacks of this traditional wastewater treatment technology. For the removal of dyes from wastewater, adsorption is a viable technology to be explored and used. Numerous studies have been conducted in an effort to findor develop new materials for dye adsorption. Adsorbents are selected for their nontoxicity, low cost, low treatment costs, and moderate conditions in this procedure. The purpose of removing dyes from wastewater using adsorbents, the authors of this review article summarized the most recent developments in adsorption technology and organized the scattered material that was previously available. The properties, advantages, and disadvantages of several adsorbents were discussed in detail. Identifying the adsorbents' ability to regenerate in the adsorption process is one of this review article's objectives. This review also addresses the impact of various process parameters and adsorptioncapacity on dyes removal. It also provides information on adsorptions isotherm and kinetic models for dyes removal,as well as the future of adsorption technology.

Keywords: Dyes, Adsorbent, Adsorption, Wastewater, Adsorption isotherm, Process parameters

---

Efficient Selenium Removal from Water using Iron-based Mixed Oxide Adsorbents

Prajakta Ramteke [a], Asmita S. Jadhav [a], Sunit Kumar Singh [a], Petra Ecorchard [b], Nitin K. Labhsetwar[a, *]

[a] *Energy & Resource Management Division, CSIR– National Environmental Engineering Research Institute, Nagpur–440022, India*

[b] *Centre of Instrumental Techniques, Institute of Inorganic Chemistry of the CAS, Husinec-Řež č.p. 1001, 25068 Rez, Czech Republic*

Abstract: Selenium is essential to living organisms at low concentrations as a micronutrient, but when consumed in excess it shows detrimental health hazards. In India, the northwest region is getting increasingly affected by selenium contamination of soil and water. The groundwater selenium concentration in this region is observed up to 1000 µg L^{-1}, whereas the safe drinking water WHO limit is 40 µg L^{-1}. The widely applied selenium removal technologies include ion exchange, reverse osmosis, chemical methods, co-precipitation, and chemical reduction methods. Apart from these, the adsorption processes are known for various inorganic pollutant remediations from water. Thismethod is widely known for easy operations, cost-effectiveness, environmentally safe process, and ability to reduce the contaminants to low levels. In this study, the application of a few Iron-based mixed oxides synthesized by the coprecipitation method was studied for selenium uptake from contaminated water. The results displayed excellent adsorption capacities from trace level to higher selenium concentration (50–500 µg L^{-1}) removal from water with a very low adsorbent dose of 0.1 g L^{-1}. The adsorbent was also found to treat higher Se concentrations of up to 5000 µg L^{-1} with increased adsorbent dose up to 1 g L^{-1}. We observed that these Iron-based mixed oxides could be easily regenerated with mild alkali (0.1M NaOH) and performance in consecutive 4 cycles was also maintained. Continuous column experiments were also performed to check the adsorbent capacities of the adsorbents. The results indicated that the iron-based mixed oxide is a suitable candidate for field applications by preparation of single-use cartridges. Where a single cartridge with 300 g adsorbent will be able to treat 7500 L of Se contaminated water (1000 µg L^{-1}) serving a family with a drinking water requirement of 20 L/day up to one year as approximated by conducted experiments.

Keywords*: Drinking Water; Selenium; Adsorbent; Iron; Mixed oxide; Cartridges*

Adsorption and regeneration of pine bark biochar using bio-sulfide precipitation of copper

Misbah Bashir**, Chander Mohan*, and Ajit P Annachhatre*

** Indian Institute of Technology, Mandi, Himachal Pradesh,175005, India

* Indian Institute of Technology, Mandi, Himachal Pradesh,175005, India

Abstract: This research investigated adsorption of copper from aqueous solution onto the pine bark biochar (PB-BC), removal of adsorbed copper by bio-sulfide precipitation and simultaneous regeneration of biochar adsorbent. Initially, biochar was prepared from pine bark residue and characterised for its physico-chemical properties. Alongside in parallel, sulfidogenic reactor was established and operated under anaerobic conditions. At the beginning of the sulfidogenic phase, COD:SO42- ratio of 24:1 with the loading rate of 0.29 kg COD/m3d was maintained. This reactor was converted into sulfidogenic phase by gradually increasing the sulfate loading to the reactor with final COD:SO42- ratio of 4:1. Use of sulfide rich effluent from bio- sulfide reactor at around 7 to 7.5 pH yielded above 99% copper removal from aqueous solution. In the second stage of experiment, copper was adsorbed onto the biochar under operating condition of pH 6-7 and contact time of 6 hours. Maximum adsorption capacity of 106 mg/g of copper was obtained. Finally, the biochar was regenerated by precipitating the adsorbed copper as copper sulfide using sulfide rich effluent from sulfidogenic reactor. Complete recovery of adsorbed copper from biochar as copper sulfide precipitates was obtained which was also confirmed by EDX analysis of biochar and precipitates. The regenerated biochar could be reused as an adsorbent in the subsequent adsorption cycle.

***Keywords**: Adsorption, biochar regeneration, bio-sulfide precipitation, continuously stirred tank reactor, loading rate, heavy metal loaded biochar*

Role of Cationic Surfactants in Palladium Adsorptionof commercial ion exchange resins using Electroless plating solutions

Yennam Rajesh [a], Ganesh Dabhade [b], Gaurav Daware [c], Lakshmana Rao Jeeru [d*]

[a,c] *Department of Chemical Engineering, K. K. Wagh I. E. E. and R Nasik (MS)-422003, 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)*

[d] *School of Petroleum Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat- 382426, INDIA*

Abstract: This work investigates the role of cationic surfactants in the adsorption of palladium ions from spent electroless plating solutions using a commercial resin Lewatit TP-214. This would also help us in determining the batch adsorption experiments elaborated the optimal parameters such as surfactant concentration, pH, dosage, initial metal ion concentration for the development of an ion exchange resin with high metal removal efficiency. Critical micelle concentration (CMC) appears to be an important parameter in determining the adsorption behavior of ion exchange resins with Palladium ions. Equilibrium and kinetic models were measured for their fitness with the obtained Pd (II) batch adsorption characteristics. FTIR analysis confirmed that the Pd (II) metal uptake of Lewatit TP-214 resin is largely depends on functional groups and the donor atoms attached to cationic surfactant. The optimized choice of adsorption parameters (pH of 8, dosage of 1 g/L and contact time of 300 min) of Lewatit TP-214adsorbentprovided the highest metal uptake and removal efficiency as 202.5 mg/g and 90.16%, respectively for lowest Pd concentration of 300 mg/L.

***Keywords**: Adsorption; Palladium (II) Metal; Lewatit TP-214; Synthetic Electroless plating solution*

Extraction of Silica from Rice Husk Ash and Its Potential Application for the Adsorption of Methylene Blue

B V S Praveen [a], G. Srinivas [a], R.V. Saikumar Reddy [b], Lakshmana Rao Jeeru [c,*]

[a] *Department of Chemical Engineering, B V Raju Institute of Technology, Vishnupur, Narsapur, Medak 502 313, INDIA*

[b] *Department of Mechanical Engineering, G. Pulla Reddy Engineering College, Kurnool, A.P. 518007, INDIA*

[c] *School of Petroleum Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat 382 426, INDIA*

Abstract: In recent years, sustainable studies have emerged as the focal point of research globally. It includes, amongst many different things, the improvement of eco-friendly procedures and products. The current examination was embraced on a similar line, or at least, to reuse the rice husk debris which is considered as one of the significant strong waste materials, to foster a worth-added and eco-accommodating material nano-silica. In the present study, amorphous silica particles are synthesized from rice husk ash by treating with sodium hydroxide and further with sulfuric acid. The synthesized particles are characterized by the usage of X-ray diffraction (XRD), X-ray fluorescence spectroscopy (XRF), and scanning electron microscopy (SEM). Characterization analysis showed the synthesis of amorphous silica with particle size in the range of 50 to 80 nm. Experimental studies were performed on the removal of methylene blue (MB) from the aqueous solution. The results showed effective removal of MB in a 50 ppm solution using silica as the adsorbent. With the increase in adsorbent dosage from 0.05 to 0.5 g, the removal percentage of adsorption increased to more than 90%.

Keywords: Rice husk; Synthesis; silica; Methylene blue; Adsorption.

Social Life Cycle Impact Assessment applied to the implementation of new technologies for groundwater and recycled water use as drinking water in state of Gujarat, India (INDIA-H2O Project)

Ariadna Claret Carles[a], Cristina Yacoub López[a], Anurag Mudgal[b]

[a] *LEITAT Technological Centre, c/Innovació s/n, Terrassa 08225, Spain*

[b] *Pandit Deendayal Energy University, Knowledge Corridor, Raisan Village, PDPU Rd, Gandhinagar 382007, India*

Abstract: This abstract presents the first work conducted in a socio-economic impact assessment of the uptake of new technologies for groundwater and recycled water use, in the framework of INDIA- H2O project. These new technologies consist of an integration of (1) a sustainable low-cost saline groundwater purification integrated system for drinking water in rural settings; and (2) a domestic wastewater treatment by Phyto-technology and forward osmosis/reverse osmosis integration for rural water recycling. The INDIA-H2O project aim is to develop, design, and demonstrate high-recovery, low-cost water treatment system for saline groundwater and for domestic and industrial wastewaters. The project is focus on the arid regions of North- West India, where water is most scarce due to limited and seasonal rainfall. The project will demonstrate pilot systems to improve levels of quality water available for reuse and resource recovery and tackling the water-scarcity problem across India. The objective of the socio-economic impact assessment is to evaluate the positive and negative consequences, on the most relevant stakeholder groups, of the new technologies' uptake. Aspects such: quality drinking water availability and access by different demographic groups and sectors; improvement in well-being (e.g.: health, comfort) and economic development of water users, fair water distribution systems and water prices, familiarization of stakeholder groups with water policy regulations, etc. will be evaluated. The socio-economic assessment will be performed by applying the Social Life Cycle Assessment (S-LCA) methodology, and the Guidelines for S-LCA of products and organizations 2020 (UNEP-SETAC). The S-LCA methodology requires the identification of the main stakeholder groups to be affected, and the definition of the most important social impact categories (e.g.: health & safety, governance, working conditions), social impact sub- categories, and social impact indicators to evaluate the influence on the stakeholders previously identified. Till now, seven stakeholder groups have been identified: users/local community, children, workers, supply-chain providers, general society (including NGOs), policy makers, and scientific community. Moreover, a deeply analysis onto the users/local community group have been performed, to know water needs, water difficulties, and perception towards the technologies. 26 on-field interviews have been performed during December 2021 in Lodhva, Gujarat, to have data for analysis. Lodhva is characterised by criticality of water supply, absence of good quality drinking water and locality of saline aquifers The surveys analysis is ongoing and preliminary results will be obtained in the next weeks, to know the impacts and benefits of the implementation of INDIA-H2O technologies.

Keywords*: Social Life Cycle Assessment (S-LCA); social impact; stakeholder groups; water users; wateravailability; local community*

Rethinking groundwater in(justice): some reflections from Lodhva, Gujarat

Gabriela Cuadrado-Quesada [a], Maitreyi Koduganti Venkata [b] and Cristina Yacoub Lopez [c]

[a] *IHE-Delft, Netherlands*

[b] *Indian Institute for Human Settlements, India*

[c] *LEITAT, Spain*

Abstract: The salinization of groundwater resources happens because of the complex interactions of climatic conditions, geological features and groundwater practices. This article explores how does groundwater injustice look like when there is groundwater salinization and how different people (including women and girls) are affected by the salination of groundwater. Taking inspiration from water justice and water governance scholarship we explore the meaning of everyday practices of water use and sharing and discuss how these practices of use and sharing are affected when groundwater becomes saline. This article documents the practices of groundwater salinity of men, women and children living in the coastal village of Lodhva, Gujarat, who are exposed to and interact with groundwater that is saline, and are suffering from problems such as irritation of eyes, hands, hair and skin. We based our research on a combination of methods including: field observations, five focus group discussions, transect walks and thirty-five in-depth interviews. We suggest that insights into groundwater practices help to better understand and rethink the significant implications and impacts of groundwater injustice.

Keywords: *Groundwater, (In)justice, Governance, Salinity, Practices*

Water Reclamation Techniques – A Review

Namrata Thakkar [a], Bhumi Patel [a], Falak Patel [a], Karn Kavathia [a], Trushil Patel [a], Vishvesh Badheka [b]

[a] *Research Scholar, School of Technology, Pandit Deendayal Energy University, Gandhinagar 382007, India*

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

Abstract: Water scarcity is one of the significant issues that the world is facing as the freshwater reserves are limited and geographically constrained. Water reclamation can significantly reduce the freshwater inlet and decrease the water footprint. A review of different processes for the physical and biological treatment of greywater is discussed in the following paper. This process includes Aeration, Physiochemical, Advanced Oxidation Process (AOP), Resin-ion exchange. A comparative study based upon different parameters includes Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), pH is provided. The paper also gives an insight into the process and its effect on the quality of greywater.

Keywords: *Aeration, Physiochemical, Advanced Oxidation Process (AOP), Resin-ion exchange, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), pH*

Designing efficient floating bed options for treatment of eutrophic water

Sampurna Nandy [a], Divya Kalra [a] and Atya Kapley [a]

[a] *CSIR-National Environmental Engineering Research Institute, India*

Abstract: Eutrophication has emerged as a serious matter of concern in aquatic ecological research, with widespread occurrence leading to loss of ecological integrity, reduction in aquatic biodiversity, the disappearance of submerged vegetation, and the potential production of toxins. Conventional floating systems have been introduced for the remediation of polluted water but failed in the treatment of highly eutrophic water due to lack of bio-available organic substrate which can be efficiently utilized by bacteria. Herein, we designed and tested the performance of various modified ecological floating beds for nutrient reduction from synthetic hypereutrophic water under batch conditions. The purification performance of different ecological beds assembled with rice straw, plant, and aerator was compared to a control system. Under the batch conditions, average removal efficiencies of ecological system assembled with plant and aerator range as 81-82%, 80-85%, 78-86%, 61-69% for COD, NH3-N, NO3- and phosphates, respectively. The microbial community structure was also analyzed from the water samples taken from ecological beds assembled with plant and aerator by 16s amplicon library. Based on the above results, systems assembled with plant and aerator proved to be efficient for treatment of eutrophic water.

Keywords: *Eutrophication, Ecological floating beds, Rice-straw, Phytoremediation, Aeration*

A Review on Challenges, Operating Condition, Configuration and Environmental Impact of Membrane Bioreactor for Wastewater Treatment

Nikhil Chandorkar [a], Avinash Lad [a], Dinesh Bhutada [a*], Prafulla Bansod [b]

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

[b] *Department of Chemical Engineering, Sinhgad College of Engineering, Vadgaon (Bk), Pune, Maharashtra 411041, India*

Abstract: Natural resources are inadequate to satisfy the demands of an increasing population as a result of rapid industrialisation. It is critical to consider recycling and reusing natural resources such as water. Recycling and reuse have several advantages, including reduced scarcity, production costs, and environmental pollution. The management and handling of industrial and domestic waste are difficult. The conventional technology used for treatment of wastewater is not found to be economically viable or environmentally friendly, so there is a need to focus on efficient techniques such as Membrane Bioreactor (MBR). The membrane bioreactor has several advantages, such as the ability to produce high purity effluent at a cheap rate and to handle high effluent concentration levels.

This paper focuses on a review of membrane bioreactor challenges, operational parameters, advanced integrated MBR methods, and environmental sustainability for waste water treatment.

Keywords*: Membrane Bioreactor; Submerged MBR;Anaerobic Membrane Bioreactor; Water Recovery; Advanced Integrated Methods.*

A short review on Role of Nanomaterials in Wastewater Treatment: Potential applications and inference

Dinesh Bhutada [a], Pallavi Shindikar [b*], Jaya Suryawanshi

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

[b] *Plastic and Polymer Engineering Department, Maharashtra Institute of Technology, Aurangabad 431010, India*

Abstract: Although, there are a wide-range of effective water purification methods and techniques including boiling, filtration, chlorination, oxidation, chemical precipitation, ion-exchange and distillation, they often demand high amounts of energy and use of chemical agents which is only possible in areas with availability of required infrastructure which sometimes pose economical stress on the country. Some affordable and portable devices are currently available in the market but unfortunately, they are not always fit for the purpose as they cannot guarantee efficient removal of harmful viruses, bacteria, dust, and even microplastics. This has given the researchers around the world to find and develop a series of water treatment solutions and applications using some alternative, cost effective, and sustainable technology. Nanotechnology could offer affordable and accessible clean water solutions to the world's most vulnerable populations. The use of nonmaterial is beneficial due to the unrivalled properties of nanomaterials which includes high surface area, high reactivity, porosity characters, hydrophilicity and strong mechanical properties that have been shown to be highly efficient and effective characteristics for wastewater treatment. Nanomaterial originated products, processes and applications are expected to contribute appreciably to environmental and climate protection by saving raw materials, energy and water as well as by reducing greenhouse gases and hazardous wastes. In this short review, the most extensively studied nanomaterials, zero-valent metal nanoparticles (Ag, Fe, and Zn), metal oxide nanoparticles (TiO2, ZnO, and iron oxides), carbon nanotubes (CNTs), and biobased nanomaterials like chitosan are discussed in detail along with their future prospects.

***Keywords**: Nanotechnology, greenhouse gases, zero valent metal nanoparticles, carbon nanotube, metal oxide, chitosan.*

Development of Microalgal-Bacterial Aerobic Granules for Ammonium Removal from Wastewater in a Photo Sequencing Batch Reactor

M. A. Hakim*, Katiuska Savillano*, Hendrik Ewerts*, Jack van de Vossenberg*, N.P. van der Steen*

**IHE Delft Institute for Water Education, Department of Environmental Engineering and Water Technology, PO BOX 3015, Delft, The Netherlands*

Abstract: This study aimed to investigate the development, characteristics, and ammonium removal efficiency of microalgal-bacterial aerobic granules by using a photo sequencing batch reactor treating settled domestic wastewater. A fermenter type photo sequencing bio-reactor (PSBR) was operated under a constant light/dark cycle (18/6h). The study recorded the rapid aggregation of microalgae and bacterial biomass with excellent settling properties possibly due to the increasing production of extracellular polymeric substances (EPS). As an adhesive like metabolic compound of bacterial cells EPS (especially proteins) significantly induced microalgal-bacterial attached growth which further led to the formation of microalgal- bacterial aerobic granules. The stability of granules might be provided by the tightly bound EPS (EPS-TB) as it was abundant during the granules formation and maturation phases. The developed microalgal-bacterial aerobic granules showed a maximum ammonium removal rate of 3.3 mg NH4+-N/L/h, equal to 333 mg NH4+-N/m2/h or 637 mg NH4+-N/mol photon or 0.05 mol NH4+-N/mol photon, where ammonium-nitrogen oxidation was carried out by oxygen produced from the microalgal photosynthesis. Simultaneous nitrification and denitrification also recorded which indicates existence of an aerobic and anaerobic zone and/or DO gradients in the granules.

***Keywords**: Algal-bacterial symbiosis, Ammonium removal, Extracellular polymeric substances (EPS), Microalgal-bacterial granules, Photo sequencing bioreactor, Wastewater treatment*

Coal Fly Ash Derived Adsorbent For Enhancing Waste Water Treatment

Manav G Patel [a], Anirban Dey[a] *, Bharti Saini [a], Himanshu Choksi [a]

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

Abstract: The contamination of pure water by various pollutants like dyes, heavy metals, and phenolic compounds is now a global issue. Millions of tons of fly ash are generated worldwide per year. Management and utilization of coal fly ash as industrial waste for wastewater treatment application attempted as a waste recycling in useful methods and water scarcity issue. Characteristic and properties like shape, size, surface area, permeability, and composition make responsive adsorbent for the potential removal of azo, reactive, anionic, cationic dyes, and heavy metals from effluents. Some research articles summarized in this mini-review are based on coal fly ash(CFA) and their composites for better absorptivity. Moreover, the main aim is to fabricate low-cost adsorbents with high removal efficiency. Currently, the synthesis of CFA by polyethyleneimine and polyaniline for removing anionic dye from water is ongoing.

***Keywords**: Adsorption; Dye; Heavy metals; Industrial waste; Polymeric Anime; Zeolite*

Fluorescence spectroscopy for real-time wastewater quality monitoring

Haya Faizel[a], Arya Vijayanandan[b]

[a,b] *Indian Institute of Technology Delhi, Hauz Khas, 110016, India*

Abstract: Real-time wastewater quality monitoring is crucial in identifying the pollutants in treated wastewater. It is often suggested to use a rapid, sensitive and versatile technique to determine the organic content of wastewater over conventional laborious practices of Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) determination. Fluorescence spectroscopy, as an alternative method can also be used to measure the microbiological content of wastewater. The qualitative and quantitative determination of significant water quality parameters can be achieved by obtaining excitation-emission (EEM) spectral data. The present study focused on analyzing the peaks identified from spectra and their correlations with water quality parameters primarily organic matter and microbial content, to understand the extent of variation and removal of organic matter in wastewater treatment plants (WWTP). Peaks representative of humic like and protein like components are predominant in water, latter being observed more in wastewater. Modeling EEM data with suitable mathematical tools also enables source identification of pollutants, thus helping timely implementation of mitigation measures. Fluorescence spectroscopy, due to its high sensitivity and selectivity, can be employed in WWTPs to maintain treatment efficiency and monitor water quality parameters continuously. However, the involvement of huge data requires suitable data analysis models to obtain accurate readings. The major data analysis methods and their applications in decoding the EEM data to predict the water quality parameters are also included in the present study

Keywords: Biochemical Oxygen Demand, Chemical Oxygen Demand, Fluorescence, Wastewater Treatment Plant, Excitation-Emission Matrix, Dissolved Organic Matter.

Strengthening the life cycle of salt bridge to improve the performance of MFC

Anuj Saini and Dharmendra

NIT Hamirpur

Abstract: Using biological breakdown of organic matter to produce energy, wastewater treatment with MFCs has been researched for the separation and recovery of contaminants such as chemical oxygen demand (COD), heavy metals, and ammonia (NH3). This study focuses on the strengthening the life span of salt bridge (a component of Microbial Fuel Cell). The proton exchange membrane, also known as the salt bridge, allows hydrogen ions to flow to the cathode, causing the cathode chamber to fill with water. The concentration of agar-agar and activated carbon (produced from the pine tree) in the salt bridge will be varied in the study. Throughout a literature review, it was discovered that increasing the life duration of the salt bridge is required to improve the performance of the microbial fuel cell. As a result, this region has been chosen for research to cover the research gap, which will be accomplished by altering the proportion of agar-agar technical and activated carbon. The catholyte was sodium chloride, and the electrodes were graphite rods. The initial chemical oxygen demand and sodium chloride concentrations in the cathode have also been adjusted. A plastic tube with an interior diameter of 2.5 cm and a length of 5 cm was used to make the salt bridge. The best dose in the creation of the salt bridge was 2 to 8 percentage activated carbon with agar-agar technical (Merck) and 3M NaCl solution. The desired performance for open circuit voltage was discovered to be 355 mV with the optimal value of chemicals employed in the salt bridge. The increase in open circuit voltage measurements has been observed for the first 6 days after the start of the experiment.

Keywords: Microbial Fuel Cell, proton exchange, activated carbon, salt bridge

---

The role of green nanomaterials as effective adsorbents and applications in wastewater treatment

Krishna Neeti[a], Reena Singh[b], Shaz Ahmad[c]

[a,c] *Research Scholar, Civil Engineering Department, National Institute of Technology Patna, Ashok Rajpath, Patna, 800005, India*

[b] *Assistant professor, Civil Engineering Department, National Institute of Technology Patna, Ashok Rajpath, Patna, 800005, India*

Abstract: An array of nanomaterials may be defined as sub-atomic particles with a size ranging from 1-100 nanometres (nm). Biological processes are used to create green nanomaterials. Natural components like microbes, trees, and organic polymers such as lipids, carbohydrates and proteins play an active role in creating green nanoparticles. Due to their small size, nanomaterials playing an important role in wastewater treatment and provide opportunities for targeting higher efficiency of removing pollutants. Biopolymer-coated metal nanoparticles, Zinc oxide nanoparticles, silver nanoparticles in Aloe-Vera plant extract, magnetic nanoparticles, silver-impregnated cyclodextrin nanocomposites are examples of biosynthesized nanomaterials used in water pollution control. Green nanoparticles provide an alternate method of removing pollution from bodies of water. The use of green nanoparticles offers a cheap, simple, and environmentally acceptable wastewater treatment method.

Keywords: Green nanomaterials, Wastewater, adsorbents, Synthesis;

Life-Cycle-Costing Analysis of Grey Water Recycling Systems for Commercial and Residential Projects of Ahmedabad, India

Debasis Sarkar [a]

Associate Professor and former HOD, Department of Civil Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar, India.

Abstract: Greywater is the household wastewater which has not been contaminated by toilet discharge water and thus includes wastewater from bathtubs, showers, bathroom wash basins, clothes washing machines, sinks and laundry tubs. Greywater recycling is a component of sustainable green building technology which eases the problem of scanty water supply in residential and commercial buildings. Affordability of such technologies has always been a contentious issue amongst the middle income group in India. This paper aims to analyze the affordability and potential applications of such systems in Indian context considering the Life Cycle Cost (LCC) and Benefit Cost (BC) analysis. Life Cycle Cost Analysis (LCCA) and Benefit Cost Analysis (BCA) are strong decision-making tools which can judge the techno-economic feasibility of a technology or facility. These tools are applied to find out the techno-economic feasibility of the grey water recycling systems in commercial and residential projects of Ahmedabad, a mega city of western India. The findings of the present study reveals that domestically produced system will be having the cost of INR 187 ($ 2.5) / m2 per year as compared to an imported system which will be costing close to INR 327 ($ 4.5) / m2 per year. Thus, we can see that by the use of domestic manufactured system the reduction in cost is close to 75%. Also, the Benefit Cost (B-C) ratio of the domestically produced system is 2.09 in comparison to the B-C ratio of the imported system which is 1.59. Thereby, the domestically manufactured system seems to be more economically feasible subject to ready availability in Indian markets.

***Keywords**: Grey water; Recycling systems; Life Cycle Cost Analysis, Benefit Cost Analysis, Water Management Systems*

Study on Hydrodynamic Cavitation induced Degradation of Norfloxacin: Synergistic Effects of Integrated Advanced Oxidation Processes

Anupam Mukherjee [a], Birupakshya Mishra [a], Aditi Mullicka, Subhankar Roy [b], Siddhartha Moulik [a]

[a] *Cavitation and Dynamics Lab, CSIR-Indian Institute of Chemical Technology, Hyderabad- 500007, India*

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

Abstract: Realizing the strong inter-connection of water with life and energy cycle, it is our prime responsibility to fix the impact of impaired water throughout the world simultaneously with the scientific advancement. In spite of remarkable progress in wastewater treatment strategies over the past decades, degradation of micro-pollutant (present in ppb-ppt level in water) still remains a challenging domain to explore and often the treated effluent is disposed off without taking care of the same. One of the major categories of such organic micro-pollutants come from pharmaceutical industries, personal care products and wide use of different pesticides and herbicides. The present study considered norfloxacin, a widely used antibiotic of the fluoroquinonine family, as the targeted pollutant for degradation using hydrodynamic cavitation (HC) as a promising treatment technology coupled with other advanced oxidation processes. The authors have carried out a systematic study by optimizing the geometry of the cavitating device followed by studying the effect of process parameters like pH, inlet pressure, and treatment time on the degradation rate of norfloxacin. Under optimized conditions of pH 2 and 5 bar of inlet pressure, % degradation of norfloxacin was found to be 7.4% in 60 min by HC process alone. Coupling HC with O3, H2O2 and Fenton's reagent further accelerated the rate of degradation and improved the performance of the process. The maximum % degradation of norfloxacin achieved was 63.1 % for a run period of 30 mins using HC+O3 at a dosage of 0.3 gm/h followed by 55.23 % with HC+ Fenton's reagent at 0.3 g/L dosage and 51.6 % using HC+H2O2 at a H2O2 dosage of 0.3 g/L. In view of implementing the process at industrial scale, a detailed study on the energetics and economics for standalone technologies as well as hybrid process were carried out and was found that the combination of HC + O3 surpassed by far the performance of other hybrid approaches. The mineralization studies were also carried out by measuring the total organic carbon (TOC) content of the samples at optimized conditions for the best set of experimental run and liquid chromatography–mass spectra (LC–MS) was used to evaluate the degradation mechanism.

***Keywords**: Norfloxacin; Hydrodynamic cavitation; Advanced oxidation process; Synergistic effect; Ozone*

Floating wetland treatment an ecological approach for the treatment of water and wastewater – A Review

D. Arivukkarasu [a, *], R. Sathyanathan [b]

[a] *Department of Civil Engineering, GRT Institute of Engineeringe and Technology, Tiruttani 631209, Tamil Nadu, India*

[b] *Department of Civil Engineering, SRM Institute of Science and Technology, SRM Nagar, Kattankulathur 603203, Kanchipuram, Tamil Nadu, India*

Abstract: The demand for water increases day by day due to population growth; on the other hand, water quality is declining globally due to rapid industrialization and climate change. The surface water sources such as pond, lake, river, and reservoir are being polluted and had lost their ecological functions. Floating wetland treatment (FWT) is an emerging natural method for treating surface water bodies and restoration of its ecological processes. This study was attempted to collect and summarize literature to give an insight into the design, construction, applications, macrophytes, substrates, and pollutant removal efficiency of FWT. The pollutant removal mechanism of FWT mainly depends on the hydrophytes grown on a floating raft with substrates attached for the growth of microorganisms. This paper also reviews the performance of floating wetlands having planted with different hydrophytes, growth medium, and floating rafts in mesocosms, in-situ, and lab-scale environment. Several pollutants, including TN, TP, TSS, BOD, COD, ammonium nitrogen removal efficiency between different plant species and growth medium, were also reviewed. From this review, it was found that the combination of native plant species with different substrates under varying climatic conditions has improved the performance of FWT. Many studies recommend further research on FWT by adopting other macrophytes and substrates to improve the removal efficiency of pollutants present in water and wastewater.

***Keywords**: Floating wetland treatment (FWT), hydrophytes, floating raft, substrates, pollutants removal*

Water Circularity Through Decentralized Wastewater Treatment Promoting SDG-6

Sadhan Kumar Ghosh [a], Dineshkumar M [a], Prasanta Kumar Dey [b]

[a] *Department of Mechanical Engineering, Jadavpur University, Kolkata-70032, India*

[b] *Operations Management, Aston Business School, Aston University, Birmingham, UK*

Abstract: About 2.3 billion people worldwide live in a water-scarce region, with a death toll of 1.6 million children (under age five) per year due to lack of sanitation facility 2021 data. This lack of water availability and sanitation facility is causing many economic, environmental, and health-related problems, especially for a developing country like India, as per the UN economic and social affairs report. Though this nation has adequate water, because of rapid industrialization, poor infrastructure, and knowledge of handling wastewater made India the 13th extremely water-stressed country. A study has been made to recognize how the available water would be utilized efficiently to make freshwater an affordable resource adhering to water circularity. For this, India's present and future water requirements concerning various sectors, their arid regions distribution in comparison to its replenishable water potential are enumerated, and its wastewater disposal and the problem with the utilization of decentralized wastewater treatment plant (DWTP) as an alternative are studied. The finding shows that the paradigm shift towards water circularity using DWTP would be feasible only if the resource reclamation is made possible, suggesting the need for technology integration based on the region's provision to create water purification sector as a self-sustaining model. Through this, we could assess the feasibility of achieving water security of the nation, India, and other developing countries by adopting a water circularity approach to achieve sustainable development goal(SDG) -6 (clean water and sanitation to all), whose most of the wastewater generated were left untreated and contaminates the water bodies.

***Keywords**: paradigm shift, water circularity, water requirements, replenishable water potential, resource reclamation, clean water, and sanitation*

Implementation and utilization of Zeolitic imidazolate frameworks (ZIFs) based membranes in waste water treatment: A review

Brian Mwigo [a], Disha Suthar [a], Mumtaz Aliraz [a] Gulamhussein [a], Manish Kumar Sinha [a*], Surendra Sasikumar Jampa [a], Smit Vala [a]

[a] *Department of Chemical Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar – 382 007*

Abstract: For the last two decades there has been momentous development in the field of Metal Organic Frameworks (MOFs). There are two major building blocks of MOFs that is the primary and secondary building units. The Primary Building Unit (PBU) is comprised of metal salts (transition series metals) and the Secondary Building Unit (SBU) consists of organic linkers. There has been extensive use of polymeric membranes in waste water treatment but with a massive drawback which is fouling. MOFs generally exhibit characteristics of high porosity, large specific surface area, tuneable pore-size, thermal stability and chemical in-activity which all favour anti-fouling tendency. Modification of membranes by using Metal Organic Frameworks can significantly offer a better performance for wastewater treatment. This review paper will take you through the journey of synthesizing, utilizing and limitation of Zeolite Imidazolate Frameworks (ZIFs).

***Keywords**: Metal Organic Framework, Membrane, Ultrafiltration, Zeolite imidazolate frameworks, Zinc based nanoparticles*

Carbon nanomaterials for facilitated solar-powered wastewater treatment

Anuradha Awasthi [1&3], Kavita Gandhi [2&3], and Sadhana Rayalu [1&3*]

[1] *Environmental Material Division, CSIR-National Environmental Engineering Research Institute, Nagpur, Maharashtra, 440020- India*

[2] *Sophisticated Environmental Analytical Facility, CSIR-National Environmental Engineering Research Institute, Nagpur, Maharashtra, 440020- India*

[3] *Academy of Scientific and Innovative Research (AcSIR), Ghaziabad-201002, India*

Abstract: The goal of sustainable management is to govern natural resources in order to meet the needs of future generations. The need of the hour is to develop long-term treatment methods that make use of readily available natural resources and non-toxic nanomaterials. Considering solar energy's vast abundance and inexhaustibility, harnessing it to produce clean water is viable to meet current global water and clean energy scarcity challenges. The current research focuses on recent advancements and emerging applications of these solar-powered processes using novel carbon-based nanomaterials. The present research investigates the affinity of two nanomaterials, carbon nanoparticles (CNPs) and graphene oxide (GO), towards solar energy for wastewater treatment and reuse. Synthesized nanomaterials were characterized using FTIR, UV-DRS, UV-Visible spectroscopy, SEM, and DLS. Result indicates that carbon nanoparticles coated stainless steel (SS) sheet shows higher rate of water evaporation (15 %) as compared to plain (SS) sheet (4%) due to photothermal effect of carbon nanoparticles. Spectrophotometric assays co-confirm the stability of coating for a longer duration when tested against distilled water as blank. Results of Thermal profiling of nanosuspension of GO at different concentrations (5, 10, 20, 25, 30 mg) indicated that synthesized GO nanosuspension at 10 mg concentration shows high water evaporation (60 mL) loss as compared to other concentrations with excellent stability. Stability test of nanosuspension was carried out using zeta potential, which accounted to be highly negative (-31.14 to -31.39 mV) with 80 nm particles size at pH 7 with excellent dispersibility. The synergistic approach of nanocomposites and solar energy for treating water will be a new eco-friendly approach adopted to treat and reuse wastewater for domestic to large-scale applications.

Keywords*: Water treatment technologies; solar energy; solar distillation; photothermal materials; nanosuspension*

Socio-economic impact of interlinking of rivers (ILR) using social accounting matrix (SAM) based model

Rajesh Kumar Jain [a], Rajesh Goyal [b], Dulal Goldar [c]

[a] *Research Scholar, Lingaya Vidyapeeth, Faridabad, India*

[b] *Dean and Professor, NICMAR Delhi NCR Campus, Bahadurgarh, India*

[c] *Faculty of Civil Engineering, Lingaya Vidyapeeth, Faridabad, India*

Abstract: The objective of the present study is to conduct short-term financial and economic analysis of the interlinking of rivers program using the Social Accounting Matrix (SAM) based model which evaluates the impact of Interlinking of Rivers (ILR) on different sectors of the economy. The SAM model evaluates the impact of additional money on the growth in employment, value added benefits, and household income. In the study analysis 5 ILR projects viz Ken-Betwa Phase I and Phase II, Par-Tapi-Narmada, Kosi-Mechi, and Godavari-Cauvery Link have been done for the overall addition of project cost to the system and its impact on food grains, nonfood grains, mining, paints, and coal tar, clay, cement, mining metals, electric, transport, trade, banking and construction sectors, etc. It is assessed that sectors like cement, coal tar, electric/gas, water supply, and banking will be benefitted the most. In the case of Ken-Betwa Link Phase I and Phase II growth in employment shall be 56 and 28.5 points, growth in value added 12.8 and 6.5 points, and growth in household 10.7 and 5.4 points. In the case of Par-Tapi-Narmada Link, growth in employment shall 27.4 points, growth in value added 6.3 points, and growth in household 5.2 points. In the case of Kosi-Mechi Link growth in employment shall be 11.9 points, growth in value added 2.7 points and growth in household 2.3 points. In the case of Godavari-Cauvery Link growth in employment shall be 257 points, growth in value added 58.8 points, and growth in household 49.0 points. The short-term benefits on implementation found maximum is for Godavari-Cauvery Link with an increase of 2.57 times growth in employment, 5.88 times growth in value added, and 0.49 times of growth in household income. The study confirms the short-term impact on the overall economy of the project area using SAM based model.

Keywords: Social accounting matrix; interlinking of rivers; short term benefits; financial and economic analysis; growth in employment

Comparative analysis of single basin stepped and conventional solar desalination system

Krunal B Patel [a], Dr.Tushar M Patel [b]

[a] *KSV University, Sector-15, Gandhinagar-382015, India*

[b] *LDRP-ITR, KSV University, Sector-15, Gandhinagar-382015, India*

Abstract: Pure drinking water is an essential need of human being. Everyone has the right to consume clean, safe, and fresh water. As we all know, water covers over 71% of the Earth's surface. It may be found in the form of oceans (which encompass over 96.5% of all Earth's water), rivers, lakes, glaciers, and icecaps, as well as water vapour and soil moistures. The proportion of freshwater on Earth is roughly 3%, with almost 2.5% of it being unavailable (frozen in polar ice caps, atmosphere, glaciers, extremely contaminated, under soil, or lying too deep beneath the earth's surface to be retrieved at a fair cost). Only 0.5% of the earth's atmosphere contains fresh water. Solar desalination is one of the simplest methods used for distillation of saline water and the devices are called solar stills. There are numerous methods to increase the heat transfer inside solar stills such as the use of Nano-fluids, attaching different types of fins on the absorber plate and phase change materials etc. In addition, there various types of configurations that have been investigate till date like single-slope, double-slope, hemispherical, pyramid type, multi-basin type and cascaded or stepped type solar stills. Wind velocity, solar radiation intensity, water depth, inlet water temperature, ambient temperature, and absorber plate area are all parameters that impact solar still production. Solar still production is inversely proportional to the depth of the water in the still. Stepped solar stills retain minimum depth, which means they can boost distillate productivity. This paper explores the experimentation performance comparison on stepped-type solar still with reference to the conventional solar still for the evaluation. The stepped solar still (2835 ml/day) achieved 33.09% height yield as compared to simple solar still (2130 ml/day) of same absorber area for 10 mm basin water depth in both the configurations.

Keywords*: Desalination; Water Distillation; Solar Energy; Solar Still; Pure water.*

Thermophysical properties for MWCNT based Phosphonium Eutectic Nanofluid: An Emerging Heat Transfer Media for Solar Desalination System

Nipu Kumar Das [a], Papu Kumar Naik [a], Dhileep N. Reddy [b], Bhabani S. Mallik [b], Surya Sarathi Bose [c], Tamal Banerjee [a *]

[a] *Department of Chemical Engineering, Indian Institute of Technology Guwahati Guwahati – 781039, Assam, India*

[b] *Department of Chemistry, Indian Institute of Technology Hyderabad Hyderabad - 502284, Telangana, India*

[c] *Department of Materials Science and Engineering, Indian Institute of Science Bangalore Bangalore -560012, Karnataka, India*

Abstract: A thermal medium is prepared in this work by combining hydrogen bond acceptor (HBA) salt [Methyltriphenylphosphonium bromide (MTPB)] with hydrogen bond donor (HBD) salt [ethylene glycol] at a molar ratio of 1:4. Following that, a nanofluid with a diameter of 10-30 nm was generated by dispersing 0.02 wt percent Multi-Walled Carbon Nanotube (MWCNT) in the base fluid. Prior to dispersion, the structure and morphology of MWCNT were determined using a Field Emission Scanning Electron Microscope (FESEM) and a Field Emission Transmission Electron Microscope (FETEM). X-ray Powder Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR) were used to evaluate the crystallinity and functional groups. Visual inspection and zeta potential measurements were used to determine the stability of the prepared nanofluid. Thermogravimetric analysis (TGA) was used to determine the thermal stability of the nanofluid at temperatures around 500°C and a heating rate of 10°C /min in a nitrogen atmosphere. Different thermophysical parameters of nanofluids inludiong density, viscosity, thermal conductivity, and specific heat were determined throughout a temperature range of 25°C to 85°C. The experimental findings indicate that viscosity and density decrease with increasing temperatures. On the contrary, it was noted that the nanofluid's specific heat and thermal conductivity increased with increase in temperature. This is owing to the nanoparticle's generated Brownian motion, which results in a larger kinetic energy at elevated temperatures. Finally, all the thermophysical properties were compared with the commercial available heat transfer fluid THERMINOL VP-3 and the nanoluid was predestined to be a sustainable heat transfer medium for solar desalination systems. The penultimate segment utilised Molecular Dynamic modelling to compare and confirm the thermal conductivity of nanofluid data.

Keywords*: DES, nanofluid, Thermal Conductivity, Stability*

Performance comparison between double slope passive and active solar still based on energy matrices

Tunuguntla Arun Sri Sai Krishna [a], Sumit Tiwari[a], Rajat Saxena [b]

[a] *Department of Mechanical Engineering, Shiv Nadar University, Dadri, Gautam Budha Nagar, Uttar Pradesh, India*

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

Abstract: Water is the second most important element on the planet for the survival of human life after oxygen. The solar distillation process is one of the most important technologies for the production of fresh water in the world. A passive solar still and an active solar still are the two types of desalination technologies available. Despite the fact that active solar continues to provide superior performance in terms of output, it nevertheless consumes more embodied energy than passive solar. Increased embodied energy investment in any setup may result in a deterioration of the environmental situation over time. According to the thermal modelling results, the passive solar still (PSS) and active solar still (ASS) had average thermal efficiencies of 17.5 percent and 21.3 percent, respectively, for the setting under consideration. According to the energy matrices, this manuscript offers a performance comparison between double slope passive and active solar stills. Energy matrices include energy payback time, energy payback factor, and life cycle conversion efficiency.

Keywords: Energy; Solar still; Thermal modelling; Energy matrices

---

Exergetic efficiency of single slope passive solar still: an experimental analysis

Bandana Swain [a, *], Jatin Patel [b]

[a] *Research scholar, Pandit Deendayal Energy University, Gandhinagar-382007, India*

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

Abstract: Because of the simplicity in construction and low cost, single slope passive solar still becomes very attractive, popular and can be considered as sustainable technology to provide fresh water in rural and remote areas, particularly in developing and hot climatic countries like India. The concept of exergy provides a frame work for the analysis of an energy system based on evaluating the quality of energy carriers and judicious use of energy. An exergy analysis has been discussed extensively and also applied to a wide variety of energy conversion systems as it is helpful in identifying the magnitude, location and the causes of thermodynamic inefficiencies (exergy destruction), as well as in quantifying the corresponding rates for optimizing and improving the design of energy systems. The present study involves an experimental investigation of a single slope passive solar still of size 1.105 x 0.97 m and area of basin- liner 1.0 m2 with a transparent glass cover of thickness 4 mm, fixed at the top of the still as condensing surface at an inclination of 20° on a metal frame. The experiment has been conducted at PDEU, Gandhinagar, Gujarat (Latitude: 23° 9' 21" N, Longitude: 72° 39' 52" E), to carry out the exergy analysis for the performance evaluation of solar still for a specific day. An attempt has been carried out to find the objectives of the study: (1) the daily production of distilled water for a specific water depth, (2) energy and exergy efficiencies of the still by using energy and exergy thermal equations, (3) evaluation of exergy destruction for different components of the still such as saline water, basin- liner and condensing cover. Based on the results, analytical study has been done to have the idea of significant losses of the solar still.

Keywords: Solar energy; Solar still; Energy and exergy efficiency; Exergy

---

Design and Modeling of Vertical Tube Evaporator in a Thermal Driven Multiple Effect Distillation System

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

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

bAssociate Professor PDEU Gandhinagar 382010, India

cAssistant Professor PDEU Gandhinagar 382010, India

Abstract: The scarcity of freshwater is one of the biggest issue in the world, as a result more attention is giving to thermal distillation process for seawater and as well as brackish water distillation which removes almost all types of contaminants. Distillation is a phase change process in which steam used as a heat source for evaporating the feed water. Multiple effect distillation makes the process economical by recycling the latent heat of vaporization. In this paper, the vertical tube evaporator design and modeled for MED for estimating the overall heat transfer coefficient by using the developed correlations of Bell method, Kandlikar and Kutateladze and compared it previous work in literature. The result shows good agreement with previous work and reliability in design. Developed model can be used to design the vertical tube evaporator for estimating the dimension for large scale to micro scale MED plant.

***Keywords**: Multi Effect Distillation; vertical tube evaporator; correlations; Design*

Mechanistic study on adsorption of aqueous pollutants on waste biomass derived activated carbon

Sumata Das [a], Pritam Dey [a], Srimanta Ray [a] *

[a] *Chemical Engineering Department, NIT Agartala, Jirania – 799046, Tripura, India.*

Abstract: Aqueous pollutants usually contain both metal and organic contaminants. Several literatures have looked into the adsorption of these contaminants individually. The present study evaluates mechanistically the impact of the presence of either contaminant on the adsorption of the other onto waste biomass (rice straw) derived activated carbon (RS- AC). Accordingly, the adsorption of metal – iron (Fe) and an organic dye - methylene blue (MB) onto RS-AC was studied in batch scale. Both Fe and MB adsorption onto RS-AC has followed pseudo-second order kinetics and best fitted on the Langmuir isotherm model when considered individually. The sequential adsorption of Fe onto MB adsorbed RS-AC was noted to be improved compared to individual adsorption. However, a similar trend was not observed for MB on Fe adsorbed RS-AC. The surface adsorption was found to be the rate-limiting step for individual, sequential, and simultaneous adsorption of Fe and MB. The study presents a mechanistic perspective on Fe and MB adsorption in individual, sequential, and simultaneous adsorption scheme. A reduction in the spontaneity of adsorption due the presence of the other adsorbate in RS-AC was confirmed by standard Gibbs free energy change. The study aims to present a better insight into the adsorption of metal (Fe) and organic pollutant (MB) onto a solid adsorbent (RS-AC) in multiple adsorption schemes which are commonly encountered in different real-life conditions.

Keywords*: rice straw; activated carbon; methylene blue; iron; adsorption, mechanistic perspective*

A Review on Atmospheric Air Water Generation Technologies

Darshan Savaliya [a], Jatin Patel [b]

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

[b] *School of Technology, Pandit Deendayal Petroleum University, Gandhinagar-382007, Gujarat, India*

Abstract: The need of sustainable freshwater has become a concerning global issue in the present era, but in the arid regions, where it seldom rains, it is more complicated because there is hardly any fresh water supply. Thus modern, safe and reliable means for obtaining drinkable water is urgently required. The extraction of humidity present inside the atmospheric air is one such technology for acquiring clean drinkable water. The device that works on water extraction from atmospheric air technology are known as air water generators (AWG). This paper presents a comprehensive review on different methods of freshwater extraction from humid air, companies associated with AWG manufacturing, working conditions for AWG and usage of this technology in agricultural sector as well. Any sort of energy can be used for this technology. Some renewable energy sources have also been mentioned as a feasible option for lowering energy expenses.

Keywords: Air water generator (AWG), Extraction, Air technology, Water production technique

---

Solar Still Water Desalination Sustainable Energy Solutions by Energy-Exergy-Environ Analysis

Niyant Thakkar [a], Dr. Jatin Patel [b], Dr. Anurag Mudgal [c]

[a] *Niyant Thakkar,Pandit Deendayal Energy University, Gandhinagar, India*

[b] *Dr. Jatin Patel,Pandit Deendayal Energy University, Gandhinagar, India*

[c] *Dr. Anurag Mudgal,Pandit Deendayal Energy University, Gandhinagar, India*

Abstract: Clean water scarcity is worldwide issue for human beings. Water desalination in spite of being energy intensive process, has been proved a sustainable solution. There is need to reduce specific energy consumption and exploring different renewable energy sources. One of such approach is application of solar still in conjunction with the evacuated annulus tube collector. A computational tool (Python) is used to simulate this process and its thermo-economic-environ problem under Indian meteorological conditions. The current approach highlights the utility of a modified parabolic concentrator. It integrates with evacuated tubes which improves the performance of solar irradiation energy absorption throughout its periphery. Such type of arrangements would enhance the thermo-syphon effect compared to conventional solar still. The proposed system is being optimized to achieve the maximum temperature (98.6 deg C) of the water basin. The maximum circulation rate is 47.94 kg/hr. The daily overall energy and exergy efficiencies are found to be 23.5% and 1.4% respectively. The cost of producing water is 2.91 $/m3 according to daily yield and solar energy collection area. The energy-exergy based CO2 mitigation and its environmental earned revenue are 126.38 ton, 49.43 tons, $ 1309 and $ 389.38, respectively. In addition to the noticeable yield output at a low production cost, the high mitigation, and a relatively short payback time make the system viable and sustainable with smaller and more effective collector areas for the respective solar irradiation.

Keywords*: Water Desalination, Thermo-economic-Environ Analysis, Exergy-Energy*

Performance analysis of Atmospheric water generator to generate water from Atmosphere: A case study of Patan district

Hitesh Panchal [a], Akhilesh Kumar Choudhary [b]

[a] *Assistant Professor, Mechanical engineering Department, Government Engineering College Patan, Gujarat, India 2Assistant Professor,*

[b] *Mechanical Engineering Department, National Institute of Technology Hamirpur, India.*

Abstract: Water covers 70 percent of our world, and it is simple to imagine that it will always be plenty. However, freshwater, the substance we drink, bathe in, irrigate our farm fields with this exceedingly uncommon. Only 3 percent of the world's water is fresh water, and two-thirds of that is tucked away in frozen glaciers or otherwise unavailable for our consumption. The main aim of present research paper is to generate water from the atmosphere through portable atmosphere generator and tested in climate conditions of Patan district during march 2022. Around 10 days readings have been taken to test the Atmospheric water generator to see the performance. It has been found that around 1500 ml water received per hr. and obtained water quality fits the potable water too.

Keywords*: potable water; atmospheric water generator; efficiency; water yield*

Modified Route for Industrial Effluent Treatment Using Adsorption and Performance Comparison of Activated Carbon and Lignite

Williams J. Koshy

Government Engineering College, Bhuj 370001, India

Abstract: Dye industries have been a major source of highly polluted effluent stream posing a serious challenge in its treatment and final disposal. Amongst these the effluent produced by Vinyl Sulphone dye units has been characterized by extremely high COD and pH. The general steps used to treat such effluents include the traditional primary stage of Neutralization, secondary step which consists of Physical/ Chemical and Biological treatment and tertiary step employs adsorption. The primary step raises the salt concentration which hampers the subsequent treatment processes. The present work proposes a modified flowsheet wherein adsorption is carried out first thereby eliminating the above shortcoming and increasing the efficiency of the successive stages. Experiments have been performed with Conventional Activated Carbon and a low-cost adsorbent Lignite on Acidic stream (raw effluent stream) and Neutralized streams. Chemical Oxygen Demand is the considered criteria here and the results obtained were highly motivating as the COD reduction was found to be much better in this route as compared to the conventional method. Also, the performance of Activated Carbon and Lignite are found to be competitive which is also discussed.

Keywords: Adsorption, effluent, vinyl sulphone, acidic stream, neutralized stream, Chemical Oxygen Demand (COD)

Production Water Treatment by Adsorption Produced from Waste Casting Sand

Sivakumar Pandian, Harit Tarsariya

School of Petroleum Technology, Pandit Deendayal Energy University, Gandhinagar-382426, India

Abstract: Petroleum is a major source of revenue and energy for many countries. Its production has been regarded as one of the most significant industrial activities in the world. During crude production, commonly formation water will be present along with crude. It can be disposed off or reused for injection after proper water treatment. Even though different advanced technologies are used for treatment, the removal of the residual crude oil present in it is difficult (>50 mg). Removal of the residual oil is time-consuming and costly. Among the different oil residue removal processes, adsorption plays a major role with have ease and less operation cost. In the present study, the adsorption technique was adopted to remove the residual oil from the treated water. The adsorbent is obtained from a waste material produced by foundry industries i.e., waste casting sand. Initially, the adsorbent is characterised by using different analytical techniques like Fourier transform infrared spectroscopy, scanning electron microscope, X-ray diffraction analysis, Brunauer-Emmett-Teller and size analysis. In batch experiments, the maximum uptake capacity of sorbent 74 mg g-1 was achieved with the biosorbent dosage of 0.03 g 100 mL-1 and at pH 3.0. The Langmuir isotherm model was (R2 = 0.997) proved to be a better fit than Freundlich and Elovich's model isotherms. The data acquired from kinetic studies were found to fit well with the pseudo-first-order model (R2 > 0.99) when compared with the pseudo- second-order equation and intra-particle diffusion model. The experimental data were described by Langmuir isotherm model, which suggests monolayer adsorption of oil. Overall, this study confirms the applicability of used casting sand as a feasible adsorbent for oil removal from produced water. Oil removal percentages increase as contact time and adsorbent weight increase while decreasing as adsorbate concentration rises.

Keywords*: Adsorption; Produced water; Used casting sand; Kinetics; Isotherms*

Fe (III) Impregnated activated alumina for cationic and anionic dye adsorption in water

Vaishali Chauhan [a], Kalisadhan Mukherjee [b], Anirban Das [*b]

[a,b] *Department of Chemistry, School of Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat, India- 382007*

Abstract: In India, the groundwater sources are often contaminated by colored effluents which are mainly the dye molecules released from textile, leather and paint industries. The presence of the dyes makes the groundwater toxic. It is important to explore suitable techniques to remove the dye from groundwater. In this regard, adsorbent based techniques are considered to be effective. In the present work, the performance of commercially available activated alumina (AA) and synthesized Fe3+ impregnated activated alumina (FIAA) has been investigated for the removal of one cationic (methylene blue) and one anionic (methyl orange) dyes. Comparative studies on the dye adsorption characteristics of pure AA and FIAA are carried out through batch experiments wherein the type and concentration of dyes, and dose of adsorbents are varied. It is observed that both AA and FIAA adsorbents are showing superior adsorption capacity for the anionic dye relative to the cationic dye. The kinetics for the adsorption of cationic and anionic dyes over AA and FIAA are modeled and underlying mechanisms for the adsorption process were understood. In this work, we will describe the wet chemical synthesis of FIAA, and comparative studies on the dye adsorption characteristics by AA and FIAA and their kinetic analyses.

***Keywords**: Adsorbent; wastewater; Activated alumina; Dye adsorption*

Improvement of Reverse Osmosis Performance of Polyamide Thin-Film Composite Membranes using Nanoparticles

Karthik M and Suresh A.K

IIT Bombay

Abstract: The phenomenon of interfacial polycondensation has a number of wide industrial applications. Its application in the fabrication of thin-film composite membranes is particularly important for reverse osmosis. In this research proposal, we propose to fabricate thin-film composite membranes by interfacial polycondensation between an aqueous solution of m-phenylenediamine (MPD) and an organic solution of trimesoyl chloride and prepare TFNC membranes with different nanoparticles. The membranes will be tested for their reverse osmosis performance. Polymer nanocomposites are multicomponent systems with polymer as a primary component along with filler material which has at least one dimension below 100 nm. Polymer nanocomposites are generally lightweight, require low loading, are often easy to process, and provide property enhancements extending orders of magnitude beyond those realized with traditional composites. The emergence of nanotechnology in membrane materials science could offer an attractive alternative to polymeric materials. Hence nano-structured membranes were discussed in this work including commercial zeolite nanoparticlses based on thin-film nanocomposite membranes, silica nanocomposite membranes, silver nanocomposite membranes and ZIF-8 nanocomposite membranes. And study the fundamental understanding of membrane materials with nanoparticles. It was proposed that these materials represent the most likely opportunities for enhanced RO desalination performance in the future. Zeolite incorporation of TFN membranes has better water permeability and significant salt rejection. ZIF-8 incorporated TFN membrane has better characteristic properties (more water permeability and salt rejection) than other nanoparticles incorporated (silica, silver and zeolite) TFN membranes. These four nanoparticles give more water permeability than conventional membranes. It is proposed that these novel materials represent the most likely opportunities for enhanced RO desalination performance in the future.

***Keywords**: Desalination, Thin-film composite membrane, Polyamide film, Nano-Particle*

Feasibility study on application of soft computing methods in groundwater potential mapping: A review

M Sireesha [a], T Vamsi Nagaraju [b]

[a] *Research Scholar, Department of Geo-Engineering, Andhra University, Visakhapatnam, India-530003*

[b] *Assistant Professor, Department of Civil Engineering, SRKR Engineering College, Bhimavaram, India-534204*

Abstract: In recent years, groundwater bodies have become a potential source for drinking especially in India. The surface waters are contaminated due to rapid increase in urbanization and industrialization, usage of intensive chemicals in agriculture and aquaculture practices, and other sources. Groundwater potential mapping is an important tool to understand the groundwater sources and future capacity. Groundwater potential zones and groundwater quality assessment using geographical information system (GIS) are in vogue. Soft computing techniques are emerging in many fields including geoengineering based on statistical data sets. Soft computing or heuristic algorithms can give an efficient and rational approach to solving complex problems. This article presents the state-of-the- art review study on the application of soft computing techniques in groundwater potential mapping. Research studies have shown that soft computing techniques and their learning process, rational structure, and intelligence give efficient predictions without any cumbersome tasks to solve complex problems.

***Keywords**: Soft computing, groundwater mapping, PSO, metaheuristic algorithms, water management*

Determination of appropriate Proportion of Mg and P addition in Human Urine to get Optimum Quantity of Struvite using MAP Crystallization Process

Helly Mehta, Dr. Manoj Gundalia and Kartik Sharma

Chhotubhai Gopalbhai Patel Institute of Engineering and Technology, Uka Tarsadia University

Abstract: Urine, which is high in nitrogen, makes about 0.5 percent of domestic waste water. Urine, when discharged in sewage, constitutes a strong water contaminant. Furthermore, struvite is generated during the natural breakdown of human urine, and it is a severe problem in sewage and waste water treatment, particularly after anaerobic digesters. Regardless of the fact that Struvite is a problem, its fertilizing potential should not be underestimated. Among the various method to precipitate struvite, particularly from separated sources of human urine stream, The MAP Crystallization is best and cheapest method of Precipitating struvite. The possible use of struvite precipitation as a fertilizer, analogous to Diammonium phosphate, has piqued interest (DAP). The purpose of this paper is to look at the best way to extract struvite from human urine using the MAP Crystallization method. In this experiment, we discovered that 1.2:5 is the ideal Mg: P ratio for obtaining the optimal quantity of 9.19g of struvite in 500 ml of human urine. The finding showed that the high-quality struvite can be recovered from real human urine.

***Keyword**: Urine, Struvite, MAP, Crystallization*

Remedial strategies to minimize the risk on public health due to high Nitrate concentrations in groundwater

Mukesh A. Modi* and Dr. N J Shrimali*

**Department of Civil Engineering, Faculty of Technology and Engineering, M.S. University of Baroda, Vadodara, India*

Abstract: Nitrate is one of the most common contaminants of groundwater and its concentrations increases under the influences of anthropogenic activities which can lead to severe health risks especially in new born and alders. Significant research in past decade has contributed towards the selection of suitable remedial measures to reduce nitrate contamination and minimizing health risks. Present study aimed to the assess health risks due to groundwater nitrate between two major rivers of Central Gujarat and to suggest suitable groundwater management strategy that minimize public health risk. The USEPA proposed HRA model proved to be efficient in assessing the health risk. In addition to the conventional approach, a few other key parameters such as groundwater vulnerability, land use land cover, water use scenario, population and average water demand were also included. The critical area identification was achieved through Health Risk Assessment model which drew attention towards 45% of total study area that should be prioritized for remedial measures. The northern critical area is majorly comprised of agricultural activities for which Pump and Fertilize (PAF) and Phytoremediation methods are most suitable. The western critical area having valuable agricultural land near Mahi estuary is prescribed Permeable Reactive Barriers (PRB) and PAF. The central critical region includes sub-urban settlements that need in-situ bio-remediation with injection of carbon source.

***Keywords**: Groundwater, Nitrate Contamination, Health Risk Assessment, Remediation, Management Strategy*

A Review on Adsorption of Dyes in Batch and Column Mode: Effects of Operating Parameters

Divyarajsinh Solanki [1], Prabhav Vakharia [1], Neel Suryawanshi [1], Parth Dabhole [1], Sweeti Sawant [1], Shivam Bhise [1], Shantini A. Bokil [1], Niraj S. Topare [2*], Vishnu Choudhari [3]

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

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

[3] School of Pharmacy, Dr. Vishwanath Karad MIT World Peace University, Pune-411038, India

Abstract: The planet is facing significant threats of air, soil, and water contamination as a result of various human activities. Environmental impacts, in general, have become much more severe over the years, but water pollution is quite advanced. Organic pollutants can be found in a variety of industrial wastewater sources, including textile waste liquids. Direct discharge into natural waters would pose a significant risk to the marine environment. Although direct discharge to the wastewater system will adversely affect the future treatment of biological wastewater. Innovative methods for the treatment of industrial effluents containing dyes are proposed as a means of overcoming this challenge. Adsorption is a low-cost, eco-friendly method that drew the scientific community's attention as an efficient method for the removal of hazardous dyes. In this method, the best mode and adsorbents are chosen based on their simplicity, nontoxic and low-cost adsorbents, low treatment costs, and mild conditions. The removal of dyes is examined in depth in this review paper, which discusses a variety of batch and column adsorption design experiments. Several parameters influence the adsorption process, which is the foundation of all laboratories looking for the best conditions. The primary goal of this review is to provide current information on the most researched affecting factors for batch and column operating modes. Initial dye concentration, flow rate, and bed height are all parameters in column adsorption investigations and contact time, pH, temperature, particle size, agitation speed, and adsorbent dose were all compiled for batch adsorption investigations and summarized in this review.

***Keywords**: Adsorption, Dyes, Operating Parameters, Batch, Column*

Recent advances in Synthesis, Characterization and Applications of Activated Carbons from Coconut shell for water purification: A Review

Anjali Bibin Suja [1], Sowmya Dawalapuram [2], Vamshi Polagoni [3], Jeedi Mosha [4], A.V.Raghavendra Rao [5]

[1,2,3,4,5] *Department of Chemical Engineering, B V Raju Institute of Technology, Narsapur, Medak Dist. - 502313, Telangana, India.*

Abstract: The world is developing in rapid pace technically, especially on industrial scale. Industrial development has increased the amount of effluent discharged into the environment. The environmental pollution is very serious problem if world treats it carelessly. Adsorption is one of the most effective widely used method to reduce hazardous pollutants present in industrial effluents. The activated carbons are well known adsorbent for the purification and separation of gases and liquids. Activated carbons are normally prepared either from polymeric type martial like poly vinyl chloride or from lignocellulosic materials. The activation of the carbons can be done by physical, thermal or by chemical methods. Pore size of carbon materials play a major role in meeting their requirements at the industrial level. This paper reviews recent advances in synthesis, characterization and applications of activated carbons from coconut shell.

Keywords*: Water purification, Activated carbon, Coconut shell, characteristics*

Adsorption of Brilliant Green Dye by Used-Tea-Powder: Equilibrium, Kinetics and Thermodynamics Studies

Sarika H. Vithalkara, R.M.Jugade

Department of Chemistry, R.T.M. Nagpur University, Nagpur-440033, India

Abstract: The present research is based on the removal of Brilliant Green (BG) dye from aqueous solution which is one of the recalcitrant dye molecules that persist in environment for long period and pose toxic effects in environment. Used tea powder (UTP) was used as a potential adsorbent to remove Brilliant Green (BG) from aqueous solution. Pore morphology, surface properties, crystalline nature and thermal stability of UTP were assessed by using SEM, FTIR, XRD and TGA analysis. Several operating factors in adsorption of BG onto UTP were investigated, including the solution pH, amount of adsorbent, contact time, concentration of BG, the pH point of zero charge, temperature, etc. Experimental results revealed that the adsorption efficiency increased with contact time and decreased with initial BG concentration. The optimized working conditions for BG dye from aqueous solution were found to be pH at 4.8, adsorbent dose 100mg, contact time 60min and dye concentration 100mg L-1. The maximum monolayer adsorption capacity was found to be 100mgg−1.Fixed bed column studies were also conducted at dye inlet concentration of 50 mg L-1 at a flow rate of 5 mL min-1 through a column of height 5 cm to evaluate the breakthrough volume and column efficiency. The pseudo-first-order, pseudo-second-order kinetic and the intra-particle diffusion models were used to describe the kinetic data and rate constants were evaluated. It was found that the pseudo-second-order kinetic model was suitable to describe the adsorption process. The intraparticle diffusion was not the only rate-controlling step, and the existence of boundary layer effect was observed in this study. From isotherm analysis, the equilibrium data were well represented by the Langmuir model, rather than Freundlich model. The calculated thermodynamic parameters showed that the adsorption process was feasible, exothermic and spontaneous. Therefore, as a low-cost and easily available material, used tea powder appears as a very prospective adsorbent for the removal of Brilliant Green from aqueous solution.

Keywords*: Used tea powder, Brilliant Green, Adsorption, Adsorption kinetics, Adsorption isotherms*

Biosorption of Dyes onto Cocoa Shell Powder in Batch Studies

Bandi Sumanth Kishore, Prasad Ksnv, Giri Raja Rohith, G Romie, S Ashok and Sara Harinath Goud

B V Raju Institute of Technology, Narsapur

Abstract: The focus of this study was to observe continuous removal of Methylene Blue from aqueous solution by adsorption was investigated using a laboratory scale Batch Studies with Cocoa Shell Powder. The parameters discussed are contact time, Initial dye concentration, Biosorbent size, Adsorbent dosage, pH of the aqueous solution, Temperature. FTIR, SEM, XRD analyses were taken. Kinetic, Thermodynamic and Equilibrium studies were observed in detail.

Keywords*: Adsorption, Cocoa Shell Powder, Methylene Blue, Batch studies*

Engineering the rheology and Interfacial tension behavior of mixed formulation of anionic and non-ionic surfactant with added nanoparticles

Gudendra Singh Negi, Anirbid Sircar*, Sivakumar Pandian

School of Petroleum Technology, Pandit Deendayal Energy University Gandhinagar, Gujarat, India - 382007

Abstract: To overcome the increasing demands of energy, the tertiary enhanced oil recovery (EOR) is the only feasible exploitable fossils fuel to meet the global energy consumption. The conventional EOR chemical approach has many disadvantages over the nano-EOR due to prevailing many unforeseen issues and loss of chemicals in the porous medium which can directly affect the techno- economic of the projects. The nano-EOR is unlike conventional EOR, can augment the recovery factor by controlling rock-fluid interaction and mobility. It is a promising approach to manipulate the matter at an atomic and molecular level and provides a unique platform to revolutionize the EOR process for ultimate oil gain. The other critical parameters such as interfacial tension (IFT), wettability, capillary pressure viscous forces, and rheology of formation/ injection fluids can influence the rock-fluid interaction and control mobility towards the recovery factor. The author has focused mainly on the impact of IFT, surface tension, and rheology of nano silica-surfactant formulation (Alkylbenzene sulfonate-triton-x-100) in presence of 3wt% brine, synthetic formation water SFW) and paraffinic oil. The critical micellar concentration (CMC) value of the above composition has also been estimated and found around 50 mg/lt. Reduction of IFT has been observed around 18.52mN/m against 3wt% brine-surfactant composition at room temperature which reduced further to 6.95mN/m at higher temperature (~ 600C). In the case of SFW, the IFT of 20.20mN/m at room temperature was reduced to 10.25mN/m at a higher temperature. The studies have also been conducted with nano silica-surfactant-3wt% brine composition and found the IFT of 0.80mN/m at room temperature and 0.25 mN/m at higher temperature (~ 600C). In the case of nano silica-surfactant-SFW formulation, it was found 2.32mN/m at room temperature and less than 2.0mN/m at a higher temperature. The rheological studies also confirmed that 0.10 wt % of nano silica-surfactant with base fluid composition is an optimum and desired concentration for achieving favorable rheology and better techno-economics of nano-EOR projects.

Keywords: Nano-EOR, Silica nanoparticles, Interfacial tension, Rheology

---

Performance analysis to find the distribution of TDS, Fluoride, Alkalinity and Hardness in the groundwater of Rajasthan India- A Case study

Yogendra Singh Solanki [a], Soumen Maity [a], Debojyoti Basuroy [a], Madhu Agarwal [b], AB Gupta [c]

[a] *Product Development Domain, Development Alternatives, New Delhi-110016, India*

[b] *Department of Chemical Engineering, Malaviya National Institute of Technology, Jaipur- 302017, India*

[c] *Department of Civil Engineering, Malaviya National Institute of Technology, Jaipur-302017 India*

Abstract: High fluoride concentration in groundwater occurs in the majority of the dry and semidry regions of the Indian subcontinent. The state of Rajasthan in India has been identified as a red alert zone for the presence of high fluoride in groundwater. Most of the residents in the Rajasthan are using groundwater for drinking and irrigational purposes. The main purpose of the present study was to analyse the level of fluoride with other physiochemical properties like TDS, alkalinity and hardness in samples of ten districts i.e., Jodhpur, Pali, Chittorgarh, Churu, Jhunjhunu Karoli, Bharatpur, Sirohi, Nagaur, and Jaipur of Rajasthan. The study also covers the distribution of vulnerable groundwater physiochemical properties using geographic information system (GIS) spatial analysis. Water samples were collected from 100 villages selected as the study area within the 10 districts, during the period of December 2017 to December 2021. The concentration of fluoride by ion-selective electrode method, total dissolved solids by TDS meter, and both alkalinity and hardness by titration method were analyzed. The fluoride distribution in Rajasthan state ranged from 0.2- 21.5 mg/L in groundwater samples compared to the WHO permissible limit of 1.5 mg/L. The fluoride concentration in 58 out of 100 villages was above 1.0 mg/L which may lead to adverse health issues for the people residing in the region.

***Keywords**: Fluoride, TDS, Alkalinity, Hardness, Groundwater, GIS*

Issues of Landfill Leachate and its Treatment Techniques: A Review

Meet Dhamasaniya [a] Dhruvin Sojitra [b] Harshul Modi [c] Shabiimam M A [de] Anurag Kandya [f]

[abcdf] *Civil Engineering, SOT, Pandit Deendayal Energy University, Gandhinagar, 382007*

[e] *Gujarat Energy Research Management and Institute, Gandhinagar, 382007*

Abstract: Rapid growth in urbanization and increasing population has accelerated the amount of solid waste generation. Around 70% of this waste generated is disposed of in landfill sites and dumping grounds. This creates a problem of landfill leachate. Landfill leachate has various adverse effects on the environment and contaminates the groundwater on an immense scale. This leachate contains highly toxic contaminants such as heavy metals, solids, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Organic Carbon (TOC), ammonia etc. Treatment of all these contaminants is not possible using a specific treatment technique. This review study explains the treatment techniques like physicochemical treatment, biological treatment along advanced oxidation treatments used for landfill leachate. This review study also provides some factors affecting parameters for landfill leachate generation which helps us to determine the treatment techniques and also helps to identify the effectiveness of the treatment. It is also observed that physicochemical treatment majorly removes solid particles, heavy metals, ammonia etc. and biological treatment removes organic matter. For removal of COD in medium age leachate advanced oxidation processes are used. This review study provides a comprehensive review of issues of landfill leachates and treatment techniques for landfill leachate wastewater.

Keywords: *Landfill Leachate, Heavy metals, degradation, Biological Treatment, oxidation*

Treatment of Water Using Natural Materials: A Review

Daniel Borlon [a] Meet shah [b] Shabiimam M A [cd] Anurag Kandya [e]

[abce] *Civil Engineering, SOT, Pandit Deendayal Energy University, Gandhinagar, 382007*

[d] *Gujarat Energy Research Management and Institute, Gandhinagar, 382007*

Abstract: The need for water treatment is very essential to human health in that it provides safe water that human beings can used for both drinking and irrigation purposes. During the treatment processes, contaminants and impurities such as dust, harmful chemicals, radiological contaminants, biological contaminants and total suspended solids are removed so that the purified water can be useful to the end-users. Bacteria are also reduced during the treatment. There are numerous water treatment processes including physical processes, biological processes, chemical processes and most recently the use of natural materials. Natural materials such as zeolite, peach seeds, activated carbon (charcoal), moringa oleifera etc. are considered as modern treatment processes and are incorporated as important means of removing contaminants from water thereby making it safe for human uses. However, the aim of this study is to describe the use of natural materials for treating water. Activated carbon is a porous (sieve like) material and moringa oleifera, zeolite and banana are all good natural coagulants used for purifying water. During filtration and coagulation, impurities and contaminants are absorbs from the water. They filter organic chemicals (phosphate, amine, sulfate etc.), remove COD and suspended solids from water and are considered to be sustainable. These filtration and coagulation processes are important and demonstrate that natural materials are effective and feasible for improving water quality.

Keywords: Natural materials, water treatment, zeolites, moringa oleifera, peach seeds, filtration

---

Hydro-geochemical approach to study Sea water intrusion at Lodhva in Gujarat Coast-A case study

Asim Fulzele*, Saptarshi Dutta Purkayastha, Pandurang Balwant, Divya Kalra, Paras R Pujari, Nitin Labhsetwar, Atya Kapley

CSIR-National Environmental Engineering Research Institute Nehru Marg, Nagpur-440020

Abstract: The aquifer along Gujarat coast in India is characterized by high salinity. In the present study, the high salinity in a rural village is studied by Geochemical indicators. The groundwater classification is attempted using well established Chaddha's diagram. The groundwater samples (18 nos.) were collected and analyzed for physico-chemical parameters. The results were assessed and compared with BIS (10500:2012) drinking water specification. The results indicates that most of the groundwater samples are alkaline, brackish and slightly hard in nature wheras TDS varies from 248 Mg/L to 3534 Mg/L in post-monsoon 2019 and 719 Mg/L to 4180 Mg/L in pre-monsoon 2021. It is observed that Na and Cl are the dominating cations and anions. Chloride, nitrate and magnesium are exceeding the permissible limits in most of the samples.In addition, All samples except 2 nos of samples have Na+/Cl- molar ratio lower than 0.86 (seawater) and Cl-/HCO3- molar ratio indicates that 1 nos sample is moderately, 5 nos samples severely and 12 samples shows characteristics of seawater (>= 6.6). The Gibb's diagram conveys that the samples fall in evaporation dominance area. The piper diagram and chaddha's plots indicates that samples are Na-Cl and mixed Ca-Mg-Cl type which confirms the saline water intrusion in coastal aquifer.

Keywords*: Coastal salinity, Groundwater, Sea water intrusion*

Seawater Desalination Using Hydrate Technology

Dr Pawan Gupta, Mr Issac Wilson

School of Petroleum Technology, Pandit Deendayal Energy University

Abstract: Seawater desalination using clathrate hydrates is a promising technology for water treatment. Hydrate based seawater/waste-water desalination is a sophisticated thermodynamic process where guest gas reacts with water at high pressure and low-temperature conditions required for the formation of the crystallized cage-like structures called hydrates. The process of desalination through clathrate hydrates is represented in Figure 1. The guest gas comes into contact with feed water at high pressure inside the reactor. The temperature inside the reactor is regulated using a cooling system. An agitator stirs the water to speed-up the reaction with gas to form hydrates. While hydrate is formed, salts inside the water separate from the solidification process except for some that get collected at the porous surfaces of formed hydrates. To clean them the hydrates are moved to a washer which washes the solid hydrates using clean water after which the clean hydrates are collected in the Melter and dissociated (Figure 1). This will reduce the water recovery rate of the process. During dissociation clean desalinated water is separated from guest gas. The gas is recovered for reuse and the water is collected for consumption. In desalination, specific energy consumption (SEC) may be used as indicators to compare the efficiency of each type of desalination technique currently put into operation. Proper understanding of hydrate nucleation, its growth and separation process will lead to the commercialization and technological improvement in clathrate-based desalination. In this work, a review is presented for between different processes of desalination (see Table 1), the challenges associated and way forward in hydrate desalination is highlighted.

UV Assisted Photocatalytic Degradation of Tetracycline and Ciprofloxacin Antibiotics using Biosynthesized nZVI from *Shorea robusta* leaf extract.

Aditya Kr. Jha[a] and Sukalyan Chakraborty[a]

[a] *Dept. Civil and Environmental Engineering, BIT, Mesra, Jharkhand, India – 835215.*

Abstract: Antibiotics are antimicrobial chemicals active against bacterial infections. They are widely used in human medication, veterinary medication, aquaculture, poultry, and agriculture. However, a significant fraction of these antibiotics is discharged or excreted back into the environment. Antibiotic residues in water may lead to the generation of antibiotic- resistant bacteria and antibiotic-resistant genes and adversely affect human health and the ecosystem. Most of the conventional treatment plants are inefficient in the complete removal of these wastes. They have disadvantages like ineffective degradation, generation of toxic sludge, economically unfeasible, high consumption of energy and production of secondary toxic products and so on. Effective and feasible degradation of antibiotics using nanoparticles has been reported by several scientists, but chemically synthesized nanoparticles can contaminate the water bodies. Thus, nZVI was biosynthesized using $FeSO_4.7H_2O$ and leaf extract of Shorea robusta. Characterization of nZVI was performed using SEM, TEM, DLS, FTIR, XRD and ZP. Characterization revealed iron-rich, well dispersed, spherical, crystalline nanoparticles. Tetracycline is a broad-spectrum antibiotic, effective against gram-positive, gram-negative bacteria, fungus and other microorganisms, while ciprofloxacin is the second generation of fluoroquinolone antibiotics effective against gram-negative and some gram-positive bacteria. Degradation for tetracycline and ciprofloxacin was studied using UV spectrophotometer (peak at 357 and 277 nm respectively), and optimum efficiency was 88% and 84% at antibiotic concentrations 15mg/L and 25 mg/L, 0.014gm/L and 0.0175 gm/L doses of nZVI, in the pH range 4 to 8 and time 70 minutes respectively. The degradation was further verified using mass spectrometry, which confirmed the degradation of antibiotics. Active species ($\cdot O-$, $\cdot OH$, and $H+$) which may be generated by nZVI in presence of UV light, helps in degradation and mineralization of tetracycline and ciprofloxacin. The cost analysis of antibiotic degradation using nZVI proved to be very economical, with cost less than 1.1 USD per 1000L of wastewater.

Keywords: Antibiotics, Ciprofloxacin, Iron nanoparticles, Photocatalytic degradation, Tetracycline

---

Application of electrocoagulation process for the treatment of dairy wastewater: a mini review

Dipak Ankoliya [a], Anurag Mudgal [a], Manish Kumar Sinha [b], Vivek Patel [a], Jatin Patel [a]

[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: Recently, electrocoagulation (EC) technique gained immense attention due to its efficiency. The technique involves dissolution of the sacrificial anodes to provide an active metal hydroxide as a strong coagulant that destabilizes and amasses particles and then removes them by precipitation or adsorption. Conventional treatments are less efficient and are bulkier with less controllable parameter. This study reviews on the application of electrocoagulation technology to remove major organic load present in dairy wastewater prior to safely discharge or recirculate water. This review also covers the effect of various operating parameter on contaminant removal rate. Some efforts are also given in design and economical aspect of EC process for particularly in dairy wastewater treatment. The electrode material, current density, pH of initial wastewater is crucial to optimize the process in dairy wastewater treatment.

***Keywords**: Electrocoagulation; dairy effluent; wastewater treatment; mini review*

Encapsulation of bacterial cells in hydrogel to degrade microplastics

Jahanvi, Jaigopal Sharma

Delhi Technological University, Shahbad Daulatpur main Bawana road, Delhi-110042, India

Abstract: Plastics play a very important and major role in making our lives easy in many ways, due to its low cost, durability and lightweight. When large waste plastics are crushed and allowed to decompose, it gives rise to microplastics, having size less than 5 mm. Currently, around 71% of plastic waste is absorbed by the environment directly, which results in higher microplastic pollution. They are a matter of concern these days because of their presence in all kinds of ecological environments, including living organisms. Microplastics are very abundant and widespread in Marine environment and their degradation is very complex. Naturally, these microplastics are biodegraded further by the action of certain microorganisms, using sunlight, air(oxygen), heat and moisture, but it takes nearly about hundreds of years because of its resilient properties. The first step of their biodegradation includes the formation of a microbial biofilm on the surface of polymer. Then, the deterioration and fragmentation of the polymers occur, that gives rise to the formation of oligomers, dimers and monomers, with the help of enzymatic activity. The final step consists of their mineralization to CO2 and H2O. This review aims to put forward the idea of degrading these microplastics at a faster rate as compared to natural degradation by encapsulating bacterial cells, which are responsible for degrading the microplastics naturally, in hydrogel which will act as a biofilm and will enhance microplastic degradation. Because we are providing a bacterial encapsulated hydrogel that will act as a microbial biofilm, so therefore, directly the conversion of microplastics to monomers and further to CO2 and H2O will take place, which will obviously decrease the time and increase the rate for degradation of microplastics and we will have low levels of suspended waste microplastics in the environment.

Keywords: Microplastic degradation; microplastic pollution; bacterial encapsulation; hydrogel; biofilm; environment

---

A Review on Application of Low-Cost Adsorbents for Heavy Metals Removal from Wastewater

Vinayak S. Wadgaonkar [1], Niraj S. Topare [2*], Siraj A. Bhatkar [1]

[1] *School of Petroleum Engineering, Dr. Vishwanath Karad MIT World Peace University, Pune-411038, India*

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

Abstract: Environmental pollution has been identified as the primary cause of a large number of deaths and illnesses around the world. Heavy metals in wastewater have been a major problem in recent years due to their hazardous effects. Human health, living resources, and ecological systems are all at risk because of the increasing levels of hazardous metals that are being released into the environment as industrial wastes. Heavy metals in wastewater are strictly regulated by environmental organizations and authorities due to their harmful health impacts and toxicological properties. As a result, adequate safeguards must be taken, and technologies for detecting, quantifying, and removing heavy metals from effluent waterways must be developed. Recent research has focused on the removal of harmful heavy metal ions from effluents from sewage treatment plants, industrial plants, and mines, all of which generate large amounts of waste. The most prevalent methods for removing heavy metals from wastewater include chemical precipitation, ion exchange, adsorption, and reverse osmosis. As a result of recent advances in adsorption technology, it has emerged as one of the most promising technologies for wastewater treatment. In recent years, the utilization of agricultural waste materials has grown in popularity. Due to their physicochemical and nontoxic properties, agricultural wastes have the potential to be employed as adsorbents. A low-cost adsorbent made from agricultural waste is one of the most common applications for agricultural waste products. This review provides an overview of applications for various agricultural waste materials, as well as their adsorption capacities for heavy metal removal. The different properties of agricultural waste materials are also summarized. The review paper also discussed the treatment performance, challenges, environmental and health implications, and other aspects of the treatment process. It's also described in detail the process parameters, adsorption isotherm, as well as adsorption kinetics. Low-cost adsorbents have proven to be excellent in removing some heavy metals from wastewater.

***Keywords**: agricultural waste; heavy metals; low-cost adsorbent; adsorption*

Constructed Wetlands for Heavy Metals Removal: A review

Mohammad Baquir [a], Nadeem Khalil [a]

[a] *Department of Civil Engineering, Aligarh Muslim University, Aligarh - 202002, India*

Abstract: Anthropogenic activities are the major cause of heavy metals (HMs) disposal and contamination which are hazardous for living organisms and ecosystem. Treatment and disposal of HMs laden wastewater is additional major problem due to toxic and carcinogenic property of HMs. HMs aggregate in the environment and reach the food chain due to nonbiodegradable properties. Constructed Wetlands (CWs) are gaining more attention because this technique harness self-healing property of nature to treat HMs. CWs system consists of key elements as macrophytes and bacteria which play a vital role in HMs removal from the effluents. These systems are engineered for imitating and improving natural working through scientific approach to achieve desirable standards for HMs. CWs treatment mechanism involves HMs' concentration, uptake through roots, precipitation and adsorption on substrate and roots. Treatment of HMs through conventional methods are costly methods but on the contrary, it comes with adaptability in design and repeatability, cheap running and maintenance and low amount of by-products. In this review paper, emphasis is given on the role of macrophytes, their species and substrate in the removal process of HMs through the constructed wetlands. The finding of the review reveals that the CWs are one of the most effective and sustainable approaches for heavy metals removal in particular chromium and arsenic.

Keywords*: Heavy Metals (HMs); Constructed Wetlands (CWs); Macrophytes; Uptake; Adsorption; Substrates*

Removal of Heavy metals and Dyes from its aqueous solution utilizing Metal Organic Frameworks (MOFs): Review

Shivam [a], Rajvi Megha [a], Vatsal Lakhani [a], Smit Vala [a], Manish kumar Sinha [a*] Surendra Sasikumar Jampa [a*]

[a] *Department of Chemical Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar – 382 007.*

Abstract: Because of their negative impacts on human health and environment, effective and substantial treatment of organic pollutants, particularly heavy metals from water, remains a significant issue from both an environmental and biological standpoint. Adsorption, ion exchange, co-precipitation, chemical reduction, ultrafiltration, and other methods for removing heavy metal ions and dyes from water have all been documented. Adsorption, on the other hand, has become popular due to its simplicity and ease of usage. Metal Organic Frameworks (MOFs), a new class of nano adsorbents with unique properties such as increased surface area, excellent chemical stability, green and reusable material, and so on, have been used for wastewater treatment. A detailed study of some recent developments in MOFs to eliminate toxic metals such as arsenic, chromium (VI), cadmium (Cd), mercury (Hg), and lead (Pb), as well as organic dyes such as Methylene blue, Congo red, Methyl orange, Rhodamine B, Reactive black, and Methyl red, is presented in this review paper.

Keywords: Metal Organic Frameworks, Adsorption, Dye, Heavy metals

---

Ecofriendly Synthesis of Pure and Modified CuMnO3: It's Application as Gas Sensor

Ganesh Dabhade [a*], Gaurav Daware [b], Yennam Rajesh [c], Lakshmana Rao Jeeru [d]

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

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

[d] *School of Petroleum Technology, Pandit Deendayal Petroleum University, Gujarat- 382426, INDIA*

Abstract: Recently a novel material like gas sensing metal oxides, mixed metal oxides and modified mixed metal oxides has great attraction owing to their key role in monitoring environment pollution, security in hospitals, home, public places, hazardous emission from industries and automobile exhaust. Initially mechanochemical method employed for synthesis of CuMnO3 catalyst and then modification CuMnO3 through hydrothermal route. These synthesized catalysts were characterized by UV-DRS, FTIR, XRD, SEM, TEM and BET surface area. The average particle size obtained for 3% Fe/CuMnO3 were found to be 14-26 nm with 132 m2/gm, BET surface area, which is greater than undoped CuMnO3(18-32nm with 121 m2/gm BET Surface area). Our work proclaimed that, among all synthesized 1,3,5% Fe/CuMnO3; the 3% Fe modified CuMnO3 material shows significant gas sensing properties towards highly toxic gas such as H2S gas released from sewage plants, oil and natural gas industries among the CO, CO2, H2, NH3 with moderate temperature requirement with better sensitivity and excellent selectivity.

Keywords*: Mixed metal oxide; Mechanochemical; Hydrothermal route; Gas sensor.*

Accumulation of heavy metals in crops irrigated with wastewater in various parts of India: A review

Bibhabasu Mohanty [*a, b], Anirban Das [a],

[a] *Department of Sciences, Pandit Deendayal Petroleum University, Gandhinagar-382007, India.*

[b] *Department of Civil Engineering, SAL Institute of Technology and Engineering Research, Ahmedabad-380060, India.*

Abstract: Higher quantities of heavy metals have been found in the environment and in the food chain as a result of increased industrialization and urbanisation. Even in low quantities, heavy metals such as cadmium (Cd), copper (Cu), chromium (Cr), lead (Pb), mercury (Hg), and others are potentially hazardous due to their non-biodegradable nature, extended biological half-lives, accumulation, and biological interactions. Known as persistent pollutants, these heavy metals can bind to soil surfaces and then be absorbed by plant tissue. Vegetables play a significant part in our food supply since they provide micronutrients, antioxidants, vitamins, and other nutrients that are essential for human health. The eating of tainted food poses a threat to both human and animal well-being. When vegetables are cultivated in suburban areas, it is potential for heavy metal pollution and build-up to occur. In accordance with the type of vegetable, some have a significantly greater predisposition than others to accumulate significantly larger quantities of heavy metals in their sections than others. Our evaluation concentrated on the findings of numerous researchers from across India, where heavy metal contamination of various leafy and non-leafy vegetables is a serious concern due to the use of wastewater for irrigation and atmospheric deposition of heavy metals. In addition, an attempt was made to establish the cumulative effects on human health of consuming these veggies that were cultivated in contaminated sections of the environment.

***Keywords**: Contaminants; heavy metals; non-biodegradable; sewage; accumulation; toxic*

Small molecule-based optical chemosensors for detection of heavy metal ions in water

Nandini Mukherjee [*a], Nikunjkumar Vagadiy [a], Mohil Odedar [a]

[a]*Department of Chemistry, School of Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat-382426, India*

Abstract: Water pollution arising from the over-exploitation of natural resources has become a serious concern. Heavy metals like Hg, Pb, As, Sb, Cd, and Cr constitute one of the major classes of water pollutants. Even some of the biologically significant metals including Cu, Fe, Zn, Mn, if present in excess amount, could cause toxicity when consumed directly or indirectly. Therefore, detection and removal of these metals from water prior to its consumption is crucial. Detection and quantification of the heavy metals in water bodies in remote areas is not an easy task. It demands the development of frugal and reliable sensors for trace analysis prior to the deployment of any water treatment system. In that context, the small molecule-based optical chemosensors owing to their optical properties, easy synthesis, and scale-up opportunities could prove to be suitable candidates. This article will majorly focus on the design and performance of cost-effective, reusable, and efficient molecular sensors for the detection and quantification of heavy metal ions in water. The article will summarize the use of different molecular scaffolds such as anthracene, BODIPY, coumarin, fluorescein, etc. for the rational design of optical chemosensors for specific heavy metal ions. The recent studies reporting sensors for real sample analysis will be highlighted.

***Keywords**: small molecule; optical; chemosensor; heavy metal; water; detection*

Laser induced breakdown spectroscopy: A robust technique for the detection of trace metals in water

Darshitsinh Parmar, Rohit Srivastava, Prahlad K. Baruah

Department of Physics, School of Technology, Pandit Deendayal Energy University(PDEU), Gandhinagar, 382426, India

Abstract: Modernization and industrialization have resulted in the addition of significant micropollutants in the form of trace metals in the environment. Large amounts of wastewater containing traces of various metals are generated due to industrial output and pesticide usage, which can pollute surface as well as groundwater. Many metallic components, especially the heavy metal ones are abundant, poisonous, difficult to degrade and even their low concentrations can be toxic to natural health. Hence, it is essential to detect and remove these hazardous species in order to prevent water pollution. Traditional methods for detecting these metals in water such as atomic absorption spectroscopy (AAS), X-ray fluorescence spectroscopy (XRF), inductively coupled plasma-optical emission spectroscopy (ICP- OES) and inductively coupled plasma mass spectrometry (ICP-MS) are expensive, time-consuming, and some of these methods may even cause secondary pollution. In contrast, Laser-induced breakdown spectroscopy (LIBS) is a quick and easy analytical method for obtaining qualitative and quantitative elemental information from materials without damaging them. LIBS can be applied to all types of samples, including solids, liquids or gases. Although the collection of the signal for solid samples is easy, there are certain disadvantages or challenges associated with the analysis of liquid samples using LIBS. In this regard, there is a need to improve the LIBS set-up to address the problems associated with LIBS in liquid. The present paper provides an insight onto the various experimental methodologies and highlights the advantages of LIBS over other conventional techniques for the detection of trace elements in water. This study will go a long way in establishing LIBS as a very convenient and reliable technique for the identification of trace elements in wastewater as well as drinking water, especially in the Indian context.

***Keywords**: LIBS, Trace element detection, Heavy metals, Drinking water, Wastewater;*

Removal of lead from water using transition-metal complex

Marelli Dhanush [a], M.Sai Siddhardh [a]

[a]*Department of Pharmaceutical Engineering, B. V. Raju Institute of Technology, Narsapur, Medak, 502313, India*

Abstract: Lead is one of most dangerous pollutants present in drinking water. It causes serious ill effects like behavioural problems and reduces intellectual capacity in children. In pregnant women lead can enter placental barrier and exposes foetus to lead. Hence it is important for us to treat water to remove lead. Conventional techniques for removing Pb2+ ions from aqueous phases include Adsorption, ion exchange, biological treatment, membrane filtration, But these processes cannot remove lead to major extent and not economical. Hence, we have designed procedure to remove lead by metal-theobromine complex. In this method, Lead is chelated with theobromine to replace water molecules. Theobromine-lead complex is identified using TLC and Insoluble theobromine-lead complex is removed from water.

Keywords*: Theobromine; Adsorption; Metal-theobromine complex; TLC*

Arsenic occurrences, health impacts and arsenic removal technologies for drinking water: A Comprehensive Review

Shubham Sharma [a], Sadaf Asharaf [a], Gunjan Som [a], Soumen Maity [a], Yogendra Singh Solanki [a]

[a] *Product Development Domain, Development Alternatives, New Delhi-110016, India*

Abstract: The presence of arsenic (As) in groundwater poses a health risk to people worldwide. The occurrence of arsenic in groundwater is due to favorable geological and anthropogenic conditions. The World Health Organization and Bureau of Indian Standards has set an upper limit for arsenic in drinking water to be 10 and 50 µg/L respectively. Excess arsenic in drinking water is liable to skin cancer, nervous system disorder, cardiovascular diseases, chronic diseases, and acute diseases. Furthermore, a comprehensive scenario for high arsenic levels in groundwater in countries like India, Nepal, Bangladesh, Germany, Pakistan, Japan, Cambodia, Australia, the United States, Peru, and China has been outlined. This problem is mainly acute in South-east Asia, particularly in India, Bangladesh, and China. In India, out of 29 states, ten states are affected with higher arsenic contamination in groundwater. Out of seven reported states, Bihar and West Bengal have highly affected arsenic groundwater. The article also discussed various technologies for removing arsenic from water, including reverse osmosis, nanofiltration, adsorption, ion exchange, precipitation/coagulation, and their removal mechanisms. This article reveals that different techniques have different levels of arsenic removal capacity. Some critical factors and mechanistic changes that could lead to newer frontiers for arsenic removal approaches have been proposed.

Keywords*: Arsenic, Groundwater, Adsorption*

Experimental Investigation on Colloid-Facilitated Chromium Transport in Variably Saturated Soil

Dipto Deb[a *], Sumedha Chakma [a]

[a] *Department of Civil Engineering, Indian Institute of Technology Delhi, New Delhi – 110016, India*

Abstract: Colloidal particles present in the subsurface environment can attach the contaminants like heavy metals, radionuclides and act as contaminant carriers to provide faster movement of pollutants through the interconnecting pores of the porous medium. Significant amounts of hexavalent chromium (Cr (VI)) can be released in liquid and solid wastes form from several anthropogenic activities such as leather tanning, electroplating, wood preservations and are transported to groundwater by colloids due to their high absorbance properties. It is essential to investigate the transport characteristics of colloid-facilitated Cr (VI) in the variably saturated porous medium. To address this aspect, experimental inspection is carried out in the three-phase soil system to study the effect of soil grain size and flow velocity on the transport of carboxyl modified latex microspheres (CML) and CML colloid-facilitated Cr (VI). A numerical model is developed to perform parameter optimization from the experimental data and to focus on the effect of various transport parameters on migration behaviors of CML colloids and Cr (VI). From the experimental study, the infiltrated water flux is found to be dominating criteria in the transport of colloid and colloid-facilitated Cr (VI) compared to the initial moisture content of the medium. The result indicates that the colloids migrate at higher depth with decreasing sand grain size. The peak concentrations of CML colloids and dissolved Cr (VI) reduce with decreasing sand grain size and the observation suggests that attachment coefficient plays a crucial role in the unsaturated soil system. A reduction in the degree of saturation decelerates the migration of colloids and provides longer residence time within the soil system. The higher residence time of colloids and Cr (VI) in the unsaturated soil medium indicate the long-term effect of toxicity due to the contaminants in the subsurface ecosystem.

Keywords*: Colloidal particles; Chromium; Soil grain size; Attachment coefficient; Unsaturated soil*

Removal Of Heavy Metal Ions from Wastewater Using Graphene-Oxide and Its Composites

Abhishek Kagalkar*, Bhavi Panchal, Ashish Chaudhari, Yash Thakrar, Yash Thakare, Sujay Kore, Manan Shah, Swapnil Dharaskar*

Nano Research Group, Department of Chemical Engineering, School of Technology, Pandit Deendayal Energy University, Raysan, Gandhinagar, Gujarat, 382426, India

Abstract: In current scenario, many river water, groundwater and industrial wastewater is creating a major environmental impact on the ecosystem. The heavy metals present in the wastewater affects the aquatic life as well as flora and fauna in adverse manner. Rural area groundwater has concentration of heavy metals more than permissible limits which effects the rural population with chronic effects. Many sacred riverwater also has heavy metal concentration that needs to be treated. The treated effluents from industries have heavy metal concentration which cannot be traced during disposal and unfollows the zero-liquid-discharge. This paper describes various heavy metals detected (Cd, Cr, Pb, As, etc.) which are to be removed using Carbon-based Graphene Oxide (GO) nanomaterials and its possible composites to eliminate selective heavy metals from various sources collected, i.e., Sabarmati and Ganga River, CETP (Dahej), groundwater from rural area of Valvada (Surat) and Bharuch. This paper also shows the methods for synthesis, adsorption and removal of heavy metals from the adsorbents showing the regeneration of Graphene Oxide. The study also studies the concentration of the heavy metals in untreated as well as treated water sample and higher adsorption capacity for heavy metals.

***Keywords**: Heavy Metals, Graphene Oxide, Adsorption, Regeneration*

Niobium Pentaoxide (Nb2O5) as an Efficient Photocatalyst for Photocatalytic Degradation of Rhodamine-B

Niraj S. Topare1*, Shantini A. Bokil [2], Satish V. Khedkar [3] Anish Khan [4,5]

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

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

[3] Department of Chemical Engineering, College of Engineering and Technology, Akola 444104, India

[4] Chemistry Department, Faculty of Science, King Abdulaziz University Jeddah, 21589, Saudi Arabia

[5] Center of Excellence for Advanced Materials Research, King Abdulaziz University, Jeddah 21589, Saudi Arabia

Abstract: The treatment of textile effluents is one of the most significant environmental concerns facing the world right now. Photocatalysis has been shown to be successful in the removal of intractable chemicals and is regarded as a viable wastewater treatment technology. The photocatalytic degradation of Rhodamine-B (RB) in an aqueous solution was investigated in this study, as well as the photocatalytic behavior of niobium pentaoxide (Nb2O5) as a photocatalyst was tested. It's important to note that good photocatalytic efficiency is highly dependent on the operating conditions. There are a number of process parameters that influence RB photocatalytic degradation, including the amount of photocatalyst (Nb2O5) used, the concentration of RB at the start of the reaction, and the pH of the solution optimized under visible-light irradiation. The maximum RB degradation was attained under the optimum conditions of 10 ppm concentration, 1 mg / L catalyst (Nb2O5) dosage, and pH 11 according to the findings. The results also revealed that after utilizing the catalyst three times in a row, the catalyst preserved its efficiency and the rate of degradation remained higher.

***Keywords**: Photocatalysis, Degradation, Rhodamine-B, Nb2O5, Visible-light irradiation*

Application of Mechanically sand reclaimed fines as an adsorbent for textile waste treatment

Satchidanand R Satpute [1*], Rushikesh Chimkar [1,2]

[1] Department of Chemical Engineering, Vishwakarma Institute of Technology, Bibwewadi, Pune, India

[2] Department of Chemical Engineering, Research scholar at IIT Bombay, Mumbai, India

[3] Department of Chemical Engineering, Research assistant at IIT Bombay, Mumbai, India

Abstract: The main aim of this article is to explore the possible use of fines which are generated during the sand reclamation. During mechanical reclamation, dead clay coating from sand grains remove in the form of fines. These fines mixture of dead clay, sand and coal additives. Fines generation also varies from sand to sand. The size of these fines is less than < 50 µm. These fines cannot be used in the foundries because mostly fines are dead clay and do not provide strength to the molds. Dumping of these fines is also a big environmental concern. Therefore, it is an urgent need to explore possible use of these fines. In this study, fines were used an adsorbent for removal of methylene blue dye from aqueous solution. This adsorbent was also used for textile waste water. Liquid phase batch operations were carried out to observe the effect of various experimental parameters such as contact time, Adsorption dosage, pH of the solution, effect of temperature and the optimum conditions for these parameters were evaluated. Adsorption of textile wastewater is also examined. The characterization of these samples were done by SEM and FTIR analysis and thereafter comparisons have been done. The results reveal that these fines can be used effectively as an adsorbent at economical rate, particularly for textile industries.

***Keywords**: Reclamation, Fines, Adsorption, Textile wastewater, Waste management.*

Removal of methylene blue dye from textile wastewater using vertical flow constructed wetland

Jayalakshmi.R [a], Soundaranayaki. K [b*], Subhash Kannan. M [a]

[a] *PG student, Centre for Environmental Studies, Anna University, Guindy campus, Chennai 60025, India*

[b] *Assistant Professor, Centre for Environmental Studies, Anna University, Guindy campus, Chennai 600025, India*

Abstract: The aim of this study is to assess the performance of vertical flow constructed wetland system to treat synthetically prepared textile wastewater containing Methylene Blue dye (MB) of two different dye concentrations of 50 mg/L and 100 mg/L. Three lab scale Vertical Flow Constructed Wetland systems (CW1, CW2 and CW3) of size 30cm diameter and 60cm depth were fabricated. CW1 acted as a control system without plants and was packed with sand, zeolite and gravel. CW2 and CW3 were planted with wetland plants - Canna Indica. CW2 was filled with packing media: sand, zeolite and gravel and CW3 with sand and gravel respectively. The wetlands were operated in batch and continuous mode. The systems were evaluated by measuring colour removal, Chemical Oxygen Demand (COD), pH and Electrical Conductivity (EC). The absorbance of the Methylene Blue dye in the wastewater before and after treatment was measured at the wavelength of maximum absorption using UV/visible spectrophotometer. The results showed that the wetlands CW1, CW2 and CW3 reduced colour by 85%, 93% and 74% for 50 mg/L of MB and 89%, 99% and 74% respectively for 100mg/L of MB. COD removal of 70%, 93% and 89% was achieved in CW1, CW2 and CW3 respectively for 50 mg/L MB. At 100 mg/L MB, COD removal was 65%, 89% and 83% in CW1, CW2 and CW3 respectively. This study shows that the constructed wetland system with zeolite is a promising technique for the colour removal of methylene blue dyeing textile effluents.

Keywords*: Constructed Wetland; Methylene Blue; Textile wastewater; colour removal*

Synthesis of spinel LaFe2O4 catalyst for degradation of Rhodamine- B by using photocatalytic wastewater treatment

Satishkumar K. Movaliya [a], Sanjay S. Patel [b]

[a] *Department of Chemical Engineering, Nirma University, Ahmedabad-382481, Gujarat, India*

[b] *Department of Chemical Engineering, Nirma University, Ahmedabad-382481, Gujarat, India*

Abstract: Photocatalytic oxidation is an advanced oxidation method for wastewater treatment. In this work, the synthesis and characterization of lanthanum ferrite nanoparticles (LaFe2O4 NPs) were carried out. LaFe2O4 spinel structured mixed metal catalyst synthesized by Co-precipitation (CP) and Microwave-assisted Solution Combustion (MASC) method and catalyst were characterized by using X-ray powder Diffractometry (XRD), Scanning Electron Microscopy (SEM). Single-phase cubic spinel structure was confirmed by the XRD patterns having the single largest characteristic pick. The photocatalysis of LaFe2O4 was investigated by decomposing Rhodamine-B (RhB) solution. Various parametric studies have been carried out during the experiments like dye concentration, presence of oxidative agents, the effect of stirring and process time. The presence of oxidizing agent hydrogen peroxide H2O2 reduced the dye degradation process time maximum up to 2 hours. The maximum efficiency of RhB dye degradation was achieved around 98.6 %. Hence we conclude that spinel structured LaFe2O4 catalyst promising for photocatalytic applications in dye wastewater treatment.

Keywords*: Photocatalysis; Spinel catalyst; Co-precipitation; Microwave-assisted solution combustion*

Recent Techniques of Textile Industrial Wastewater Treatment: A Review

Dipti C [a] Aakanksharaje G [b] Hetvi D [c] Shabiimam M A [de] Anurag Kandya [f]

[abcdf] *Civil Engineering, SOT, Pandit Deendayal Energy University, Gandhinagar, 382007*

[e] *Gujarat Energy Research Management and Institute, Gandhinagar, 382007*

Abstract: The textile industry is one of the largest industries in India that contributes to about 14% of the total industrial manufacture. It is the most chemically intensive industry that consumes a huge amount of water for two major processes: Dyeing of fabric and washing away excess dyes from the treated fabric. The effluent generated from the textile industry is characterised by intense colour, high pH, high Temperature and COD. The pollutant load in the effluents is due to the presence of dyes, dissolved solids, suspended solids and toxic metals. The treatment of this effluent is highly essential before its discharge into the water bodies as it can contaminate the aquatic habitats and can cause harm to aquatic life. Treatment of textile industry wastewater is carried out using physical processes, chemical processes and advanced oxidation processes (AOP). Since various chemicals and raw materials can be used in the textile industry selection of specific technique is challenging. This review study discussed the recent techniques used to remove colour, solids and organic load from the effluents such as adsorption, coagulation, Fenton process, photo Fenton process, ozonation and electro-coagulation.

Keywords*: Textile industry, Dyes effluent, Colour Removal, COD Removal, pollutants.*

Bioremediation of Textile Waste Water Using a Photosynthetic Microbial Fuel Cell with Simultaneous Energy Production

A. Khandelwal [1, 2], A. Mangal [3], J. Swaminathan[1*], P.N.L. Lens [2], C. Ghoroi [3]
[1] *Department of Mechanical Engineering, Indian Institute of Technology, Gandhinagar, Gandhinagar 382355, India*
[2] *National University of Ireland Galway, University Road, Galway, H91 TK33, Ireland*
[3] *Department of chemical Engineering, Indian Institute of Technology Gandhinagar, India*

Abstract: Gujarat is a major hub of textile industries of India. It is estimated that India produces around 130000 tons of dyestuff, of which 80% is consumed by textile industries alone (Holkar et al., 2016). Wastewater containing toxic dyes is often discharged without sufficient treatment, thereby affecting the natural ecosystems. The conventional methods for textile wastewater treatment (TTW) include several physiochemical approaches such as, coagulation, flocculation, enzymatic degradation, membrane-based separation, advanced oxidation strategies, etc. However, these processes involve the use of expensive chemical agents which could further contribute to environmental degradation. On the other hand, biological methods are effective as these degrade the dyes avoiding secondary pollution and are relatively cost effective. In this context, the present study aimed to remediate the TWW using algae-assisted microbial fuel cell (MFC). MFCs are energy generating devices and can be powered by wastewaters. MFCs are two compartment systems made of an anode and a cathode chamber which are separated by a cation exchange membrane. In the anode, the TWW adapted microbial consortia can use the dyes as electron donor substrate and/or degrade it enzymatically. Similarly, in the cathodic chamber the dyes can be removed by accepting the electrons coming from anode and/or degraded by employed algae with the help of enzymes. Therefore, a synergistic bacterio-algal approach can be used to enhance the overall dye and COD removal. In this study, a low-cost MFC was developed using clayware and plastic bucket as anode and cathode compartment, respectively, and both of the chambers were fed with real TWW. The system was assessed in terms of dye degradation, COD removal and power production. The reactor exhibited 1.6 W/m3 and 5.46 A/ m3 of power and current density, respectively. In addition to this, the dye/colour removal (%) was 89.55 % and 40.53%, from the anode and cathode chamber, respectively. The cyclic voltammetry analysis revealed the occurrence of redox reactions at both anode and cathode. The specific algal growth rate observed in cathodic chamber was 0.18 d-1, which suggests the potential of algae in using TWW as nutrient medium and simultaneously remediate it. The proposed system was able to remove dye as well as generate bio-electricity and algal biomass.

Keywords*: Textile wastewater treatment; Microbial fuel cell; Power production; algal biomass production; Low-cost*

Comparison of Photo Fenton and H2O2/UV Advance Oxidation Process in treating textile Wastewater for Reduction of COD and Color: A Review paper

Israel Hailu Abraham [1], Dr. Reshma Patel [2]

[1] *M.Tech. Environmental engineering, Birla Vishvakarma Mahavidyalaya, 388120, Vallabh Vidyanagar, Gujarat, India*

[2] *Associate Professor, Civil Engineering Department Birla Vishvakarma Mahavidyalaya, 388120, Vallabh Vidyanagar, Gujarat, India*

Abstract: Contaminants in textile wastewater are characterized as Recalcitrant, which usually contains high concentrations of organic compounds, expressed as high COD, a varied range of pH, low biodegradability, and the presence of colors. Such waste is difficult to treat by conventional biological treatment methods because the majority of the dyes present in textile wastewater are non- biodegradable and are toxic to microorganisms. These conventional methods' limitations create a motivation to adopt more efficient systems. AOPs are powerful systems capable of converting contaminants within a short reaction time into harmless substances and can be used for the treatment of effluents from industries such as pulp and paper, dye manufacturing, textile, and other industries. This review paper will review two advanced oxidation processes namely photo Fenton and photolysis of hydrogen peroxide in treating textile wastewater and dyes found in textile wastewater and factors that affect the processes. The efficiency of both the H202/UV and Photo Fenton process is influenced by different independent variables such as intensity of UV irradiation, pH, time, and concentration of H2O2, Fe2+ and pollutant concentration.

Keywords*: Advanced oxidation process; Textile Wastewater; Photo-Fenton; H2O2/UV; Hydroxyl radical*

A Comprehensive Review on Recycling and Reusage of Oil-field Waste Water

Harsh Patni and Balasubramanian Ragunathan

Pandit Deendayal Energy University, Gandhinagar

Abstract: The petroleum sector is one of the fastest expanding businesses, and it helps emerging countries like India thrive economically. Due to the growth of energy demand, the production of crude oil/gas is increasing rapidly. Oil field waste water produced in largest stream during exploration of oil and gas. It contains wide range of pollutants such as petroleum hydrocarbons, mercaptans, oil and grease and other organic compounds. All of these compounds are found in a very complicated form in the water that the petroleum industry sends out into the earth. They are bad for the environment either directly or indirectly. In this review paper, we want to talk about how different recycling technologies have been used in the historical and contemporary to deal with oil field wastewater. Various recycling operations like physicochemical and biological processes are used to clean up wastewater from the petroleum industry. The results of recycling process, improves the quality of water which can be used for reinjection along with makeup water for recovery of oil from the reservoir. Also, the treated water can be used for agriculture and many other industrial applications.

Keywords: Crude oil, Oil-field waste water, Physicochemical method, Biological method, Reservoir

Sequential coagulation/flocculation and sonolytic oxidation using persulfate and hydrogen peroxide for real rubber processing industry wastewater treatment: Kinetic modelling and treatment cost analysis

Rahul Das [a], Sajal Rudra Paul [a], Animesh Debnath [a]

[a] *Department of Civil Engineering, National Institute of Technology Agartala, Jirania, Barjala, Agartala 799046, India*

Abstract: Rubber industry consumes huge volumes of water, uses chemicals and produces enormous amounts of toxic wastewater with high level of chemical oxygen demand (COD), solids and turbidity. In this study, treatability of real rubber processing industry effluents using a sequential coagulation followed by sonolytic oxidation was studied with the real wastewater collected from an industry located near to Agartala, Tripura, which is the second largest rubber producing state in India. Initially coagulation-flocculation (C-F) using alum was first used to reduce the COD of the wastewater followed by sonolysis (US) and sonolytic oxidation using per sulphate (US+PS) and hydrogen peroxide (US+H2O2) as oxidants. The only C-F process with alum dose of 500 mg/L could reduce the COD of wastewater from 18267 mg/L to 12800 mg/L (29.93 % COD removed). Thereafter, C-F followed by only US (sonication time 30 min), C-F followed by US+PS (PS dose 500 mg/L), C-F followed by US+ H2O2 (H2O2 dose 0.75 mol/L), and C- F followed US+PS+ H2O2 (PS dose 500 mg/L and H2O2 dose 0.75 mol/L) resulted to effluent COD value of to 7250 mg/L, 4200 mg/L, 3200 mg/L, and 2450 mg/L, respectively. The experimental results suggested that the C-F followed US+PS+H2O2 was the best option among the considered combination of treatment techniques to treat the real rubber processing industry effluent. The treatment cost analysis revealed that C-F followed US+PS+H2O2 involve the treatment cost of 116.31 USD/kg of COD removal with 91.24% of COD removal. As per Central Pollution Control Board (CPCB) guidelines (1993) the permissible limit of COD for discharge of wastewater in to the environment is 250 mg/L, but this study could reduce the COD to 2450 mg/L from initial COD of 18267 mg/L, thus further appropriate treatments are required in order to safely dispose the wastewater in the aquatic environment.

***Keywords**: COD; Coagulation; Sonolysis; Per Sulphate; Hydrogen Peroxide;*

An Efficient Removal of Indigo Carmine Dye (IC) From Aqueous Medium Using Environmental Friendly Synthesized ZnAl2O4

Ganesh Dabhade [a*], Gaurav Daware [b], Yennam Rajesh [c], Lakshmana Rao Jeeru [d]

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

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

[d] *School of Petroleum Technology, Pandit Deendayal Petroleum University, Gujarat- 382426, INDIA*

Abstract: In recent years, materials not only show significant application in human life, but also have a very important role in various industries. From the last few decades, metal oxide and mixed metal oxide (MMO) have been acknowledged as efficient and environmentally friendly alternatives to present available materials for different chemical, food, dye and pharmaceutical industries along with environmental treatments. In view of the significant use of MMO different field, in the current work nanocrystalline zinc aluminate (ZnAl2O4) have been successfully synthesized by ecofriendly cost-effective solid state mechano-chemical method and used for photocatalytic degradation of Indigo carmine (IC) pollutant present in waste water of different industries. Numerous appropriate techniques like FT-IR, UV-DRS, XRD, SEM, TEM and BET surface area were used for its characterization. It is revealed that ZnAl2O4 exhibits a pronounced photocatalytic activity under the influence of UV-visible light exposure. Photoluminescence spectrum clearly shows single phase ZnAl2O4 nanoparticles whose emission peak appeared at 480 nm, when excited by 350 nm light. Present study also reveals a possible pathway for photocatalytic degradation of IC using LC-MS.

***Keywords**: Photocatalyst; IC pollutant degradation; LCMS; Photoluminescence; UV- visible.*

Ultrafiltration study of polysulfone (PSF) membrane modified with branched polyethyleneimine (PEI)

Smit Vala [a, *], Dr. Surendra Sasikumar Jampa [a, **], Dr. Manish Kumar Sinha [a, ***]

[a] *Department of Chemical Engineering, School of Technology, Pandit Deendayal Energy University, Gandhinagar – 382 007.*

Abstract: This work discussed the fabrication of polysulfone (PSF) ultrafiltration membranes with hydrophilic behaviour by adding the polyethyleneimine branched (PEI) as an additive. By directly blending the base polymer and additive in organic solvent the casting solution is prepared. Asymmetric ultrafiltration membrane was fabricated by phase inversion method. The presence of PEI was confirmed by comparing IR spectra of plan PSF membrane and modified PSF membrane. A scanning electron microscope was used for the comparison of morphological changes in plan and modified membranes. The membrane was characterized with respect to Bovine Serum Albumin (BSA) adsorption, pure water flux, permeability, compaction factor, Humic acid (HA) rejection and water uptake. Pure water flux increased when the wt% of additive increased from 0 to 3.

***Keywords**: Membrane, Hydrophilic, Polysulfone, Fouling.*

Application of Hydrodynamic Cavitation Devices in Industrial Wastewater Treatment: A brief review

Chaina Ram[a], Anirudh Kulakarni, S.S. Kachhwaha

Department of Mechanical Engineering School Of Technology PDEU Gandhinagar 382421, India

Abstract: The cavitation devices drop the fluid pressure below vapour pressure by the accelerating flow or shearing effect, producing cavitation bubbles and collapsing has tremendous application in the industries such as wastewater, Pharmaceuticals, refinery and chemical industries. Present work gives a brief review of applications of different cavitation devices, their suitability and scalability for industrial applications. The review paper focuses on several types of cavitation devices (orifice, venturi and rotating hydrodynamic cavitation reactor) used to degrade contaminants extract and intensify the process. Modification in the geometry of simple orifice and venturi can enhance the intensity of the cavitation phenomenon and efficacy of the process. For example, 100 % disinfection of E Coli can be achieved with an advanced rotating cavitation device. The effect of the geometric parameter (throat diameter, length, converging and diverging angles and contours) and performance parameters (disinfection rate, cavitation number, vapour volume fraction and heat generation rate, operating pressure, degradation rate of COD and CFU) for both rotating and non-rotating cavitation devices are quantified in the present study

***Keywords**: Degradation of Dye, Cavitation Devices, COD, CFU, Cavitation Number and Vapour volume fraction*

---

g-C3N4@charred wood-sawdust as buoyant biodegradable photocatalysts for enhanced photocatalytic oxidation of organic wastewater pollutants

Ravi Tejasvi [a*], Setu Visavadi [a]

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

Abstract: Photocatalytic oxidation (PCO) of organic water pollutants is a lucrative puzzle. Typical photocatalytic particles (PCPs) get submerged in the wastewater and, therefore, lose access to the light coming in through the top surface. Zeolites and other catalytic supports increase the buoyancy of the PCPs but soon become the pollutants themselves because these are not biodegradable. In our work, we present the use of the charred wood-sawdust as the biodegradable core to support graphitic carbon nitride (g-C3N4) photocatalysts. Firstly, the wood-sawdust was vacuum pyrolyzed at 700 °C for 4 hours and subsequently cooled to room temperature in a vacuum. Then, the charred powder was mixed with melamine in a 1:4 w/w ratio in an aqueous solution. The dried mixture was heated to 580 °C for 4 hours under argon to allow the formation of g-C3N4 by the thermal polycondensation of the melamine adsorbed on the charred powder core. This way, the g-C3N4 shell layer was anchored to the core particle's pores, reducing the shell's detachment from the core. Physical characterizations including x-ray diffraction, Raman spectroscopy, and Fourier Transformed Infrared spectroscopy confirmed the presence of crystalline g-C3N4 on amorphous charred wood-sawdust. The efficacy of the new formulation in wastewater treatment was assessed through the buoyancy and floatation tests and the photocatalytic degradation of Rhodamine-B dye under simulated sunlight. The results inferred the increased buoyancy of the PCPs along with a reduced degradation time under mild-stirring and no-stirring conditions.

***Keywords**: Photocatalytic oxidation; Biodegradable catalyst support; g-C3N4; charred wood sawdust; core-shell structure*

Plastic circuit boards from computer e-waste as the cost-effective and flexible electrodes in electrolytic wastewater treatment

Ravi Tejasvi [a *]

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

Abstract: Removal of dissolved metallic ions from wastewater involves using ion-exchange resins, and it increases the overall cost of water treatment. Newer methods use the electrolytic precipitation strategy to remove these ions. However, simultaneous water oxidation generates oxygen which corrodes the metallic electrode surfaces, and the cost- effectiveness of the method is rendered moot. The work presented here proposes a solution to both problems. The computer keyboards use resistive circuits to convert keystrokes into electrical signals, identified and processed by the computer processing unit. These resistive circuits are printed on transparent, flexible plastic sheets. When retired, these keyboards are discarded as electronic wastes. The present work uses the plastic sheet circuit boards of the discarded keyboards as flexible electrodes for electrolytic precipitation of dissolved metallic ions in the wastewater. Firstly, electrical characterizations were carried out to assess the ohmic potential drop caused by the circuit lengths. Then, the electrochemical characterizations, including electrochemical impedance spectroscopy, cyclic voltammetry, and chronoamperometry, were carried out in synthetic wastewater to measure the efficiency and reliability of these electrodes in prolonged wastewater treatments. Atomic absorption spectroscopy measured the pre-treatment and post- treatment metallic ion concentrations. Results concluded that these plastic-based printed circuits from the 'retired' keyboards could remove the dissolved metallic ions to a considerable extent at a paltry to no additional cost.

***Keywords**: e-waste; Electrolytic wastewater treatment; Flexible electrode; Waste to wealth; Computer keyboards*

Salt rejection study of reduced graphene oxide-polysulfone mixed matrix membrane

Dixita Prajapati, C. N. Murthy

Macromolecular Materials Laboratory, Applied Chem. Dept., Faculty of Tech. & Eng., The Maharaja Sayajirao University of Baroda, Vadodara-390001,Gujarat

Abstract: Graphene based membranes have shown great potential application prospects in many fields, especially for water purification. In this work, graphene oxide (GO) was prepared by using an improved Hummer's method and then GO was reduced by using hydrazine hydrate as reducing agent to produce reduced graphene oxide (rGO). GO and rGO were characterized by using Raman and FTIR spectroscopy. From Raman spectrum it is observed that both D and G bands are broader in GO than rGO and in FTIR spectra all corresponding peaks in rGO was obtained at smaller intensities as compared to GO. Reduced graphene oxide/polysulfone mixed matrix membranes were synthesized by the phase inversion method using different weight % (0.0, 0.1, 0.5, and 1.0%) of rGO in DMF as solvent and water as coagulant. The performance of membranes was studied in terms of pure water flux and salt rejection. Membranes exhibited improved salt rejection after embedded with rGO. These results will be discussed in this presentation.

***Keywords**: Graphene oxide; Reduced Graphene oxide; Mixed matrix membrane*

Surface Modification of Polysulfone/Azide-functionalized MWCNT Mixed Matrix Membrane using Click Reaction

Priyanka Mistry, C. N. Murthy [1]

[1] *Macromolecular materials Laboratory, Applied Chemistry Department, Faculty of Technology and Engineering, The M. S. University of Baroda, Vadodara, Gujarat, India, 390001, India*

Abstract: Surface Modification on Prepared membrane imparts new properties like improved separation characteristics, energy, and chemical efficiency varying from the unmodified membrane. The modification allows chemical resistance such as swelling resistance, fouling or solvent resistance, control pore size, and removal of membrane irregularities with improved flux or selectivity. Here, in this work, Polysulfone/Azide-functionalised MWCNT Mixed Matrix Membrane undergoes surface modification using the Click Reaction, Where Azide Group converted into the triazole ring. This Modification Confirms by the XPS Characterisation. After Modification the Membrane shows improved Pure water flux as well as Salt Rejection. The modified Membrane gives 50 LMH flux Which is higher than the unmodified membrane. Also Modified Membrane gives 50% Na2SO4 Rejection and 60% MgSO4 Rejection which is improved after the modification. These results indicates that the membrane become more hydrophilic and Permeable after the Modification.

***Keywords**: Carbon nanotubes, Mixed Matrix membrane, Polysulfone, click Reaction, Pure water flux*

Study on water and gas permeation characteristics with ZIF-8 mixed matrix membranes

Ajay V Gawali, Sapna A Gawali, Dr. Manish Kumar Sinha and Surendra Sasi Kumar Jampa

Research scholar, Pandit Deendayal Energy University Gandhinagar-382007, Gujarat, India.

Assistant Professor, Pandit Deendayal Energy University Gandhinagar- 382007, Gujarat, India.

Abstract: Among the different separation technologies, membrane separation has been shown to have a high purity of product; low energy cost, free from pollutions, and cleans technology with outstanding separation characteristics. For the case of water, effective and economical oily wastewater and organic pollutant separation are highly desirable in several industries. Whereas, in the case of gas. The purification of the gas process was required for an impure gas because of unwanted impurities and moistures with us.Membrane separation processes lack intrinsic permeation characteristics to compete with other separation technologies like adsorption, sedimentation, coagulation, skimming, and distillation. A mixed matrix membrane is one of the strategies to improve the separation characteristics with embedded nanofillers particles. ZIFs has a new subclass of inorganic-organic hybrid materials that are being introduced as new fillers for incorporation into the polymer matrix for various applications in water and gas are oily wastewater separation, wastewater treatment, natural gas dehydration, landfill gas upgrading and mixed gas separation. In this experimental work, a metal-organic framework that is Zeolitic Imidazole Frameworks (ZIF-8) as nano particles are synthesized and used as filler for modification of a mixed matrix membranes and characterized with FTIR and SEM. ZIF-8 nano particles with 5 wt % loading in PSF then the permeation characteristics of MMMs shows the result, the pure water flux of the modified membrane at 2.5 bar are increased up to 456.38 L/ m2hr. In the case of pure gas separation, at loading 5wt% ZIF-8 in MMMs, the pure gas CO2 permeability at 9 bar pressure has shown to increase up to10.54barrer.

Keywords: Polysulfone, ZIF-8, 1-methyl-2-pyrroidylene solvent

Modification of functionalized MWCNT incorporated polyether sulfone mixed matrix membranes using click chemistry

Km Nikita[a], V. K. Aswal [b], C. N. Murthy[a]*

[a]*Applied chemistry Department, Faculty of Technology and Engineering, The M. S. University of Baroda, Vadodara, India*

[b] *Solid-State Physics Division, Bhabha Atomic Research Centre, Mumbai, India*

Abstract: This study includes the development of new type of surface modified mixed matrix membrane. We have functionalized MWCNT with azide functionality and prepared the MWCNT/ PES composite membrane by phase inversion technique. The functionalization of MWCNT was confirmed from FTIR, TGA, and Field Emission Scanning Electron Microscopy (FESEM). Further, click reaction is applied to introduce the triazole group to the membrane surface which interestingly enhanced the hydrophilicity of the membrane surface. The click reaction modification on the membrane surface was confirmed by X-ray Photo electron spectroscopy. The pure water flux of the surface modified membrane increased reaching a maximum of 331.2 L/m^2 h while the rejection performance for heavy metals is retained as compared to that of the unmodified membrane. The Bovine Serum Albumin adsorptionof the surface modified triazole containing membrane was considerable reduced indicating an enhanced surface hydrophilicity. On the whole, surface hydrophilicity and porous structure of the membrane are considerable factors for improved membrane performance and limiting protein adsorption which indicate an enhanced fouling resistance.

Keywords*: MWCNT; Click reaction; Hydrophilicity; Rejection*

Role of Membrane Technology in Food Industry Effluent Treatment

Hiralkumar Morker [a], Bharti Saini [a, *], Anirban Dey [a]

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

Abstract: Water is essential for all industrial as well as domestic use. With the increase in population and development of industry, the demand for freshwater increases day by day. Wastewater discharge is a major issue for industries as regulatory bodies mandate adequate treatment before releasing it to the aquatic bodies. The food industry is one of the most water-intensive industries. The demand for food increases with the increase in population which leads to more production of readymade food products. This will lead to more water demand and usage for production, which ultimately generates more and more wastewater. Food industry effluent characteristic depends on the type of processing operations. Conventional wastewater treatment plants can treat this type of effluents to some extent. Advancement and improvement are the keys to treating this effluent so that it can be reused in industrial processes, for agricultural and domestic use. Membrane Technology is gaining more and more attention for the treatment of wastewater due to some of its advantages over the conventional process. Membrane technology is used to extract out valued compounds from the waste stream in many food industries. Membrane technology can also be used as a pre- or post-treatment to enhance the performance of the conventional processes. Many integrated membrane techniques are recently developed and used by various food industries to treat their effluent.

Keywords*: Food industry effluent treatment; Membrane separation; Ultra-filtration; Reverse Osmosis; Dairy Effluent*

Hybrid Membrane Process for Water Treatment

Pratik Saha [1], Manish Kumar Sinha [1*], Surendra Sasikumar Jampa [1]

[1] *Department of Chemical Engineering, School of Technology, Pandit Deendayal Energy University, Raysan, Gandhinagar 382421, India*

Abstract: Water shortage is one of the most arduous issues confronting people all over the world. Rapid urbanization and water scarcity necessitate immediate action to improve sustainable water management without jeopardizing global socioeconomic growth. Thus, conventional water treatments are implemented for the purpose of eradication of various pollutants in wastewater. Traditional water treatment methods, whether in water treatment facilities or RO plants, have run across a number of roadblocks that have significantly hampered their performance and efficiency. Natural water resources are becoming contaminated, rising demand, and excessive usage of fresh water have all placed present conventional water treatment/desalination facilities under severe strain. Integrating the membrane process with other water remediation technologies in a hybrid process is a novel technique to improve contaminant removal efficiency for our target streams.This process is termed as Hybrid Membrane Process. On this aspect, this paper would highlight the benefits of using HMP compared to conventional methodologies & their applications conducted in various sectors around the world.

Keywords*: Hybrid membrane process, fouling, water treatment*

Structured Nano Materials Derived From MOF

Sapna Ajay Gawali [1], Smit Vala [1], Ajay Gawali [1], Ashish Prabhudas Unnarkat [1], Nagarjuna Reddy Paluvai [2], Manish Sinha [1*], Surendra Sasi Kumar Jampa [1*]

[1] *Chemical Engineering Department, School of Technology, Pandit Deendayal Petroleum University, Gandhinagar, India-382421*

[2] *Revin Labs Private Limited*

Abstract: Nowadays, zeolitic imidazolate framework-8 is used in multiple areas from wastewater treatment, membranes, drugs delivery and catalysis to photo electronics owing to their inherent exclusive pore structure and high specific surface area as well as their advanced thermal and chemical stability. The molecular differentiation qualities of the product will affect by porosity and pore size distribution and due to this affect the product selectivity. Ordered porous materials are broadly achieved by classical hard and soft templating techniques leading to diverse pore size distributions and morphologies. In recent years, ZIF-8 derived from Metal-organic frameworks (MOFs) and ZIF-8 is a subclass of MOFs. Metal-organic frameworks (MOFs) are emerging as a new category of nanoporous materials with especially high surface areas and narrow pore size distributions. In the present work, we have synthesized and characterized carbonized metal-organic framework, in case ZIF-8. Nano ZIF-8 is prepared via a single step room temperature crystallization with 2-MIM and zinc nitrate hexahydrate as precursor materials. As-prepared ZIF-8 materials were characterized by DLS, XRD, and SEM analysis for identifying morphological and compositional changes. Carbonized ZIF-8 (CZIF-8) is produced via the single-step carbonization technique by decomposing ZIF-8 in an inert atmosphere at 1000º C. Parent material is compared with the carbonized material for morphological and elemental composition changes. ZIF-8 and CZIF-8 were used as an additive in the preparation of a mixed matrix membrane to modified polysulfone membrane for wastewater treatment. As a result, compared with pure polysulfone membrane and ZIF-8/PSF Mixed Matrix Membrane, the pure water flux increase by 14%. The pure water flux of 5 wt% CZIF-8/PSF MMM is 521.12 L /M2 h, which is much greater than that of pure PSF and 5 wt% ZIF-8/PSF membranes. as shown in Fig 6.

Keywords*: Membrane, Metal-organic Framework, ZIF-8, CZIF-8, Water Treatment, Permeability*

Effects of feed and draw solutions temperature on the performance of Aquaporin HFFO.6 membrane in forward osmosis

D. Dsilva Winfred Rufuss [*1,2], Yawen Wu [1], P. A. Davies [1]

[1] *School of Engineering, University of Birmingham, Edgbaston, Birmingham B15 2TT, United Kingdom*

[2] *School of Mechanical Engineering, Vellore Institute of Technology, Vellore-622014, Tamil Nadu, India*

Abstract: Recently, forward osmosis (FO) has attracted increasing attention in many potential applications including food processing, fertilizers and manufacturing industries. This study investigates the effects of feed solution (FS) and draw solution (DS) temperature on the water flux, reverse salt flux, and specific reverse salt flux. The temperature of both the DS and FS were varied at the same time. Four typical temperatures such as 20 °C, 25 °C, 30 °C and 35 °C were selected to maintain at FS and DS sides, respectively, for each iteration. Except for the temperature, the other operating conditions like concentration, flow rates, and the type of membrane used were not varied in this experiment. The experiments were performed with tap water as FS and 1.5 M of NaCl as DS. The flow rates of the DS and FS were maintained at 15 L min-1 and 25 L min-1, respectively. The membrane used was the hollow fiber forward osmosis (HFFO.6) membrane procured from Aquaporin A/S, Denmark. The results showed that as temperature increased from 20 °C to 35 °C, the water flux, reserve salt flux (RSF), and specific reverse salt flux were enhanced in a different percentage. This is due to the enhanced diffusion coefficient of both DS and FS as the temperature increased. This further reduces the concentration polarization and in turn augments the water flux. Hence, it is recommended to operate the FO at a higher temperature considering the other influencing operational parameters such as specific reverse solute flux, recovery and rejection percentage.

Keywords*: Water flux of FO; Temperature; Reverse salt flux; Specific reverse salt flux*

A mini review on adsorption of industrial dyes and removal of heavy metals

Milan Raninga [a], Anurag Mudgal [b], Vivek K. Patel [b], Jatin Patel [b], Manish Kumar Sinha [b]

[a] *Research Scholar, School of Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat, INDIA*

[b] *Associate Professor, School of Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat, INDIA*

Abstract: The water resources are contaminated due to discharge of a large number of pollutants from industrial and domestic sources. A variety of a single and multiple units of physical, chemical, and biological processes are employed for pollutants removal from wastewater. Adsorption is the most widely utilized process due to high efficiency, simple procedure and cost effectiveness. Adsorption is widely used for removing these Contaminants from wastewater. This mini review focused on physical, chemical, and biological modified adsorption system that showed improved adsorption capacity towards dye and heavy metals from wastewater. Literature suggests that chemical modified activated carbon showed maximum adsorption capacity towards dye and heavy metals. Chemical modifications, including acid, base, and impregnation, are studied extensively due to reagent availability, easy modification, and tuning facilities of surface functional groups. However, systematic documentation of chemical modifications on activated carbon is required for dye and heavy metals removal efficiency improvement from wastewater.

Keywords*: Adsorption; Dye; Heavy Metals; Wastewater*

Assessment of ultrafiltration membranes for domestic food waste and blackwater treatment with AnMBR

Rubén Rodríguez-Alegre [*1,2], Abel Lara [1], Xialei You [1], Natalia Rey-Martínez [1], Montserrat Pérez-Moya [2], Julia García-Montaño [1]

[1] *LEITAT Technological Center, C/ de la Innovació 2, 08225 Terrassa (Barcelona), Spain*

[2] *Chemical Engineering Department, Universitat Politécnica de Catalunya, EEBE, C/ Eduard Maristany 10-14, 08930 Barcelona, Spain*

Abstract: Continuous population growth has led to an unsustainable generation of domestic solid and liquid wastes. Dumping this type of waste produces severe environmental problems that must be faced with the study of the feasibility of new technologies. One of the most promising technologies for the treatment of high organic load wastes is the Anaerobic Membrane Bioreactor (AnMBR), consisting of an anaerobic digestor coupled to a filtration unit, usually in the ultrafiltration range. The present study aims to assess two ultrafiltration membranes as filtration system coupled to a Upflow Anaerobic Sludge Blanket (UASB) anaerobic digestor for obtaining regenerated water suitable to be reused according to Spanish legislation. Both membranes resulted in similar regenerated water quality, though the regenerated water quality reported to be highly conditioned by the UASB outlet stream quality. Two tubular ultrafiltration membranes were tested, one polymeric and ceramic, with areas of 0.6 and 0.35 m2 respectively. The membranes were operated at 0.9 and 6 bar of transmembrane pressure for the polymeric and ceramic membranes, respectively. In operational terms, both membranes showed similar results in terms of permeate flow in the tested batch and was not observed significant fouling (29.32% and 27.19% of flux decrease for polymeric and ceramic membranes respectively), which reveals the capability of both membranes to treat higher volumes. The results have demonstrated the feasibility of using ultrafiltration polymer membranes for the reduction of critical parameters for the reuse of water such as COD up to 45%, turbidity up to 90% and the presence of microorganisms a 100%.

***Keywords**: black water; anaerobic digestion; UASB, ultrafiltration*

Energy Efficient CO_2 Seperation using Nanoparticles Supported Membrane: A Review

Anwesha Mohanty, Hrishikesh Saikia*, Nitya Tailwani, Tushar Patil, Swapnil Dharaskar

CO2 Research Group, Department of Chemical Engineering

School of Technology, Pandit Deendayal Petroleum University, Raisan, Gandhinagar, Gujarat - 382426

Abstract: Energy and environment are the two most important issues of this century due to climate change. One of the foremost importance is the control of greenhouse gases mainly CO2. The composition of CO2 has increased by 100 ppm form the pre-industrial age. The technology to separate gases using the membrane has been popularized and attracts various industries, mainly in gas separation industry. Membrane and membrane process have been considered as one of the most promising technologies for mitigating CO2 emissions from the use of fossil fuels. In this paper, recent advances on membrane processes for CO2 separation are reviewed. A comparative study between absorption, adsorption and membrane separation is also reviewed in this paper. Another are we have focused is nanoparticles. Nanomaterials are being extensively employed for gas adsorption processes as they provide excellent porous surfaces. In comparison to the traditional methods, these methods are more economical and efficient alternatives. Different kinds of metal-organic frameworks (MOFs), zeolites, alumina, silica, carbon nanotubes are commonly employed nanomaterials for the purpose of carbon dioxide separation. The choice between these available options is based on the type of operation whether it is gas based or vapour-liquid based and also on the desired levels of separation. The combination of nanomaterials and membranes provides a better alternative to the nanomaterials. In this review paper we have covered the possible variations in the composition of the membrane in order to enhance the adsorption rates considerably. These combinations are studied under varied ranges of operating conditions, in order to account for the commercialization of these methods.

***Keywords**: Nanomaterial; CO2 adsorption; Membrane separation; Separations; Environment; Efficiency*

Practical brackish water desalination with 94% recovery and specific energy consumption below 0.6 kWh/m3

P. A. Davies [*1], E. Hosseinipour [1], S.Karimi [1], A. Mudgal [2], D. Patel [2]

[1] *School of Engineering, University of Birmingham, Edgbaston, Birmingham B15 2TT, United Kingdom*

[2] *Department of Mechanical Engineering, School of Technology (SoT), Pandit Deendayal Energy University, Raisan, Gandhinagar- 382007, Gujarat, INDIA*

Abstract: With widespread salinisation of groundwater and soaring water demands across the globe, desalination of brackish water is very much needed. To conserve water and energy resources, the desalination process should achieve high recovery with low energy consumption. Two processes have been put forward for this purpose: batch reverse osmosis and semi-batch reverse osmosis. Batch reverse osmosis has high energy efficiency but becomes large and costly for high recovery. Semi-batch reverse osmosis is less energy efficient, but more compact to implement. To provide a practical and efficient overall solution, we have developed and tested a hybrid semi-batch/batch reverse osmosis system. Using a single 8-inch spiral wound reverse osmosis membrane, the system produces about 20 m3 of freshwater per day when operated continuously. With feed water containing up to 1.5 g/l, specific electricity consumption ranges from 0.4 to 0.6 kWh/m3 per cubic metre of water output, at 94% recovery. This means that the system only consumes about 10 kWh of electricity per day, while discarding only 1.3 m3 of brine. Besides the membrane unit, the system comprises three valves, two pumps and a work exchanger unit consisting of a pressure vessel and a piston. All these parts are 'off-the-shelf' except the piston which has to be manufactured following an engineering drawing. The presentation will explain all the practical details of the system and show the results obtained so far. The engineering drawing of the piston will be provided in the conference proceedings.

***Keywords**: Desalination, reverse osmosis, groundwater, high recovery, energy efficiency*

Usage of Flap Gate for Optimisation Of Discharge: A Sustainable Water Management Approach

C.R.Suribabu [1], J.S.Sudarsan [2], Padma Parija [2]

[1]*Centre for Advanced Research in Environment, School of Civil Engineering, SASTRA Deemed University, Thanjavur – 613401*

[2]*School of Civil Engineering, National Institute of Construction Management and Research, Pune – 411002*

[2]*School of Civil Engineering, National Institute of Construction Management and Research Pune – 411002*

Abstract: Water is a basic necessity of all living beings for their survival in Earth. Hence, it has to be ensured that water is effectively distributed. Nowadays tube well irrigation has become very common due to non-availability of surface water. Often, farmers supply more water than actually required for a crop that is grown in the field. Correct amount of water is to be released by knowing the rate of discharge of particular field. Releasing and finding particular discharge is typical task even nowadays. There are several methods available for measuring discharge from pipe outfall but there is no method for finding discharge directly. The present work is to develop a methodology that can read the discharge directly. This method can be applied where sufficient quantity of water that comes out from pipe as free fall (trajectory). In the present study a novel method is proposed to find discharge using flap gate. Flap gate device consists of circular plate hinged at pipe outlet. The jet of water comes out from the outlet of the pipe just lift the plate due to water force. The discharge can be computed very easily once angle of deflection is measured. This can be used in irrigation field for supplying sufficient quantity of water for irrigation purpose. Excess usage can be minimized by knowing correct flow rate from pipe outfall. The reason for trying to develop this instrument is to make it available for everyone at less cost and proper usage of pipe outfall is to be done.

Feature Selection for Decision Making in Water Treatment Plant: A Modified AHP Approach

Harsha Sahu, * Soumyadeep Dutta ** Tilottama Chakraborty, ** Mrinmoy Majumder

** M.Tech Scholar, Hydro-informatics Engineering (Under Civil Engineering Department), National Institute of Technology, Agartala, India.*

***Assistant Professor, Hydro-informatics Engineering (Under Civil Engineering Department), National Institute of Technology, Agartala, India.*

Abstract: Huge population around the world, do not have access to safe drinking water. Portable water scarcity has become a common problem these days. To overcome this, water available on the surface needs to be treated. Regarding this, Analytical Hierarchy Process (AHP) MCDM method is followed. MCDM is about making decisions when multiple criteria (or objectives) need to be considered together, in order to rank or choose between alternatives. Most significant parameters were selected in the current study to obtain maximum efficiency and minimum cost.

***Keywords**: AHP, Maximum efficiency, MCDM, Minimum cost, Parameter selection, Water Scarcity.*

Dose Optimization of Oil Field Produced Water and Advanced Water Treatment for Heavy Viscous oil

Siraj Bhatkar, Lalitkumar Kshirsagar, Yash Chavan, Niraj Topare, Vinayak Wadgaonkar

Dr. Vishwanath Karad MIT World Peace University, Pune, 411038, India

Abstract: Oil and gas industry faces tremendous challenges in disposing the produced water from payzones. In this research work extensive laboratory studies were carried out on produced water for designing water treatment facility for a specific type of formation under study. Physico-chemical characterization of raw produced water, treated produced water from oil field and physical parameters of raw effluent needs to be studied for heavy viscous oil payzones. Handling of produced water is difficult in case when it is being produced from payzones containing viscous heavy oil. After finding the physical parameters, chemical parameters of the oil field produced water was studied in order to understand the treatment strategies needs to be designed for the treatment of produced water. Oil field produced water was treated effectively and efficiently to make the water fit for discharge / on board discharge. The oil field produced water was used for injection purpose for maintaining the pressure of the reservoir. If the quantity of produced water is large, due to high water cut, the cost of water treatment will be high as chemicals used for treatment and overall treatment becomes expensive. Proper design of effluent treatment facility was done with identification of adequate doses of the chemicals and studying the ionic concentration of produced water. If the oil field produced water is not treated properly then it may lead to injectivity loss and it may cause damage to the formation. After evaluation of the physicochemical parameters, determination of chemical parameters and then determination of biological parameters was carried out for a given sample of produced water. Filtration studies and dose optimization studies for coagulants and flocculants was carried out. Where filter size optimization, series filtration study and Cerini filtration studies were performed for the given sample of produced. Fluid compatibility study and rock fluid compatibility studies were undertaken for maintaining the quality parameters of produced water used for injection purpose. Further overall water treatment design was performed with finalization of proposed dose of treatment chemicals. This study was of a unique kind as focuses mainly on the treatment of produced water from payzones containing viscous heavy oil. The treatment design was performed considering the injection of produced water after treatment in reservoir containing thin stacked payzones with viscous heavy oil. The treated produced water can be suitable to be injected in the reservoir for recovery of heavy oil along with chemical enhance oil recovery method like alkali-surfactant –polymer flooding.

***Keywords**: Produced water, Cerini filtration, Coagulants, Flocculant, chemical flooding, enhance oil recovery.*

Optimizing produced water quality for enhancing oil recovery

Siraj Bhatkar [a], Nishank Badhe [b], Avishkar Adhatrao [c]

[a] *School of Petroleum Engineering, MIT World peace university Pune*

[b] *School of Petroleum Engineering, MIT World peace university Pune, Nagadwadi Kandali, Pune, Maharastra,412412*

[c] *Schoolt of Petroleum Engineering, MIT World Peace University Pune, Ambav, Sangameshwar, Ratnagiri,415804*

Abstract: Produced water is a complex mixture of organic and inorganic compounds and the largest volume of by-product generated during oil and gas recovery operations. The potential of oilfield produced water to be a source of fresh water for water-stressed oil- producing countries and the increasing environmental concerns in addition to stringent legislations on produced water discharge into the environment have made produced water management a significant part of the oil and gas business. In offshore operations, seawater is often injected to maintain reservoir pressure for enhanced oil recovery. A sulfate-reducing membrane (SRM) is typically used to reduce the sulfate content in the seawater from 2900 mg/L to less than 50 mg/L to prevent souring of the reservoir by sulfate reducing bacteria and formation of barium and strontium sulfate scale when seawater is mixed with formation water. As an oil field matures, it produces larger quantities of produced water. Appropriate treatment levels and technologies depend on a number of factors. Treated produced water can be a valuable resource, for oil and gas field and other beneficial uses. The major barrier to use of produced water is the high treatment cost. Produced waters characteristics vary greatly, so an array of technologies is needed to treat these waters for various uses.

***Keywords**: produced water, treatment method, coagulation flocculation, oil*

Optimal Operation of the KLRao Sagar Pulichintala Reservoir using Genetic Algorithm under RCP4.5 Climate Change Scenario

Jerripotu Gopala Rao [a1], Gunwant Sharma [b], Sudhir Kumar [c]

[a] *Ph.D. Research Scholar, Department of Civil Engineering, MNIT Jaipur, Rajasthan, 302017, India*

[b & c] *Professor (HAG), Department of Civil Engineering, MNIT Jaipur, Rajasthan, 302017, India*

Abstract: This study investigated reservoir operation under climate change for a base period (2014-2019) and future period (2021-2099) in the KLRao Sagar Pulichintala Reservoir, Guntur District, Andhra Pradesh. The objectives were to: (1) Provide detailed information on calibration, validation and sensitivity analysis of Soil and Water Assessment Tool (SWAT) model; (2) Assessing future water supply and demand in a reservoir to meet the downstream requirement. The Objective one concern, the ability of a watershed model to mimic specified watershed processes is assessed through the calibration and validation process. The SWAT watershed model was implemented in the Reservoir Watershed. Information on calibration and validation of SWAT models has been provided to assist watershed models in developing their models to achieve watershed management goals. The second objective concern, Genetic Algorithm (GA) was used for reservoir operation and used for minimization the subtraction of the target amount of water and also, connect to the reservoir simulation to find the optimal clearance for downstream at different increased demand such as 10%, 15% and 25%. The climate change models predicted increasing temperature from 28.1 to 41.9°C and decreasing precipitation from 830 to 450mm for the future period at the reservoir location. Also, runoff volume for the basin would decrease and demand for the downstream consumption would increase for the future period. The highest monthly water deficit would likely be around such as 156.4MCM, 288.3MCM, 204.4MCM, and 226.5MCM occurred under the climate change RCP4.5 scenario.

Keywords: SWAT, Climate Change, Genetic Algorithm, Krishna River, Water Supply and Demand.

Modelling and simulation of Bubble column Integration with HEIR Technology for Water Purification

Vishal Dhakane [1], Dharmik Gohil [1], Manish Kumar [1], Paawan Sharma [1]

[1] *Department of Nuclear Science and Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar-382421, India*

Abstract: Due to the industrial revolution in the last several decades pollution level increased significantly in water. The main factoris that pollutants are produced in industry. For Water, Pollutants are asbestos, lead, nitrates, phosphates, acids, alkalis, dyes, benzene and fugitive organic chemicals. In 21st century pollutants from Industrial sector are released in different water sources and due to that water gets polluted. Waste water contains hazardously, lethal and reactive pollutants. Day by day water quality is reducing and demand for freshwater is increasing. As impurities in water are hazardous to health, it is necessary to keep it clean. To overcome demand of fresh water with limited resources we need to work on with recycling of used water by purification using radiation. HEIR (High Energy Ionizing Radiation) is one of the effective techniques. HEIR is an effective tool for waste water treatment in Industry by virtue of its strong ionisation ability. With Bubble column integration of HEIR helps to purify water. In this Paper, simulating bubble column reactors under water treatment conditions is a challenging task. The main purpose of this study is to predict bubble size, which is closely related to the reactor hydrodynamic conditions, using computational models, by modelling bubble breakage and coalescence. To validate the model, experimental data are collected, including bubble size measurements via an innovative cross-correlation technique. Both Impure water and demineralized water are used in the experiments. We use the experimental data to validate our unsteady two-dimensional Eulerian-Eulerian CFD simulations. A population balance model is coupled to the hydrodynamic model and solved using the quadrature method of moments. A set of breakage and coalescence kernels is proposed, capable of predicting the bubble size for different operating conditions. Scale-up effects are also investigated.

Keywords: HEIR Technique; industrial waste water; Sewage treatment; Ionizing radiation; CFD simulation

---

Electrooxidation of leachate: Understanding effect of cathode material and process optimization using Response Surface Methodology

Chintavi Patel[a], Abhilash T. Nair[b], Abhipsa R Makwana [a]

[a]*Department of Civil Engineering, Faculty of Technology and Engineering, Maharaja Sayajirao University of Baroda, Vadodara, India.*

[b]*Department of Applied Sciences and Humanities, National Institute of Advanced Manufacturing Technology, Ranchi, Jharkhand, India*

Abstract: The present study aims to evaluate the efficacy of electro-oxidation (EO) process for primary treatment of leachate generated from industrial waste landfill site. Graphite anodes were used. The effect of graphite and stainless-steel cathodes was also addressed. Response surface methodology (RSM) was used to optimize process variables viz. initial pH, current density, and electrolysis time. For optimum 30 mA/cm2 current density, initial pH 7 and 35 min electrolysis time graphite cathode showed 89.53% COD removal. While stainless steel cathode showed 75.30% COD removal with 19.70 mA/cm2 current density, initial pH 5.5, and 174-min electrolysis time as suggested optimum conditions. EO was observed to more efficient when graphite was used as cathode material compared to stainless steel cathode.

Keywords: graphite; stainless-steel; electrooxidation; leachate

Contaminant transportation modeling with time dependent dispersion

Reshma R. Malan [a], Narndrasinh B. Desai [b]

[a] *Department of Mathematics, Government Engineering College, Valsad-396001, India*

[b] *Department of Mathematics, A.D. Patel Institute of Technology, Anand-388121, India*

Abstract: A mathematical modeling of contaminant transportation has been presented in the current paper. The time dependent dispersion is considered in the transportation of contaminant in finite homogeneous porous medium. The study of contaminant concentration presented for the uniform unsteady flow of groundwater. Instead of a constant dispersion, in order to consider the effect of groundwater velocity on contaminant transportation, dispersion is considered as groundwater velocity dependent quantity. As found in the many practical aspects, a linear increase in concentration at a source point with time is assumed for the present modeling. The model also considered the initial contaminant concentration spread linearly decreasing along the direction of flow as it deals with the one-dimensional flow. The contaminant transport equation for the above-mentioned conditions and environment has been solved. Laplace transform variation iteration method (LVIM) is adopted to obtain a solution. Spatial and temporal variation of concentration for a developed model have been presented graphically by varying dispersion. The LVIM founds suitable for the present study of contaminant transport modeling. The MATHEMATICA package is used for present study.

Keywords*: Contaminant transport; correlation function; Lagrange's multiplier; Laplace transform variational iteration method*

Thermo-Ecological Optimization of Shell and Tube Heat Exchanger

Jigar.P Modi [a], Vivek.K Patel [b]

[a] *Pandit Deendayal Energy University, Gandhinagar-382007, India.*

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

Abstract: Shell and Tube Heat Exchangers are a type of equipment which are used in industries that it has to deliver optimum performance in terms of high efficiency, high heat transfer rate, less losses, low cost, etc. In the heat exchanger "Entransy" determines how much efficient the system is to deliver the work and transfer the heat and "Ecological function" defines how effectively it affects the environment and another term "Total cost" is associated in making of the system comprising of different geometric parameters [1]. In this paper the multiple objectives are Ecological and cost functions and the design parameters based on geometry (Tube diameter, Shell diameter, pitch, etc.) are discussed. By varying the design variables and by parametric analysis optimum value of each variable is obtained from a predefined range and at that value highest Ecological function value and Lowest cost values are obtained [2]. This was the overview of the detailed analytical work mentioned in this paper. The main outcome of this research study is to analyze how different values of design parameters affect the building cost as well as work output so accompanying the variables according to the need of application as well as modifying its properties as per our requirements is necessary in this revolutionary era of technical domain.

Keywords*: Entransy; Total Cost; Ecological Function; Parametric Analysis*

Multi-Objective Optimization of Offset Plate-Fin Heat Exchanger

Trushil A Patel [a], Vivek K. Patel [a]

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

Abstract: Plate-fin heat exchangers (PFHE), are also called brazed aluminium heat exchangers. Due to their small size when compared to other heat exchangers they are user friendly and allow greater flexibility in plant architecture. The heat exchanger is made by stacking up fin surfaces which are separated by a sheet. With the increase in the area of the offset fin structure, the heat transfer also increases. The higher the fluid turbulence higher will be efficiency. The optimum result for the offset plate and fin heat exchanger are obtained using MATLAB for Single and Multi-objective functions including minimum Cost, maximum effectiveness and minimum entropy generation. The variation of a variable parameter such as the length, fin height, fin spacing etc. is considered for obtaining the optimized result for the objective in this paper.

Keywords*: Plate-Fin heat exchanger, Effectiveness, Total Annual Cost, Entropy Generation*

Optimization of Cooling System

Harshil Pancholi [a], Vivek K. Patel [a]

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

Abstract: The requirement for a stable, low-temperature operating environment for infrared detectors, laser diodes, semiconductor equipment and other various electronic devices has increased the demand for thermoelectric coolers (TEC). The objective is to apply innovative methods to optimize TECs while focusing on the technical challenges faced in single-stage thermoelectric coolers (STECs) and as well as two-stage thermoelectric coolers (TTECs). By optimizing the dimensions of the thermoelectric cooling device legs, an increase in cooling capacity is achieved. Similarly, considering the effects of other parameters, the Coefficient of Performance (COP) & the cooling capacity of TECs can be maximized and improved significantly through slight tuning. Henceforth the Cooling Capacity and Coefficient of Performance (COP) have been taken into account as the main objective functions for optimization in this paper.

***Keywords**: Thermo-couples, semiconductors, Parametric Analysis.*

A Review on Various Mathematical Techniques for Groundwater Quality Analysis and Assessment

Praharsh Patel, D M Pandya, Manan Shah

Department of Mathematics, Pandit Deendayal Energy University, School of technology Department of Chemical Engineering, Pandit Deendayal Energy University, School of technology

Abstract: Water is utilized everywhere in the world without being monitored sufficiently for its quality. Several parameters need to be taken into account for the purpose of quality analysis and assessment. In this review, we tried to cover various available mathematical methods to find the quality of water for drinking and irrigation purposes. Some of them are The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and Improved TOPSIS Method, Osculating Value Method for Multi-Criteria Decision Making, Improved water quality index. These methods provide the ability for the assessment of water quality and then one can derive the suitable purpose of its usage. The paper also shed a light on the vital role of Mathematics in such inferences to carry out the best conclusions.

Design and Analysis of Heat Exchanger for Safety of Tubes by Radiated Water

Parthiv Pal [a], Anurag Mudgal [a], Manish Kumar [a],

[a] *Department of Nuclear Science and Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar-382421, India*

Abstract: Heat exchanger found frequently in process industries like fertilizer plants, oil and gas, food processing, nuclear power plants, etc. In nuclear industry, heat exchanger plays an important role to transfer heat from reactor core, where heat generated to the ultimate heat sink (UHS) and then its dissipated. The actual design of heat exchanger for nuclear application is not only relied on thermal-hydraulic consideration, but also depends on economical aspects and radiological safety. The design should be more robust when it is handling high temperature water containing radioactive particles. For optimum design of heat exchanger for specific applications, a compromise should be specified for determine the important factor affecting the design. This paper describes the different types of heat exchanger used for their associated design parameters for the safety of the tubes by high temperature radiated water. Also, provide a framework for selecting heat exchanger materials, especially those used in nuclear power plants, so heat exchanger can used safely for long time with high temperature radiated water.

***Keywords**: Heat Exchanger Design; High Temperature Radiated Water; Nuclear Safety; Heat Transfer; Power Plant; LMTD*

Curb Pollution of River -Dealing with Dry Weather Flow Interception

Mr. D.S.Kumbhar [a], Dr Ashok B. More [b], Dr Sachin J. Mane [c]

[abc] *D. Y. Patil College of Engineering, Akurdi, Sector 29 Nigdi Pradhikaran Pune-41104, India*

Abstract: The Mithi River that runs 17.8 kilometers through densely populated residential and industrial areas, except during the monsoon, behaves as a non-perennial water body and carries only sewage during the rest of the year. In addition, the river continues to operate as a linear rubbish dump since formalized waste management arrangements, particularly for the slum encroachments, are not in place. This is damaging to the environment, public health and visual landscape of the river. In this work, an attempt has been made to control the pollution of Mithi River through different survey approaches and sample analysis methods. Moreover, adequate Dry Weather Flow Interceptors (DWFI), Sewer Network, Sewage Pumping Station & Sewage Treatment Plant (STP) are designed to treat the Dry Weather Flow for concerned polluted areas.

***Keywords**: Mithi River, Dry weather flow, Drinking water, Pollution.*

A Study of Physico Chemical Parameters of Sabarmati River in Ahmedabad District, Gujarat, India

Divya Ramesh Kumar Patel and Sandesh Chibber

Associate Professor, Rai School of Sciences, Rai University, Ahmedabad-382260

Abstract: Water is very essential parameter for survival of life. Water is the most important parameter among the natural resources. Soil particles and loose clay are found at the bottom of the water bodies. Considering the polluted level of river water which is supplied for domestic and drinking purposes to humans is now required proper management of wastewater. Either home or at industrial level, demand of water is increasingly day by day in daily life. The water get polluted from some industries like pollutes of textile, steel mills, pesticides, fertilizer, paint industry waste, refining effluents to mention a few. These pollutants will definitely affect the pH of water which ultimately affects the aquatic life. In the present study five regions are selected of Sabarmati River in Ahmedabad district to estimate the polluted level in Sabarmati River. We have compared the toxicity level month wise and in the present study we report the comparison from month of January to May, 2021. The level of toxicity is monitored on the parameters of, Conductivity, pH, BOD, COD, Phosphate, Heavy metals and DO analysis. Present study will reveals seasonal polluted level and with help the government to opt for best safeguard methods to be applied depending upon the seasonal pollution level.

***Keywords**: water quality assessment, pH, BOD, COD, DO, Phosphate, Heavy metals*

Phyto hydraulic Management of Automotive wastewater treatment using High Rate Transpiration System

Karthik Raghunathan [1,2*], Deepak Marathe [1,2], Umakant Thawale [1], Sheshpal Rathod [1], Prashant Thawale [1,2]

[1] *CSIR-National Environmental Engineering Research Institute, Nagpur, 440020, India*

[2] *Academy of Scientific and Innovative Research (AcSIR), Ghaziabad 201102, India*

Abstract: Treatment and disposal of huge amount of wastewater with toxic pollutants in terms of inorganic salts and heavy metals is challenging task. The present conventional treatment technologies reverse osmosis (RO) and multiple effective evaporator (MEE) for wastewater requires high capital operating expenditure (CAPEx), operating expenditure (OPEx) and huge manpower to operate. The wastewater generated through automotive industry consists of high concentration of heavy metals and salts in terms of total dissolved solids (TDS) and which persists in the wastewater in trace amount even after primary and secondary treatments. Direct disposal of these type of effluents can contaminate the soil, groundwater and freshwater streams. The high-rate transpiration system (HRTS) is new treatment and disposal technology for the treated wastewater from the automotive sector. The HRTS is land based treatment technology in which huge amount of treated wastewater can be managed in small area. The HRTS incorporates the use of ridges and furrows, in which ridges are planted with high transpiration potential plants and filter bedding material (FBM) is laid in furrows. FBM consists of organic raw materials such as rice straw, rice husk, coconut husk, bamboo dust, saw dust and bagasse etc. which neutralized the pH, thereby removing various nutrients and salts from the wastewater to meet the standards below permissible limits prescribed by pollution control board. In present study field study of HRTS has been established at Chakan and Supa for treatment and disposal of wastewater with 60-80 m3 day-1 ha-1 capacity. The obtained results clearly revels that there was no massive build-up of salts in salts in furrows. In addition, groundwater quality was continuously monitored through sampling from piezometer and groundwater resources from upstream and downstream. The quality of groundwater was found to be appropriate in terms of drinking water standards thus making HRTS more prominent treatment technology. Based upon the results, treated wastewater from automotive sector can be directly discharged in HRTS system for sustainable development.

***Keywords**: Hydraulic loading rate; automotive industry; high-rate transpiration system (HRTS)*

Mathematical approach for better performance of flat-sheet forward osmosis membrane

Dhaval Patel [a], Anurag Mudgal [b], Vivek Patel [c], Jatin Patel [d]

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

Abstract: Forward osmosis is the promising membrane-based desalination technique, and it uses low energy compared to other technologies. Integration of forward osmosis with other technologies will make it an attractive technology. However, availability of commercial membrane, cost of the membrane, low water flux, low retention of impurities, and availability of the draw solution are the major hindrance in the commercialization of this technology. Application and mass transfer is the major covered area of forward osmosis technology. In this study, mathematical modeling and simulation are carried out for the flat sheet membrane/Plate and frame membrane, which comprise mass balance, permeate flux, and effect of concentration polarization. Membrane orientation, the flow rate of the draw and feed solution, the concentration of the draw and feed solution, and flow arrangement of the solutions are variable inputs to the mathematical modeling. The result shows that higher dilution of the draw solution can be achieved using a lower draw solution flow rate and higher feed flow rate. Also, the flow direction of the solution is slightly influencing the variation in the concentration difference for both streams. Wisely choosed operating conditions using mathematical modeling give better membrane performance.

***Keywords**: Forward osmosis, Membrane, Water flux, Draw solution, Feed solution*

Environmental Effects of River Sand Mining: A study on the Mahanadi River Basin of Mahasamund District, Chhattisgarh, India

Gopal Prasad Patel [a], Ishtiyaq Ahmad [a], Samir Bajpai [a]

[a] *Department of Civil Engineering, National Institute of Technology Raipur, Raipur-492010*

Abstract: Most of the rivers in the Southeast Central part of India are non-perennial in nature. Due to the rapid growth of the population, various rivers and water bodies are under enormous pressure and the urban–cum-industries where the valuable grade of sand is the most catastrophic one. River sand mining is basically of two types: (I) in-stream mining and (II) flood plain mining, the first of which is applicable to perennial rivers and the second is applicable to non-perennial rivers. In this study, flood plain mining and in stream mining is considered and deals with the environmental impact and over exploitation of sand. The result has been analysed by the Sand Auditing Method, and it is concluded that the mining rate of sand is higher as compared to sand replenishment rate, therefore, having various adverse effects on fauna and flora. The over exploitation of sand mining activities cause environmental damages such as revenue loss, insufficient ground water recharge, vulnerable for aquatic species, vegetation losses, and soil erosion. Hence, it will lead to topographical change in respective area where loss of life, money and mainly environmental losses will take place. In addition, the overall conclusion of the present study, suggested that some key factors need to be change, like regulation of sand mining activities and its monitoring, rules and regulations at local and national level.

Keywords*: sand mining; environmental impact; sand mining amount; sustainability*

Water quality assessment of open wells in Malappurm district, Kerala

Sajeesh Adangampurath Kolothumthodi [a], Ajmal Koya Pulikkal [a]

[a] *Department of Chemistry, National Institute of Technology Mizoram, Aizawl - 796012, India*

Abstract: Most of the open well water is of low pH and polluted by an excess of turbidity, acidity and iron in Malappuram district, Kerala. In this work, samples were collected in a random manner from fifteen blocks of Malappuram district in between post and pre monsoon and studied using standard analytical procedures to determine various physico-chemical characteristics such as turbidity, temperature, pH, total dissolved solids, total alkalinity and iron. It was found that all samples under investigation was of low pH and some samples were contaminated by turbidity, acidity and iron. The parameters, like total dissolved solids, total alkalinity were within the desirable limit in all of these samples. Samples having excess turbidity and iron shows a reddish-brown color and it can cause for coloration and stain to sanitary fittings, clothes etc. Excess of iron also causes an unpalatable metallic taste.

Keywords*: Water quality; Open well; Total dissolved salts; Alkalinity; Turbidity*

A review on methods for effective management of water losses an effort made by Indian Authors

Dipesh H. Dalal [a],

[a] *Research Scholar, Gujarat Technological University, India., Lecturer in Civil Engineering, Government Polytechnic for Girls, Ahmedabad, Gujarat, India*

Abstract: Effective management of water losses is necessary for any country worldwide for the effective use of this natural element on the earth. Water loss is the biggest challenge for the municipalities and local bodies of various states in India. So, many researchers had given attention to this issue and tried to provide an effective solution. Various causes are responsible for loss of water from distribution networks like pipe aging, water theft, faulty design of pipe, lack of maintenance, leakage, etc. From all causes leakage in a distribution network is identified as the root cause of water loss by many researchers from different parts of the world. In this research paper, an overview was given on contribution made by Indian authors on different methods to identify the leakage from a huge network of water distribution. This article also provides the detailed methodology, working, and merits, and demerits of different methods suitable for Indian conditions to emphasize the selection of appropriate methods for the relevant scenario. Finally, there is a sincere effort made to provide maximum details on different leak identification methods and bring out the research carried out by randomly selected research papers.

Keywords*: Leakage: Water Distribution Network: Smart Cities: Leakage Detection: Methods to find leakage*

Leakage Detection in Water Distribution Systems using WSN for Smart Cities.

Dipesh H. Dalal [a], Dr. Rupesh P. Vasani [b]

[a] *Research Scholar, Gujarat Technological University, India., Lecturer in Civil Engineering, Government Polytechnic for Girls, Ahmedabad, Gujarat, India.*

[b] *Research Supervisor, Gujarat Technological University, India., Director, Sal Education Campus, Opp. Science City, Ahmedabad, Gujarat, India.*

Abstract: Smart City ensure the traditional network and different services are more efficient with the use of the latest technologies for the benefit of its inhabitant. Distribution and effective management of water losses through a water distribution network is an important tool for any city to transform into a smart city. As there are many causes responsible for water losses in a pipe network, but the important one is the identification and localization of leakage within a network. This paper presents the experimental work carried out for design, development and calibration of wireless sensors for leak identification in water pipeline based on relative changes in flow parameters in plastic pipes. The laboratory model used for experimental work can create different scenarios of leakage, Ground topography, uniform, and non-uniform pipe section, etc. to match the performance with the real scenario of the pipe network in the field. The laboratory model is capable of identifying even a small leakage within a network based on the changes of pressure and flow values relatively.

Keywords*: Leakage identification: Water Distribution Systems: Smart Cities: Wireless sensor: Laboratory Model*

Analysis of geothermal water for domestic and irrigation purposes from Tulsishyam geothermal hotspot

Namrata Bist*, Anirbid Sircar, Kriti Yadav

Pandit Deendayal Energy University, Gandhinagar, India

Abstract: Abundant surface evidences of geothermal hot springs are located in the Gujarat state in India. The present study tries to assess the geothermal spring water's excellence within the rural area of Tulsishyam in Gujarat. The water is analyzed to recognize its quality for the appropriateness of utilization in domestic and agricultural purposes. Water samples were taken and tested for a variety of geochemical parameters, including pH, total dissolved solids (TDS), total hardness, cations and anions, and so on. The research area's water is neutral to slightly alkaline in pH. Cationic Ternary diagrams indicate that the waters are mature in nature and dominant in Na ion concentration. Anionic Ternary plots show Cl ion dominance as rock and water has been equilibrated due to high residence time. Gibbs plot indicate that all the samples falls in rock dominance. The Wilcox charts indicate excellent water category due to low electrical conductivity of the samples. Groundwater in the study region can be determined to be suitable for household and agricultural use based on a variety of water quality indices.

Keywords*: water; analysis; physicochemical; origin; thermal gradient; groundwater; Gujarat*

Prediction of Dissolved Oxygen (DO) content using SupportVector Regression for Mula-Mutha River Pune-India

P. Sahu *^, S. N. Londhe*, and P. S. Kulkarni**

** Professor, Department of Civil Engineering, VIIT, Pune, India (E-mailshreenivas.londhe@viit.ac.in)*

*** Associate Professor, Department of Civil Engineering, VIIT, Pune, India (E-mail: preeti.kulkarni@viit.ac.in)*

^Ph.D Scholar, Department of Civil Engineering, VIIT, Pune, India (E-mail: palisahu18@gmail.com)

Abstract: Dissolved oxygen (DO) in water body is one of the important water quality parameter used frequently to determine the self-purification property of a river or stream. The Winkler method is the traditional technique used for calculating DO in any water systems. This method is a manual titration method, most of the time performed at site to minimize the total time taken between collections and testing which could result in changes to oxygen content. Thus, there is a need of alternative technique to minimize the error and time utilized for testing. This research aims to use Support vector Regression to predict Dissolved oxygen (DO) for Mula-Mutha River Pune, India. DO models have been developed separately for Mula, Mutha and Mula-Mutha stretch respectively using Kernel function of Support vector regression. Performance of all 3 models were evaluated through various error measures like root mean square error (RMSE), mean absolute relative error (MARE) and coefficient of correlation (R) along with hydrograph. The results indicated that SVM model could be employed satisfactorily in DO estimation

Keywords*: Dissolved oxygen, Mula Mutha, support vector regression, water quality, modelling.*

Water Management for Agro-Ecological System with Mulching

Dr. T. N. Shaikh [a], Janki R. Patel [a*], Dr. B. H. Patel [b]

[a] *Department of Textile Engineering, Faculty of Technology & Engineering, The Maharaja Sayajirao University of Baroda, Vadodara-390002, Gujarat, India*

[b] *Department of Textile Technology, Faculty of Technology & Engineering, The Maharaja Sayajirao University of Baroda, Vadodara-390002, Gujarat, India*

Abstract: The rapidly growing world population, inadequate accessible fresh water resources and frequent erratic changes in climate have stressed the human being and compelled to take strong initiatives for preventing undue wastage of water. The water conservation efforts are intensified in the world's largest water consuming irrigated agriculture sector also. The water use efficiency in agronomy has already been enhanced by the adoption of the Drip irrigation method, intended to supply water directly to the crop, rather than the land around, thereby minimizing water losses up to 70 percent occurring through evaporation and distribution. Application of mulching in association with drip irrigation in arid as well as rain-fed crop agronomy leads to mitigate vigorously water stress in agriculture. A mulch basically a layer of natural or synthetic or their combination material applied to the surface of the soil as a protective medium between the soil and atmosphere to avert sunlight and strong winds from reaching to the soil surface and also serves as physical barrier against soil pathogens. In totality, it is an efficient medium for the soil moisture conservation, soil temperature control, adds to the nutrients status of soil by preventing leaching and more efficient use of fertilizers, resistor to the erosion losses, suppressing the weeding, and eradicate the lingering effects of manures, pesticides and heavy metallic elements as well as improving the visual look of landscapes. This review paper covers up various aspects of mulch, emerging as a dynamic water and soil management tool without affecting the value of crops in agriculture.

Keywords*: Agriculture, Agro-ecological System; Drip irrigation; Water Conservation; Mulching; Textile fibers.*

Sensitivity analysis of water wastage in Indian households

Saptarchita Datta [a], Iradat Hussain Mafat [a], Rajat Saxena [a,b]

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

[b] *Department of Mechanical Engineering, School of Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar, Gujarat-382426*

Abstract: Water is considered as one of the most vital resources of any country. Around 97.5% of the water present on the earth surface is saline and only around 2.5% is fresh. Out of this, a negligible 1.2% is consumable. According to research, nearly 150 litres of water per day is a requisite for an average person for all his hygiene and drinking requirements. 5 litre of water is consumed for cooking and drinking purposes, which is estimated to be close to 3% of the total water requirement. From studies conducted, 45 litre of water is possibly wasted per capita per day. This study highlights the major causes of water wastage in households along with the quantification of wastage from various sources. It discusses major technologies for the purification of drinking water. It is found out that more than 50% of people still do not use any type of water purification technology. Further, the effect of the pandemic lockdown on water consumption and wastage is analysed. Studies for different countries are compared along with the Indian statistics. The study is then extended for a society in order to determine the total water wasted by a population of 10000. Using this unexploited water could aid in increasing the water-saving potential of any location. This study quantifies the wastage in the households thereby helping the Government of India to formulate policies related to the same. The study also discusses several solutions that can be implemented, leading to water conservation in the households.

Keywords*: Water Conservation; Waste Water Quantification; Purification Technologies; Water-Saving Potential; Policies Planning*

Biofouling Assessment, Monitoring and Control in Reverse Osmosis Systems

Almotasembellah Abushaban, Sergio G. Salinas-Rodriguez, Nirajan Dhakal, Jan C. Schippers, Maria D. Kennedy

IHE Delft, Netherlands

Abstract: Various methods have been developed recently to monitor biological fouling in seawater reverse osmosis (SWRO) systems such as assimilable organic carbon and bacterial regrowth potential. However, the relationship between these methods and actual biofouling in SWRO desalination plants has not yet been demonstrated. This research investigates if a correlation exists between the Bacterial Growth Potential (BGP) of SWRO feed water and the chemical cleaning frequency in SWRO plants using an ATP-based BGP method employing an indigenous microbial consortium. The BGP method was applied to assess pre-treatment performance in five full-scale SWRO plants with different pre- treatment processes. For the SWRO plants investigated, a higher BGP in the SWRO feed water corresponded to a higher chemical cleaning frequency. However, more data is required to confirm if the correlation found between BGP and biofouling in the SWRO plants examined in this study also exists in other SWRO plants with different feed water qualities and pre-treatment systems. Finally, more data is also required to confirm if BGP can be used as a tool to monitor and control SWRO pre-treatment systems in order to prevent biofouling in the downstream SWRO membrane elements.

Keywords*: Bacterial Growth Potential; Pre-treatment; Biological Fouling;*

Removal of heavy metals from waste water by using of textile fibrous media

Krishna Narayan Pandey [a], Subrata Ghosh [a], Sukumar Roy [b]

[a] *Post graduate research student, Dr B R Ambedkar National Institute of Technology, Jalandhar,144011, India*

[a] *Professor, Dr B R Ambedkar National Institute of Technology, Jalandhar,144011, India*

[b] *Post-doctoral Fellow, Indian Institute of Technology, Delhi,110016 India*

Abstract: The discharge of waste water containing heavy metals is increasing day by day as industry and human activities progress. Contamination of underground water poses a major threat to the world's human civilization. Heavy metal ion removal from aqueous solution is a tough task. Many advanced Physico-chemical removal methods are available, such as adsorption on absorbents, membrane filtration, electrodialysis, and photocatalysis etc but they may not be suitable due to their high cost and are only suitable for large-scale applications. To overcome such challenges, textile fibrous media may be used to remove heavy metal ions (Cu+2, Ni+2 &Pb+2) from waste water. In a laboratory column experiment, the attachment mechanism of heavy metal ions inside textile fibre media was investigated. Superior performance in removal of colloidal particles from the water can be achieved by textile fibrous media under 10- fold higher filtration velocities as compared to granular media or membrane separation [1, 8]. Physicochemical parameters such as solution pH, salt concentration, type of fibre and fibre orientation are taken into account to optimize the amount of fibre mass in given volume (porosity) and then designed a standard filter bed for column experiment. The concentrations values of solution contain Cu+2, Ni+2 &Pb+2 are determined by atomic absorption spectrophotometer. The colloidal filtration data are used to investigate the removal efficiency and interaction energy by using DLVO theory. The filtration parameters will be optimized by using laboratory made synthesized metal ions. There after water from electroplating industry waste is to be treated with designed filter media and the water qualities such as pH, turbidity and removal efficiencies will be measured. pH plays a very important role in removing metal from water. The filter media may provide safe water to meet minimum water quality standards.

Keywords*: column experiment; heavy metal; porosity; removal efficiency; Textile fibre; wastewater*

Power Generation in a Saline Microbial Fuel Cell Using Polypyrrole Modified Stainless Steel Mesh as an Effective Anode Catalyst

Ankisha Vijay [a], Suparna Mukherji [b], Prakash C Ghosh [a]

[a] *Department of Enenrgy Science and Engineering, Indian Institute of technology Bombay, Mumbai, 400076, India*

[b] *Department of Environmental Science and Engineering, Indian Institute of technology Bombay, Mumbai, 400076, India*

Abstract: The anode material is one of the key factors which determines the power density and cost of the MFC (Microbial fuel cell) system. Stainless steel (SS) mesh is considered one of the suitable anode materials in MFC due to its low cost and high mechanical strength. However, its low conductivity and poor biocompatibility limit its use in MFC. In this study, SS mesh modified with polypyrrole (PPy) using in-situ electro polymerization, was used as an anode material in a saline MFC. Under highly saline conditions, electrode stability and corrosion are the biggest challenge. Ppy has good environmental stability, biocompatibility, and high electrical conductivity. Many studies have been done already using Ppy as a conductive material for the anode in MFC. This is the first study using SS/Ppy anode in a saline MFC. Halophilic bacteria enriched from seawater (Arabian Sea, Mumbai) was used as inoculum source for treating saline wastewater. Sodium chloride (NaCl) concentration of 40 g/L was used in the anode chamber. Nitrate was used as electron acceptor at the biocathode. The maximum power density of 272.90 mW/m2 was achieved using SS/PPy electrode which was 1.9 times higher as compared to bare SS anode (146.06 mW/m2). Higher OCVmax (open circuit voltage) of 730 mV was achieved in SS/PPy as compared to bare SS (590 mV). SEM analysis revealed rough and porous microstructures in the SS/PPy electrode surface which facilitated the attachment of microorganisms. Cyclic Voltammetry analysis revealed the high electrochemical activity in SS/PPy anode. The electrode capacitance was also 11 times higher in SS/PPy anode as compared to bare SS. Thus, this study demonstrates that higher conductivity and surface area contribute to higher power density in SS/Ppy which makes it a suitable catalyst in saline MFC.

Keywords*: Microbial fuel cell; Wastewater; Polypyrrole; Salinity, Anode modification; Power density*

Reuse of Produced Water as Injection Water

T. R. Kothawade* and S. J. Naik**

** FY MTech-Student, Dr Vishwanath Karad MIT World Peace University, Pune, Maharashtra, India*

*** Associate Professor, School of Petroleum Engineering, Dr Vishwanath Karad MIT World Peace University, Pune, Maharashtra, India*

Abstract: Produced water from the petroleum industry is the huge amount of wastewater generated by it. Disposal of produced water is of utmost importance for the environment, as it is a blend of organic-inorganic, dissolved, radioactive materials, etc., proper treatment is required on produced water before disposing of it. If produced water is managed properly then it can be reused for various purposes within the petroleum industry or outside the petroleum industry. In this paper, our focus is mainly on the utilization of produced water within the petroleum industry, for operations like injection water for water flooding, hydraulic fracturing, pressure maintenances job, EOR operations, etc. This paper describes components present in produced water and the water treatment process required for making it compatible for reuse. This paper also evaluates injection water quality and determines the effects of various contaminants present in produced water on the reservoir as well as injection wellbore.

Keywords*: Injection water, Parameters of the reservoir, produced water, Water Quality*

Modifications of Petroleum Industry Effluent Treatment Method: An approach for Quality Improvement of process water for ASP flooding and Chemical EOR

Siraj Bhatkar[1*], Lalitkumar Kshirsagar[1], Vinayak Wadgaonkar[1], Niraj S. Topare[2], Yash Chavan[1]
[1*]*School of Petroleum Engineering, Dr. Vishwanath Karad MIT World Peace University, Pune-411038, India*
[2]*School of Chemical Engineering, Dr. Vishwanath Karad MIT World Peace University, Pune-411038, India*

Abstract: Several Alkali Surfactant Polymer (ASP) pilot facilities are currently being put into operation across India. The physicochemical parameters of process water play an important role in the success of ASP flood to improve the recovery. In the current study treated effluent from an effluent treatment plant (ETP) is used as process water for the ASP pilot. The ETP sample water collected shows a lack of improvement in quality in terms of iron content, higher total suspends solids (TSS), high turbidity, and low filterability. The process water has calcium (as Ca+) 60 mg/L and magnesium (as Mg2+), where a content of about 33 mg/L. These ions are critical in the ASP designing process. The increase in the rate of filtration was determined by plotting the rate of filtration against the cumulative volume (cerini filtration). The MTSN values were observed to be -1.35 and -1.09. The RPI values are 7.15 and 2.60 at two different time periods. The sample collected showed a lack of improvement in quality. This tube well water after filtration was best suited for ASP flooding. However, the high concentration of calcium may result in the formation of calcium carbonate in addition to sodium carbonate (to be used as alkali for ASP). Hence calcium should be removed by softening the process water in the softening plant. The water was treated in the laboratory with a calculated amount of sodium carbonate to remove calcium and magnesium. Which comes out to be 0.30 gm/L of water. After treatment water was filtered and calcium and magnesium concentrations were determined. The calcium concentration was found to be 13 mg/L as compared to 60 mg/L in treated water.

Keywords*: Alkali, Surfactant, Polymer, Cerini, Filtration, Turbidity*

Phytoremediation of Synthetic Saline Wastewater in Engineered Constructed Wetland

Krutika Lanjewar, Pranay Tarar, Amol Shukla, Rahat Khan, Ritesh Vijay and Atya Kapley
CSIR-National Environmental Engineering Research Institute

Abstract: Saline wastewater originating from different sources such as domestic, storm water, and many industrial sectors usually contain high salts, which adversely affects the aquatic and terrestrial ecosystem. Literature supported the evidence that halophyte plants can reduce the salinity of wastewater by accumulating salts in their tissues. In this research study,an engineered constructed wetland has been designed and developed to treat synthetic saline wastewater using three different plant species (Canna Indica, Colocasia Esculenta, and Calotropis Procera) and control (without the plant) in continuous mode of wastewater treatment. The experiment was performed to evaluate the capability of these three plant species for salt phytoremediation. Canna Indica and Colocasia Esculenta plants thrived and reduced the salinity by 40 to 60 % and COD by 50 to 60 %. Salinity reduction was attributed to osmoprotectant accumulation such as proline and glycine betaine. The effect of salinity on proline and glycine betaine accumulation in leaves and roots of different stages of development of the plants has been observed and analysed. Analysis of osmoprotectant shows that Proline tends to accumulate early, at the onset of the stress, while glycine betaine accumulation was mainly observed during prolonged stress in two plants species (C. Indica and C. Esculenta). This study may be helpful in low cost phytoremediation treatment where saline water ingress into wastewater.

Keywords*: Saline wastewater, Phytoremediation, Osmoprotectant, Constructed wetland, COD*

Chitosan-Activated Carbon Composite for Remazol Brilliant Blue R Removal from Effluents

Pradip M. Nandanwar, Ravin M. Jugade
Department of Chemistry, RTM Nagpur University, Nagpur, India-440033

Abstract: Water plays an important role in the survival of all forms of life on the earth. Hence, the rapid enrichment of toxic pollutants in water bodies due to industrialization and anthropogenic contamination poses a serious issue in order to sustain development. This provides an opportunity to capture water contaminants and the remediation of water bodies that impact human health due to severe side effects. Therefore, the efficient removal of organic pollutants from wastewater has become a challenging research field. Among all the existing processes, the adsorption process has been found to be the most reliable and effective method in terms of capability to remove the pollutants from the wastewater, economical with the cost, ease of its use, and finally recyclability. In this work, we have synthesized Chitosan-Activated Carbon composite (Cs-C) using sodium tripolyphosphate as a crosslinking agent. The Cs-C was characterized through FT-IR, BET, XRD, SEM-EDX, and PHP C for physicochemical, structural, and morphological analysis. The effects of various experimental parameters such as initial dye concentration, contact time, temperature, adsorbent dose, and pH were examined. The material was tested for adsorption of Remazol Brilliant Blue (RBB) dye. The equilibrium data was described well by the Langmuir isotherm with dye adsorption capacity of 542.7 mg/g at room temperature, which is much higher as compared to previously reported materials. The kinetics of uptake was well-described by the pseudo-second-order model. The results clearly indicate the extremely high efficiency of the synthesized composite towards the removal of the RBB dye from wastewater.

Keywords: Chitosan; Activated charcoal; Sodium Tripolyphosphate; Remazol Brilliant Blue R dye; Adsorption

Synthesis of Polyester Polyol from cyclohexanone plant wash water

Ananta K Mishra, Mayur C Valodkar, Akash M Patel, Nirmit K Sanchapara, Pujan B Vaishnav

Research & Development Centre, Gujarat State Fertilizers & Chemicals Ltd, Vadodara-391750, India

Abstract: Oxidation of Cyclohexane in presence of air produces Cyclohexanone and Cyclohexanol. However, it also produces carboxylic acid by-products due to uncontrolled reactions. The by-products are washed with water to increase purity of Cyclohexanone and Cyclohexanol. The wash water is a potential source of organic acids. This manuscript describes a process for the preparation of Polyester Polyol from the wash water obtained from Gujarat State Fertilizers and Chemicals Ltd. The solid mass obtained after removal of liquid mass from the wash water was reacted with diethylene glycol (DEG) to synthesize Polyester Polyol. The reaction parameters were varied to obtain Polyester Polyol without containing unreacted DEG and solid mass. The optimum reaction condition was achieved by reacting 50 g of solid mass with 42.5 g DEG in presence of catalyst at 200 oC without vacuum followed by the distillation of excess DEG.

Keywords*: Cyclohexane Oxidation; Cyclohexanone; Wash water; Polyester Polyol; Synthesis*

Development and physico-chemical characterization of thermally treated spent turmeric root waste to treat dye containing wastewater

Sandra Saju[a], Sourodipto Modak[a], Priyanka Katiyar[a], Karan Gupta [a]

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

Abstract: Nowadays, textile wastewater containing organic contaminants such as dyes, adversely affect the water bodies. Similarly, the post extraction solid waste from spices is either sent to the landfills or for open burning, thus creating land as well as air pollution. This study is focused on the potential application of this spent waste as an adsorbent to treat dye-based wastewater. In this work, spent turmeric root waste (STR) is torrefied at 260 °C with 30 mins residence time to obtain STR-Biochar (STR-BC). Both (STR & STR-BC) are characterized through physical, chemical and morphological methods to compare the changes in properties. Proximate analysis indicates that STR-BC has more amount of fixed carbon in comparison to STR due to increase in carbonization during torrefaction. TGA & DTG revels higher thermal stability of STR-B (up to 500 °C) in comparison to STR (up to 200 °C). FTIR shows that STR is dominated by C-H stretches & oxygenated functional groups from major bio polymers, while STR-BC has more aromatic nature depicted by C=C and C-O-C stretches due to demethylation, dehydration during torrefaction. XRD analysis depicts that STR-BC is more amorphous as compared to STR, which is good for adsorption. FE-SEM analysis shows an increase in porous structures in STR-BC as compared to STR due to thermal treatment of STR. Later, STR- BC is used to treat Methylene blue synthetic waste water to determine its adsorptive capacity. The maximum dye removal using STR-BC was proximately (~80%), which was found out using batch adsorption process by varying concentration of dye in synthetic wastewater at constant STR-BC dose, temperature & RPM.

Keywords*: Wastewater, Physico-chemical characterization, Adsorption, FE-SEM, Torrefaction, Bio-char*

Catalytic activation of peroxymonosulphate (PMS) with manganese and cobalt coated micro sand particles for the treatment of Floor-wash containing Reactive black 5 (RB5) dye

Saniya Malik, Upendra D. Patel*

Civil Engineering Department, Faculty of Technology & Engineering, The Maharaja Sayajirao University of Baroda, Vadodara-390001, Gujarat, India

Abstract: Reactive Black 5 (RB5) is an azo dye widely being used in many different industries like Textile, Cosmetics, Paper, Mineral processing, Plastics, and Leather due to its relatively low cost, bright colour, and high stability. RB5 manufacturing industries use a huge amount of water in their varied processing operations. This work is focused on treating the Floor wash wastewater, which is one of the most voluminous and coloured streams emerging from RB5 manufacturing units. It is possible to reuse this water if it is efficiently decolourised. Water containing RB5 dye is hard to treat using conventional treatments due to its high stability and solubility. In this work, decolourization of simulated Floor-wash was investigated using peroxymonosulphate (PMS) and heterogeneous catalyst. The simulated floor-wash containing 100 mg/L of RB5 was prepared using tap water. The synthesis of manganese and cobalt coated micro sand (MnCoMS) particles was done to efficiently activate peroxymonosulphate (PMS) by producing sulphate and hydroxyl radicals for degradation of RB5 dye. The operational parameters such as catalyst dosage, PMS concentration, initial pH, reaction time, and reusability of MnCoMS were investigated. Under optimum conditions: 200 mg/L PMS, 10 g/L MnCoMS, and initial pH 9.5, 97.8% decolorization was achieved at the end of 60 min reaction time. RB5 decolorization was slightly slower at initial pH near neutral (7-7.8) as compared to that at acidic (4.0) or alkaline (9.0) pH values. The rate and extent of RB5 decolorization increased with an increase in PMS concentration from 50 mg/L to 200 mg/L. Similarly, the increase in MnCoMS concentration from 5 to 25 g/L increased the rate of RB5 decolorization; however, the %RB5 decolorization at the end of 60 min was almost constant for MnCoMS concentration of 10 g/L and above. The MnCoMS catalyst demonstrated excellent reusability with >85% RB5 decolorization achieved till the sixth use. Overall, PMS activation by heterogeneous catalyst MnCoMS is an efficient method for rapid decolorization of floor-wash containing RB5 dye.

Perfomance Study of low dose Gamma Radiation on Polysulfone Membrane for Waste Water Treatment

Arpit K. Singh[a], Sarthak Mehta[a], Saurabh Bagul[a], Surendra Sasi Kumar Jampa[b], Manish Kumar[a], Manish Kumar Sinha[b]

[a] *Department of Nuclear Science and Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar-382421, India*

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

Abstract: Polysulfone membrane is widely applied in the industry especially involved with ultrafiltration as it has multiple advantages such as high mechanical strength, high rigidity, good resistance toward temperature, chemical stability Also, it is highly resistive towards the surfactants, hydrocarbon oil and oxidizing agents. In recent years modified membranes are gaining interest in waste water treatment, more recently metal nanoparticles have been added to the polymer matrix in order to reduce fouling potential and increase membrane performance. The performance of a polysulfone (PSF) ultrafiltration membrane was studied using low doses (0–30 kGy) gamma radiation. Radiations and Nanoparticles reduces the fouling rate of polysulfone membranes in wastewater, while the later also showed lower flux decline of the composite membrane. The objective of this paper is to study plain, modified and radiated PSF membrane. The plain and radiated membrane will be characterized in order to study its antifouling properties and efficiency for wastewater treatment. The composite membrane will be casted by phase inversion method. Morphology and hydrophilicity of the membrane will be studied by permeation study.

Keywords*: Polysulfone; Gamma Radiation; hydrophilicity; wastewater; Ultrafiltration membrane; Non-Power application of Radition*

Applications of Heavy Water in the Nuclear and Non-Nuclear Fields: A Review

Manish Kumar[1], Saurabh Bagul[1], Sarthak Mehta[1], Arpit K. Singh[1]

[1]*Department of Nuclear Science and Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar-382421, India*

Abstract: Heavy water is a type of water that exclusively includes deuterium, not the common hydrogen isotope that makes up the majority of hydrogen in ordinary water. When compared to conventional water, the presence of the heavier hydrogen isotope gives it different biological properties, and the increase in mass gives it slightly different physical and chemical properties. The production of heavy water in the world has spanned about fifty years, and for much of that time, the commodity was in short supply, but that has changed. There are currently sufficient heavy water reserves and a suitable installed production cap for fulfil our production demand. The GS process has produced more than 90% of the world's heavy water inventory, but it may not be the method of choice when it comes time to expand heavy water production. Some countries, such as India, have previously chosen ammonia hydrogen exchange process as a heavy water production alternative. Despite the current heavy water excess, new technology research and development is quite active. This article discusses the potential of some of these new techniques, compares them to already used methods, and examines the likely influence on future supply and nuclear & non-nuclear application of Heavy water.

Keywords*: Heavy Water; Hydrogen atoms; isotope; Exchange process; Deuterium; Non-Nuclear Applications*

Groundwater remediation processes from toxic hexavalent chromium: a review

Sukanya Acharyya and Anirban Das

Pandit Deendayal Energy University

Abstract: Groundwater contamination and its adverse health effects are extensively studied researched topics. Hexavalent chromium [Cr (VI)], a trace metal present in groundwater is regarded as a carcinogenic element. Chromium can contaminate the groundwater via weathering from chromium bearing rocks or from various industries such as leather tanning, electroplating and paints. Unlike Cr (VI), Cr (III) being less mobile and less soluble is not harmful to human. Therefore, chromium removal could be done by reducing the hexavalent chromium to its trivalent state. In recent years, several experimental approaches were conducted to remove the hexavalent chromium from groundwater; the primary basis of these remedial methods is to reduce the chromium (VI) ion to chromium (III) ion. This paper reviews recent findings of the removal processes both by organic and inorganic methods. The methods discussed here are: (i) inorganic nanoparticles where activated carbon fibre, sodium algenate, carboxymethyl cellulose etc are used as a stabilizer with zero-valent iron for reduction method, (ii) Electrocoagulation method where cathode and anode are used to dissolute the metals, (iii) Biological treatment, where organic matter and reduced sulfur compounds may take part in chromium removal, with Fe (II) bearing minerals also aiding in bio-reduction process, (iv) removal method by adsorbents, where silica is coated by water treatment residue and then used as adsorbent. The reactions pathways, mechanisms and effectiveness of each of these methods are also reviewed. It was found that zerovalent iron and electrocoagulation method are one of the best effective for chromium removal among these methods.SA-nZVI can remove 96.4% Cr (VI) at pH 6 and through electrocoagulation method, 100 % of Cr (VI) could be reduced within first three minutes.

Keywords*: Chromium, Groundwater contamination, Reduction method, Nanoparticles, Zero-valent iron, Electrocoagulation*

Safety Analysis of Near Surface Nuclear Waste Repository Constituting an Aquifer in Proximity

Deepika Davuluri [a], Manish Kumar [b], Vipin Shukla [c], Rishikesh Tiwari [d]

Pandit Deendayal Energy University, Raisan, Gandhinagar-382421, India

Abstract: Probabilistic safety assessment involves the calculation of risk associated with possible radioisotope contamination of Ground water. The overall scenario and the consequences that may occur on failure of the external barriers are identified using an Event Tree analysis to be the multi barrier failure due to rain water intrusion into the near surface disposal site and leaching out of radionuclides into ground water which is extracted as drinking water by critical groups present around the repository. A program is developed in the Python 3.0 for such a scenario to assess necessary parameters such as radioactivity release rate, radionuclide concentration in ground water, dose to members and total risk associate with each radio isotope. The initiation is with assessment of the failure probability of the multi barrier system operating in redundancy, using the failure density functions. The radionuclide concentrations in the near surface disposal facility are necessary to be calculated to know the probable release rate of each radionuclide into ground water. The concentration depletion with spatio temporal variance is also considered as a factor for radioisotope concentration variation in ground water. The concentration of radionuclides in ground water when ingested at rate of 2.2 liter/day helps us to calibrate the Radiation dose to human through this pathway by using the Ingestion dose coefficient for each isotope fixed by International Atomic Energy Agency [IAEA]. The final risk assessment is accomplished by multiplying the radiation dose ingested by member of the critical group with risk factor for fatal, non-fatal cancers and severe hereditary effects by International Commission on Radiological Protection. In the present work, a comprehensive analysis is carried out to estimate the radiation dose of five radionuclides (3H, 60Co, 59Ni, 90Sr, 129I) for single mode disposal. Radioactive Iodine delivered maximum risk despite a low percentage in the inventory of low level radioactive waste. But much lower than permissible dosage suggested by International Commission on Radiation Protection [ICRP] i.e., 1 mSv in a scenario where exclusion zone is considered to be existing and a drinking water well is located at distance of 1.6 km from repository and the risk is computed over a period of 150 years since the multi barrier failure.

***Keywords**: Probabilistic Assessment; Ground Water Contamination; Radionuclides Safety; Event tree analysis; Nuclear waste Management; Spatio-temporal variation*

Assessing the impacts of climate change on the performance of reservoir system using a simulation model

Biltu Pal [a], Prof. Mahender Choudhary [b], Prof. Y.P.Mathur [b]

[a] *Research Scholar, Malaviya National Institute of Technology Jaipur Marg, Jaipur 302017, India*

[b] *Professor, Malaviya National Institute of Technology Jaipur Marg, Jaipur 302017, India*

Abstract: Reservoirs play a fundamental role in developing sustainable water resource management, among many other water infrastructures. Currently, many experts face difficulty solving the water shortage issue in the agriculture sector and domestic water supply because of climate change's impact on water resource systems. To get the measure of the effects of climate change on water resource systems is very important for sustainable water resource management in semi-arid regions, such as the Kadana reservoir command area. For this purpose, we use two Representative Concentration Pathways (RCP) scenarios to compare the historical, near future (2021-2044) and far future (2075- 2099) reservoir system performances under its current operation rule in the Kadana Dam, India, as a case study. The runoff generated from two climate change scenarios, RCP 4.5 and RCP 8.5, are used for reservoir simulation with standard operation policy (SOP). For performance evaluation of the reservoir system, statistical parameters are used, such as reliability, resilience, vulnerability, shortage index (SI) and modified shortage index (MSI). Results show that the system gets 100% reliability to meet demand under the present operating policy except for RCP 8.5 far future (2075-2099). There is a shortfall to meet all water demands. An increase in water demand by 10% showed reliability is decreasing by 5% for the future period. An increase in water demand by 20% showed reliability is decreasing by 10% for future time periods except RCP 4.5 near future (2021-2044). Here, the shortfall of reliability is around a 12% decrease from the base period. From the above scenarios, we have observed a water shortage for the worst-case scenario for RCP 4.5 near future.

***Keywords**: Climate change; reservoir operation; Adana dam; standard operation policy; performance indices*

Comparative study of a Multi-Functional H.V.A.C. system

Darshan Savaliya [a], Jatin Patel [b]

[a] *Research Scholar, Institute of Technology, Nirma University, Ahmedabad-382481, India*

[b] *Assistant Professor, School of Technology, Pandit Deendayal Petroleum University, Gandhinagar-382007, India*

Abstract: In today's world water scarcity has become one of the severe issues which whole world is dealing with, meanwhile with the rise in the living standard of human being the need for proper cooling i.e. air conditioning has increased. People expect their heating systems to keep them warm during the winter, and they also rely on air-conditioning to keep them cool during the summer. All these three purposes of pure water generation, heating and cooling can be satisfied combinely using the current research. In this research, a multi-functional heating, ventilation and air conditioning (H.V.A.C.) system of 1 Ton Refrigeration (TR) capacity is proposed and analyzed, generating about 22 to 25 litres of water per day from the air at 30°C temperature and 70% relative humidity, also the heating and cooling temperature of about 43°C and 20°C can be achieved respectively. The Experimental setup consists of vapour compression refrigeration (VCR) system along with heating and humidification unit for producing various climatic conditions. 1 TR VCR system is thermodynamically designed using engineering equation solver (EES) software to execute the calculations. Analytical and experimental investigation for determining the condensate extraction rate, hot and cold air temperature is carried out in this research work.

Keywords*: Multi-functional, H.V.A.C. system, condensate, VCR, EES*

Potential Assessment of Water Crisis Solutions in Coastal Areas

Sanket Singare [a], Janki Jagani [a], Rajat Saxena [a,b]

[a] *Department of Chemical Engineering, School of Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar, Gujarat, India_382426*

[b] *Department of Mechanical Engineering, School of Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar, Gujarat, India_382426*

Abstract: Amidst of increase in water requirement in agriculture and commercial sectors, the projected increase in demand is expected to approximately double by the year 2030. This study focuses on water production, suitable for drinking, agriculture etc., which is a major cause of villagers migrating from coastal villages on western coast of India. This study aims to compare efficiency, cost analysis, and productivity of different technologies that can provide optimal water quality, less maintenance and more efficiency. It aims at identifying a feasible cost-effective potable water solution in these areas. This study also compares different membranes for solar-powered desalination of seawater in coastal areas of Gujarat State. According to the surveys and studies, it is concluded that the production cost per liter of potable water using solar-powered membrane is relatively high and low-cost flat plate solar still having glass/polyethylene cover treated with ultra-hydrophilic coating is more suitable for desalination of seawater. Design modification for seawater desalination has been focused to reduce the requirement of trained workforce and easy working of the system. Single layered flat plate has productivity up to 4-4.5 kg/m3, to increase the productivity the absorber tray can be modified in Pyramid shape to increase the radiation effect, resulting in increase in production to 5-7 kg/m3. Other such solutions have also been discussed in this present study.

Keywords*: Solar Desalination; Flat Solar Still; Ultra Hydrophilic Glass; Potable Water*

Qualitative detection of Algae using RGB Based indices from drone images

Shubh Agrawal [1], Rohini Ochawar [1], Divyansh Kumbhare [1], Navyashree Raghupatro [1], Rasika Rewatkar [1], Piyush Kokate [2]

[1] *Romdeobaba College of Engineering and Management, (RCOEM) Nagpur*

[2] *CSIR-National Environmental Engineering Research Institute, CSIR-NEERI, Nagpur*

Abstract: UAVs are a low-cost, on-demand option and photogrammetric tool for visual, ecological parameters monitoring in real-time. This paper focused on monitoring a small aquatic body using plant spectral indices, which are determined solely from the visible part of the electromagnetic spectrum and differentiating land covers from water bodies. It describes the utilization of a low-cost and commercial unmanned aerial vehicle used to detect water bodies and the concentration of algae in a single drone image. The Simple Linear Iterative Clustering (SLIC) and Density-based Spatial Clustering (DBSCAN) are used to classify the boundaries of water bodies. Then the multiple algorithms like Normalized Green- Red Difference Index (NGRDI), Green Leaf Index (GLI), etc. are used to identify particular land cover types. Finally, the algal concentration index was identified qualitatively using an RGB drone image. This algorithm shows a reliable option for qualitative identification of algae using a few RGB drone images.

Keywords*: Green Leaf index, DBSCAN method, UAV RGB images, Algae detection*

Efficient Water Management of Gandhinagar by Rainfall Forecasting Using Machine Learning

Tapan Patel [a], Zeel Raval [a], Manish Kumar [a], Debabrata Swain [a]

[a] *Pandit Deendayal Energy University, Raisan, Gandhinagar and 382421, India*

Abstract: There are billions of planets in the universe but Earth is the most unique amongst them all, due to presence of water on the planet that supports life. Water is significant not only for drinking but is a vital economic resource (ER) that promotes economic as well as social growth. Increasing water demand (WD) due to industrialization, rising population, overuse of water etc. has led to potable water scarcity thereby endangering life. Rainfall is the most important water resource. Therefore, this study focuses on proposing an effective water management (EWM) system based on rainfall prediction for a particular year using machine learning. The study will use regression learner (RL) to compare the performance of algorithms like linear regression, Lasso regression, Ridge regression, and coarse tree for predicting rainfall in a particular year based on the past data available. The comparison parameters to be used are root-mean square error (RMSE) and mean-squared error (MSE) and the algorithm with least RMSE or MSE is treated as the best algorithm. The proposed study will use about last 40 years weather data to make rainfall predictions for Gandhinagar area. Also, along with rainfall prediction the study will focus on water demand prediction and will compare predicted water demand with predicted rainfall to help clarify water harvesting strategies. This study can be very useful to an agriculture based country like India, as agricultural activities are rain dependent, one's the rainfall is predicted farmers have clear idea of what crops they should invest upon in that particular year.

Keywords*: Water demand; Efficient water management (EWM); Regression learner (RL); Lasso regression; Ridge regression; Machine learning (ML).*

Rejuvenation of Water Resources Management for Sustainable Development: A case study on Mission Kakatiya Strengthening Community Based Irrigation Practices Restoration of Tanks and Lakes in State of Telangana

Venkat Ram Reddy Minampati, Paul Sugandhar Darur

Ph.D. Assistant Professor, SLS, PDEU, Gujarat.

Ph.D. Director AIPPA, Hyderabad.

Abstract: Land is under greater pressure and ecosystems that provide water are disappearing. Climate change is making water scarcer and more unpredictable, wreaking havoc and displacing millions of people. United Nations Sustainable Development Goal-6 (SDG 6) the goal of ensuring water and sanitation for all by 2030, is a national responsibility. Policymakers at the national level need to set bolder priorities when we invest in water it has a catalytic effect on other areas such as health, education, agriculture and job creation. For national action to be effective, it needs to include all parts of society. Everyone has a role to play. Dramatic gains in water and sanitation are possible when governments, civil society, business, academia and development aid agencies pull together. Mission Kakatiya is to enhance the development of agriculture-based income for small and marginal farmers through sustainable irrigation resources by accelerating the development of minor irrigation infrastructure, strengthening community-based irrigation management, adopting a comprehensive programme for restoration of tanks. Against this backdrop, this in-depth study explores through quantitative and qualitative methods whether strengthening of community-based irrigation practices restoration of tanks and lakes in state of Telangana using the data from government of Telangana between 2015 and 2019, lessons drawn from this case study can be helpful to actors and policy makers.

Keywords*: Water, Sustainable, Development, Mission Kakatiya, Irrigation, Telangana State*

Optimal Location of Intermediate Pumping Station to Minimize the Total Cost of the Sewerage System

Santosh Kumar [a *], Prof. Yogesh Prakash Mathur [a]

[a] *Department of Civil Engineering, MNIT Jaipur, Jaipur-302017, Rajasthan, India*

Abstract: In this paper the total cost of sewerage system has been optimized using Modified Particle Swarm Optimization (MPSO). The total cost of the sewerage system with intermediate pumping station (IPS) depends on the capitalized cost of operation and maintenance of intermediate pumping station. The cost of intermediate pumping station is a function of its location in the sewerage network. This paper gives a methodology in two parts to fix the optimal location of intermediate pumping station to minimize the total cost of the sewerage system. In the first part, maximum cover depth of sewer line is minimized with identification of main sewer line and corresponding total cost of the sewerage system. In the second part, optimal location of intermediate pumping station is determined, which minimizes total cost of the sewerage system. The methodology has been applied on a benchmark sewer network presented first by (Li and Matthew, 1990). Results show that first part reduces total cost of the sewerage system by 9.04 % as compared to optimal cost without pumping station and maximum cover depth reduces to 8.461 m. The second part reduces total cost of the sewerage system by 11.37% and maximum cover depth marginally increases to 8.581 m.

Keywords: sewerage system; intermediate pumping station; particle swarm optimization

Water Crises as Women's Crisis: Strategies for an equitable water resource management

Tanushree Patel [a], Dr. Sriram Divi [b]

[a] *Pandit Deendayal Energy University, Gandhinagar 382007, India*

[b] *Pandit Deendayal Energy University, Gandhinagar 382007, India*

Abstract: The water sector in India has been facing numerous challenges of scarcity and pollution by increasing disputes over water. The inequalities in access to water and the lack of participation in the decision-making process have raised questions on our processes of delivery of services. Women often play a vital role in the provision, allocation, and management of water at a household level. However, their contribution is less extensive in terms of decision- making, planning, and management of water resources. The need of the hour calls upon Integrated Water Resource Management, considering the increasing scarcity and inequalities. The national water policies in India i.e. 1987, 2002, and 2012 have been proved unsuccessful in bringing in concerns of the women wherein their participation is limited to a certain degree. The paper is an attempt to apply the gendered lens to the programs designed for equitable distribution of water, the institutional process, and the role of the state in ensuring a balance of economic and ecological activities for development. The analysis documents the relationship between the women's access and participation in the formal as well as informal water sector and sustainable water management by examining the nature, degree, and factors affecting the participation. It reviews and presents a course of action into sustainable practices and the holistic analysis of the use of water-based on domestic, productive, and environmental needs through a gender-sensitive approach and governance.

Keywords*: Women's crisis, Gender, Water Resource Management, National Water Policy*

Sustainable Management of Groundwater Resources: Study of the Policy and Planning Framework

Dr. Sriram Divi [a], Tanushree Patel [b]

[a] *Associate Professor, Deendayal Energy University, Gandhinagar 382007, India*

[b] *Research Assistant, Pandit Deendayal Energy University, Gandhinagar 382007, India*

Abstract: Water sector in India has been facing numerous challenges of scarcity, pollution, depletion of ground water which has in turn led to disputes over access and equal distribution of water. An estimate of 80% population in India relies on ground water to meet their basic domestic and productive needs of water. Despite several efforts, we have been unable to shift towards alternative resources for water. Due to high rate of extraction, groundwater replenishment has been unable to sustain desired water levels. Over the years, the water table in India has depleted at a higher rate due to the overexploitation of ground water resources. The national water policies in India i.e., 1987, 2002 and 2012 have been disregarded in bringing in regulated use, social equity and effective measures for replenishment of ground water resources. The paper looks into the policy discourse in context of existing modes of groundwater management and the administrative actions. The analysis documents the relation between the groundwater governance, its withdrawal regulations, decentralised availability, allocation and its monitoring needs by drawing out evidences from the implemented water conservation techniques and projects across India. The principles concerning the governance of groundwater are studied and applied at a local context focussing on the needs of the people and addressing the underlying challenges. It further reviews and presents a course of action into practices for responsible ground water usage and alternatives to water resources, keeping into consideration the equity, sustainability and efficiency aspects.

Keywords*: Ground Water Resources, Water Governance, Water Sustainability, National Water Policy*

Case Study of PHWR Nuclear Steam Generator Tube Design for Minimizing Water Driven Corrosion and Inter-Granular Cracks.

Ravi Patel [a], Jaynam Patel [a], Anurag Mudgal [a], Manish Kumar [a],

[a] *Department of Nuclear Science and Technology, Pandit Deendayal Energy University, Raisan, Gandhinagar-382421, India*

Abstract: The Steam Generators (SGs) are vital equipment in the PHT system of Pressurized Heavy Water Reactors (PHWR), wherein heat transfer takes place from the hot primary coolant (pressurized heavy water) coming from reactor core to the light water on the secondary side to generate saturated steam. The thin-walled tubes of SGs are important part of reactor coolant pressure boundary and forms a substantial part of total primary system pressure retaining boundary. The major safety function of SGs is to act as a barrier between radioactive primary side and non-radioactive secondary side. Any degradation of this function renders non-availability of SGs. The nuclear power generation industry experienced a variety of reliability problems with PWR steam generators. Most of these problems were associated with corrosion and mechanically induced damage like - secondary water IGC and SCC, primary water SCC, wastage, high cycle fatigue, fretting and wear of SG tubes, accelerated corrosion of carbon steel tube support structures in crevice regions. Corrosion and mechanically induced damage were caused by complex interactions of water chemistry, thermal-hydraulic design, design choices of materials, fabrication methods, secondary system materials, design and operations. Corrosion had affected almost 90% of SGs operational prior to 1977, resulting in forced and scheduled outages to plug or sleeve tubes and repair or replace SGs. The normal procedure for correcting the effects of corrosion is to plug the tubes, thereby taking them out of service. The solutions to these problems include a variety of chemistry related actions as well as mechanical and systems related actions to the SGs and secondary system. These will be dealt with in more detail in this paper at appropriate places.

Keywords*: Steam Generator Tubes; Tube Corrosion; Nuclear Steam Generator; Pressurized Heavy Water Reactor (PHWR)*

Understanding climate change resilience through rainfall heterogeneity over Western India and Arabian Sea

Ruchita Shah and Rohit Srivastava

Department of Physics, School of Technology, Pandit Deendayal Energy University (PDEU), Gandhinagar, 382426, India.

Abstract: Due to changing climate, country like India, which has high dependency of monsoon, is becoming more vulnerable. Distribution of water is varying even at regional scale due to changing precipitation patterns, which appears to be inevitable. These changes are making existing models predictions less accurate. Thus, it is important to look towards climate change adaption policies from climate change perspective, which suggest to adopt changes in water resources and can influence (directly or indirectly) agriculture, ecology and economy of the country. To address these changes, present study focuses to understand regional heterogeneity through different type of regions-one ocean (Arabian Sea- AS) and one land (Western India-WI). Country receives most of its rain from southwest monsoon (~70%), hence it becomes important to study AS being source of it. Long-term data (2000-2018) for various atmospheric parameters have been used to understand different monsoon scenarios viz. normal, excess and deficit to understand monsoonal heterogeneity over selected regions. Present study show a comparatively high (~0-18 mm/day) amount of rainfall during excess years, whereas it declines to ~0-10 mm/day for deficit and ~0-12 mm/day for normal rainfall years over WI. Also, changes in relative humidity along with water content in cloud are studied, which shows significant amount of variations. These factors/measurements would play an important role while addressing current climate variability. So, these measurements can be considered and their changes needs to be implemented in weather climate models to improve weather predictability. Adaption of these measurements in climate change policies would be an effective step towards betterment of whole climate system.

***Keywords**: Climate change adaption; Monsoon; Rainfall amount; Regional heterogeneity.*

Machine Learning Based Approach for Metaphoric Investigation of Ground Water Quality

Zeel Raval [a], Tapan Patel [a], Debabarata Swain [a], Manish Kumar [a]

[a] Pandit Deendayal Energy University, Raisan, Gandhinagar and 382421, India

Abstract: Earth is often referred to as the "Blue Planet" because of so much of its area covered by water (almost 71%). After air, water plays a fundamental role in human life. Water is used for various purposes like drinking, agriculture, industry and many more. As population is growing at unprecedented rates globally, it is becoming critical handling our waste water. For this the immediate action we can take right now is to improve water quality monitoring. Water quality describes the chemical, physical and biological characteristics, usually with respect to its suitability for a particular purpose. Water quality plays an important role in a healthy ecosystem, poor water quality not only affects aquatic life but the surrounding ecosystem as well. So, it becomes mandatory to examine the water quality to ensure that only safe water is available for consumption. Water quality is classified into four main types: Potable Water, Palatable Water, Contaminated Water and Infected Water. Traditional methods of water quality classification are cumbersome process and hence Machine Learning can be used as a catalyst for this. This study predicts ground water quality using Machine Learning. Hence, the study is useful for prediction of drinkable water.

***Keywords**: Ground Water Quality; Machine Learning (ML); TDS (Total Dissolved Solids); Potable Water*

In silico prediction of direct interactions between contaminants of emerging concern and regulatory RNAs.

Patrizio Arrigo

CNR IEIIT, Via De Marini 6, 16149 Genova Italy

Email: patrizio.arrigo@ieiit.cnr.it

Abstract: Man's activities keep producing new pollutants which raise concern about their impact both on environmental biodiversity and organism wellness. Recently it has emerged the concern about those pollutants that are spread, at low concentrations or those which lack of experimentally established toxicity, through the environment. These substances are called Contaminants of Emerging Concern (CECs). This class includes chemical substances, which come from different applications. The exposure to CECs is generally marked by low concentration and long term exposure. Untangling subtle metabolic modifications seem to be important for the research focused on analysis of mechanism of their bioaccumulation in biological systems. Wastewater contains a complex mixture in which CECs can play a significant role. The CECs derived from health and domestic activities could be assumed as common elements in mixtures obtained from different environmental contexts. The use of wastewater for irrigation needs an efficient monitoring system to mitigate the impact of these pollutants. The persistence of CECs in water and soil is an important factor that influences bioaccumulation in a biological system that leads to metabolic changes. Phthalates are one of the most insidious CECs because they have different industrial sources, such as plastics and pharmaceuticals, that can simultaneously contribute to chronic exposure. The available knowledge about their toxicity seems to be relatively little. Many researches have put forward the study of possible direct interactions of phthalates with regulatory RNA. This paper shows an application of "in silico" system that assesses the capability of a phthalate to interact with regulatory RNAs (an aptamer and a riboswitch). Moreover, it shows how a phthalate is able to modify the conformational flexibility of an RNA. These findings could be sizable in order to design specific biosensors based on nucleic-acid technologies.

Keywords: *Contaminants of Emerging Concern, wastewater, phthalates, Bionformatics, biosensors*

Techno-economic analysis of forward osmosis system for domestic wastewater treatment

Dhaval Patel [a], Anurag Mudgal [b], Vivek Patel [c], Jatin Patel [d]

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

Abstract: Forward osmosis technology is a highly potential and energy-efficient technology to treat different types of wastewaters, but commercialization of this technology seems far ahead. Economic evaluation and technological alignment with it are the crucial assessments for the commercialization of these technologies. Domestic wastewater is used as a feed solution, while reverse osmosis reject/brine is used as a draw solution in the forward osmosis system. Capital expenditure and operating expenditure were used to calculate specific solution costs. Assuming membrane cost 30 $/m2. Specific solution cost is obtained 0.37 $/m3 and 15 % recovery of single forward osmosis membrane module is recorded. Analysis suggests that forward osmosis membrane flux is the reason for lower specific solution cost. A major cost of the FO is comprised of FO membrane and draw solution. Despite good innovation potential, FO needs to overcome some of the technical issues like less water flux, availability of the draw solution, poor retention of the impurities, advances in membrane rejections, fouling potentials, and membrane cleaning processes. Techno- economic assessment suggests a technological aspect that needs to improve to commercialize the technology.

Keywords*: Forward osmosis, Membrane, Techno-economic, Specific solution cost*

Microcosmic Plant and Fungi synergism-based filter to remediate the pollutants from industrial wastewater

Monika Chhimwal [*1], R. K. Srivastava [2]

[1, 2] *Dept. of Environmental Science, CBSH, G. B. Pant University of Agriculture and Technology*

Abstract: Plants release compounds that signal microbes to engage in interactions. This interaction results in increased germination efficiency and root elongation, resulting in improved pollutant breakdown in both the rhizosphere and the phyllosphere. Most plants are symbiotic with fungi and these fungi play important roles in the structure, function, and health of plant communities. This study focuses on the potential of Syngonium podophyllum and Trichoderma harzianum fungi synergism to uptake the pollutants from the pretreated industrial wastewater collected from CETP common inlet point characterized by high COD (401 mg/l), BOD (159 mg/l), Nitrate (10.6 mg/l), and Lead (0.3 mg/l). Three setup S1 (Syngonium with Industrial wastewater water), S2 (Immobilized Trichoderma with Industrial wastewater), and S3 (Syngonium with Trichoderma & Industrial wastewater) were installed to treat pretreated industrial wastewater before entering CETP (Common effluent treatment plant). Compared to other treatments, S3 setup was found more efficient to reduce the pollutants COD, BOD, NO3-N, and Pb by 82%, 75.4%, 70.7%, and 80% respectively in 6 days while S1 could reduce only 59.6% COD, 63.1% BOD, 42.4% Nitrate and 67.5% Lead and S2 setup reduced the COD, BOD, Nitrate, and Lead by 55.1%, 40.8% 33.9% and 63.3% respectively. The BCF (Bio Concentration Factor) and TF (Translocation Factor) of Syngonium were also improved in setup S3 (0.66 and 0.4 respectively) as compared to other treatment setups (S1 and S2). Based on the findings, it is feasible to conclude that plant- immobilized fungal cell synergism can become an eco-friendly and low-cost approach to treat industrial wastewater by reducing the burden on secondary, tertiary wastewater treatment setups.

Keywords*: Rhizosphere, Phyllosphere, Industrial wastewater, Bio Concentration factor, Translocation Factor*

Groundwater quality assessment of Pantnagar region using pollution index of groundwater (PIG)

Diksha Pandey*, R.K Srivastava

G.B Pant University of Agriculture and Technology, Pantnagar, Uttarakhand

Abstract: For the quantification of water contamination, a pollution index of groundwater (PIG) is proposed. PIG evaluates the status of water quality parameters concentrations in accordance with respective drinking water quality requirements. Using a groundwater pollution index, this study looked into the quality of drinking groundwater in the Pantnagar region. The main ions distribution revealed that they are below their maximum permissible limits according to drinking water standard (IS: 10500). Na+ and K+ are found to be the most common ions. According to the PIG classification, 90% of the water samples exhibit lower levels of pollution in absence of alternate sources and are thus safe to drink. However, 10% of the samples exhibit high levels of contamination and are consequently unfit for human consumption. As a result, this study suggests that contaminated groundwater be treated before being consumed by humans. The research areas computed index ranges from 0.68 to 2.0. The index divides the area into three pollution zones viz. Negligible, low, and moderate. The upstream area, where the groundwater is dominated by HCO3- and Ca2+ has a low pollution zone, while the downstream area, where the groundwater is connected with Cl, has a moderate pollution zone. This implies that the quality of groundwater in the research area is mostly impacted by geogenic sources, but that it is also influenced by anthropogenic sources. The indicator is also quantitatively based on geochemical ratios (Na+, HCO3-, Cl, Na+, Ca2+, and Mg2+). The current study sets the way for competent management measures to be implemented at a given site in order to avoid pollution. PIG becomes a universal evaluation tool for groundwater contamination in any test area since classification of pollution zones is based on drinking water quality criteria.

Keywords*: Contamination, Geogenic sources, Groundwater, Pollution index of groundwater*

Synthesis of PVDF-HNT-Ceria mixed matrix UF membrane for dye elimination and oil-water separation

Triparna Chakraborty*, Amita Bedar**, Shobha Shukla**, Manoj Pandey*

**Pandit Deendayal Energy University, Gandhinagar ** Indian Institute of Technology Bombay, Mumbai*

Abstract: There are two major issues in wastewater streams, one is the separation of oil from the spills and oil-water cocktail emulsion, and another is the elimination of dye. Conventional approaches for dye and oil removal from water such as gravity separation, centrifugation etc., demands high energy and complex operation. PVDF membranes are effectively used in the separation of dyes and oils. Due to their tendency of surface fouling, these membranes cannot operate continuously. This limitation has been addressed by adding halloysite clay (HNT) and cerium oxide (Ceria) nanoparticles. As an adsorbent of cationic dye molecules, HNT nanoclay is a stable nanotube that is hydrophilic in nature. HNT along with ceria nanoparticles are expected to provide the antifouling property to the membrane with the high permeability and rejection rate. The membranes were prepared using phase inversion by embedding ceria nanoparticles in PVDF matrix with HNT. Ceria-HNT-PVDF UF membrane were prepared and investigated by SEM, XRD, FT-IR, AFM and contact angle analysis. SEM analysis shows not much change in the morphology of the pristine and mixed matrix UF membrane due to the homogenous dispersion of HNT and Ceria.

Study of effects of beads for reduction of bubble formation in waste water treatments using model simulation

Aziz Lokhandwala* [(1)], Shrey Upadhyay [(1)], Dhyanvi Rao [(1)], Mansi Patel [(1)] and Rohit Srivastava [(2)]

[(1)] School of Technology, PDEU, Gandhinagar, 382005

[(2)] Associate Professor, Department of Physics, PDEU, Gandhinagar, 382005

Abstract: Various methods to treat the wastewater such as Methods like electrodialysis, membrane-based methods, UV treatments, Coagulation, and Sedimentation methods have been developed over the past few decades. However, various studies show that in steps of coagulation- sedimentation and membrane-based filtration, bubble formation is a major issue. Issues like over- loading of the membrane, reduction of the longevity of membrane, turbulent flow through the water carrying channels making it more prone to system failures, leakages, reduction in structural integrity, increased dissolution of gases in stages of settling and coagulation thereby reducing the overall efficacy of the filtration system. The basic causality for the formation of a bubble is the supersaturation of water by dissolved gases. The usage of beads has shown promising results mainly in cement industries. Hence the present paper explores the possibility that the same can be extended to reduce bubble formation in treatment plants. In this paper, we study the effect of beads using simulation tools to reduce turbulence in the flow with the help of Navier-Stokes equations. The beads of critical diameter and density will reduce the bubble formation in the filtration system thereby reducing its Reynolds number. The paper will study the bubble formation for different bead parameters such as diameter, density and the concentration of beads in a unit volume of the fluid parcel. With the help of these simulations, we attempt to show the reduction in membrane load and increase the longevity of filters in the treatment systems.

***Keywords**: Beads; Bubble formation; Naiver-Stokes equations; Turbulent flow; Waste water treatment.*

Potentialities of Plant based hybrid wetland systems for the treatment of Household grey water using Canna indica, Agave americana and Tagetes sp.

Nikhil Savio [1*] and Rajeev Kumar Srivastava [2]

[1, 2] Department of Environmental Science, GB Pant University of Agriculture and Technology, Uttarakhand India

Abstract: The ever-increasing population is generating large amount of waste water and it is increasing with time especially with the higher per capita consumption of water in the country. Besides the ample amount of energy required by the conventional water treatment methods are hampering the economic viability of the procedure. This asks for newer and efficient low-cost nature based water treatment system which along with cost takes into consideration the sustainability of the ecosystem. In this study a hybrid plant-based wetland system consisting of three plant species were used to treat the household grey water. American aloe and Marigold were used in constructed wetland and Canna plant was used in floating wetland for a period of 24 hours retention to know the efficiency. The pollution reduction was analysed after 2 hours, 4 hours, 6 hours, 8 hours and 24 hours retention period in all these systems. Three parameters basically BOD, COD and salinity reduction were checked as initial research to know the viability. The results showed that BOD reduction ranged from 7.40-35.29% in various systems within 24 hours of retention, whereas COD showed a reduction range of 5.22-33.80% and salinity exhibited a reduction range of 6.93- 20.83% based on the different systems. This showed that if integrated with other systems or in combination the plant-based system can prove to be efficient and further research can be done on them.

***Keywords**: BOD, COD, Salinity, retention*

Sustainable method for removal of heavy metals: Phytoremediation

Varsha Mudgal [a*], Milan Raninga [b], Dhaval Patel [b], Dipak Ankoliya [c], Anurag Mudgal [d]

[a] *Project coordinator, PDEU, Gandhinagar, Gujarat, India*

[b] *JRF, PDEU, Gandhinagar, Gujarat, India*

[c] *SRF, PDEU, Gandhinagar, Gujarat, India.*

[d] *Associate Professor PDEU, Gandhinagar, Gujarat, India*

Abstract: Heavy metals (HMs) entered in water due to industrial activities like mining, glass, fertilizer, paper, textile, Pharmaceuticals and others. These HMs in water above threshold level are toxic and affects soil fertility and crop productivity. HMs are biologically magnified in the upper trophic levels and pose risk to animal and human health. Removal of these HMs with growing plants in affected water/soil (phytoremediation) is an ecologically and economically effective method. These plants capable of absorbing, immobilizing, extracting, and degrading HMs. Phytoremediation capacity can be increase with the help of biotechnology and genetic engineering. Present review describe the mechanism of phytoremediation, its suitable plants and recent development in the technology to enhance the removal capacity of plants for HMs along with different uses of growing biomass. Proper disposal methods of the harvested biomass, to prevent entry of the HMs in the food chain, also discussed. To reduce the risk of HMs toxicity in water/ soil/crop and low-cost biomass disposal, it is necessary to popularise the method with scientific knowledge.

***Keywords**: Heavy metals, threshold level, phytoremediation, biomass management*

Anion detection employing synthetic chemosensors in aqueous media

Nikunjkumar Vagadiya, Mohil Odedara, Dhrutikumari Patel, Sudhanshu Sharma, Nandini Mukherjee*

Department of Chemistry, School of Technology, Pandit Deendayal Energy University, Gandhinagar, Gujarat-382426, India

Abstract: Water is a vital component of our daily life. A variety of human-caused climate change, as well as natural geochemical aging of soil and rocks, leads to water pollution. Through water, the pollutants can easily enter human and animal food networks. These contaminants include heavy metals cations, anions, pesticides, cosmetics, polymers, dyes, and drugs. When consumed through the contaminated water these toxins can cause direct injury to human beings and animals even at concentrations slightly higher than the permissible limit. Thus wastewater or contaminated water treatment is a major goal for scientists and policymakers these days. To remove the contaminants from water, first and foremost, the pollutants must be identified. As a result, many techniques are used and/or being developed to validate water adulteration, such as detection of pollutants using nanocomposites, supramolecular approaches, metal-organic frameworks, heteronuclear-organic frameworks, polymeric membranes, molecule-based optical chemosensors, etc. This article focuses on the detection of particular anions (Cl–, F–, CN–, PO 3–, NO –, SO 2–) in an aqueous medium using synthetic optical chemosensors as well as computational research to validate the detection method of anion in the aqueous media.

***Keywords**: anion; detection; chemosensor; water; pollutant; optical*

Design of ORC-RO System for Utilizing Waste Heat from Flue Gases of Coal-Fired Thermal Power Plant

Milan Raninga [* a], Anurag Mudgal [b], Vivek K. Patel [b], Jatin Patel [b]

[a] *Research Scholar, Department of Mechanical Engineering Pandit Deendayal Energy University, Gandhinagar 382 007, India*

[b] *Associate Professor, Department of Mechanical Engineering Pandit Deendayal Energy University, Gandhinagar 382 007, India*

Abstract: Waste heat recovery is an effective tool for reusing waste energy to provide useful energy products. This method addresses the practical solution for sustainable products, which reduces CO2 emissions. ORC is usually used in waste heat recovery systems due to it operates with low heat source temperature, which advantage to design flexible and compactable design of the system. This paper aims to design a waste heat recovery based organic Rankine cycle coupled with reverse osmosis to drive RO Pump. The boiler feed water has been treated using the RO system, and the reject concentrate from the RO system can be used to suppress coal fly ash. The recycling reverse osmosis system is designed according to the boiler feedwater input, achieving more than 80% recovery rate. Also, the latent heat and sensible heat of the flue gas, which can be utilized at above dew-point temperature to avoid corrosion, are discussed. This concept design is developed for a 1000 MW coal-fired thermal power plant. Nevertheless, the RO feed water is preheated by condensing vapor from the ORC expander, which reduces the specific energy consumption of the RO system.

***Keywords**: Waste heat recovery, Organic Rankine Cycle, Reverse Osmosis, Cross Flow Heat Exchanger.*

Techno-economic analysis of hybrid electrodialysis-batch reverse osmosis process for brackish water desalination

Dipak Ankoliya [a], Anurag Mudgal [a], Manish Kumar Sinha [b], Vivek Patel [a], Jatin Patel [a]

[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: Hybridization of Electrodialysis (ED) and batch reverse osmosis (BRO) process to reduce brine volume and water production cost. Electrodialysis process have benefit of high-water volume recovery in brackish water desalination while reverse osmosis can produce pure water at low production cost. To take benefit of both, the high-water volume recovery and low water cost, the hybridization of ED and BRO process is studied. Here the simple hybrid process layout is preferred in which ED process is kept in reject stream of BRO process and permeate from both ED and BRO is mixed together. This arrangement can reduce the ED membrane area requirement and in turn the cost of ED stack. The recovery of ED process is kept at 70% which can decide the blending ratio of ED permeate and BRO permeate. The capital cost and operating cost of ED and BRO process is used to calculate water production cost. The water production cost from hybrid BRO-ED process is compared with standalone ED as well as BRO process. Hybrid process has 45% less water production cost than standalone ED process and 69% higher cost than standalone BRO process. Despite the higher cost, the hybrid process has 18% higher water volume recovery compare to standalone BRO process.

Keywords*: Electrodialysis; batch reverse osmosis; hybrid process; techno-economic; brackish water desalination*

The DFT/TD-DFT study on benzothiazole based chemosensor to decipher anion sensing mechanism

Anu Manhas[a], Siddhi Kediya[b], Mohil Odedara[a]

[a]*Department of Chemistry, School of Technology, Pandit Deendayal Energy University*

[b]*School of Applied Material Sciences, Central University of Gujarat*

Abstract: The F- anion sensing mechanism of a fluorescent probe N-(2-(benzothiazole-2-yl)-phenyl)-4-methoxybenzamide was investigated using density functional theory (DFT) and time-dependent density functional theory (TD-DFT) (4). The selected probe's amidic proton (N–H) may form an intramolecular hydrogen bond (IMHB) with the nitrogen atom of the benzothiazole moiety. The weak IMHB in the excited state of N24–H26—-N12 supports the reverse proton transfer mechanism in 4. The F anion interacts with the F—-H–N link in the ground state of 4, deprotonating the amidic proton and causing the geometry to be distorted. The considerable intramolecular charge transfer (ICT) feature was identified in 4 after deprotonation. The redshift in absorption and emission spectra was found as a result of the significant ICT process. These findings were used to figure out how molecule 4 senses its surroundings.

Keywords: DFT, TD-DFT, sensing, intramolecular hydrogen bond, intramolecular charge transfer

---

Reuse of domestic grey water with green wall and alternative post- treatments

Rubén Rodríguez-Alegre [*1,2], Abel Lara [1], Xialei You [1], Montserrat Pérez-Moya [2], Julia García-Montaño [1]

[1] *LEITAT Technological Center, C/ de la Innovació 2, 08225 Terrassa (Barcelona), Spain*

[2] *Chemical Engineering Department, Universitat Politécnica de Catalunya, EEBE, C/ Eduard Maristany 10-14, 08930 Barcelona, Spain*

Abstract: Nowadays, the population growth and the resulting wastewater generation has driven to find reuse paths in order to reduce its environmental impact. In this context, greywater generated in households can be treated by Nature Based Solutions (NBS) with the aim to reduce its pollutant activity for achieving a proper quality for being reused. In this study, greywater was treated by using a NBS technology named Green Wall to reduce the content of chemical oxygen demand (COD), biochemical oxygen demand (BOD) and total organic carbon (TOC) among other parameters, but the use of this kind of technology can't reduce the microbiological content so a post-treatment is mandatory. Two different disinfection alternatives were tested a combination of advanced oxidation processes (AOP) with UV-light and hydrogen peroxide and a membrane process based on ultrafiltration (UF). The NBS reduced significantly COD (58.37% of reduction), TOC (25.20% of reduction), turbidity (37.21% of reduction) and suspended solids (100% of reduction) but does not lead to microbial removal. By using AOP as post treatment, the COD was reduced 86.93% and 82.93% at a H2O2 dose of 20 and 50 mg L-1, respectively. In the case of microbial inactivation, both doses of H2O2 used reported a 100% of microorganism removal. By using UF membranes, it was observed a significant reduction on electrical conductivity (more than 77.20% in all cases), as well as a total removal of microorganisms (100%). The turbidity is reduced to zero with 10 nm and 5 nm pore size membranes. The treatment system resulting in a regenerated water quality suitable for being reused according to Spanish legislation (RD 1620/2007).

Keywords: Green wall; Nature Based Solutions; Grey water; UV-H2O2; Ultrafiltration

Centre of Excellence in Water Treatment and Management

Centre of excellence in Water is being conceptualized 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.pdeu-h2o.com

www.pdpu.ac.in

ISBN 978-93-5620-618-2

PDEU PANDIT DEENDAYAL ENERGY UNIVERSITY

Formerly Pandit Deendayal Petroleum University (PDPU)