National Conference on

Sustainable Practices for Environmental Remediation

NCSPER-2025

February 19-20, 2025

Abstract Book

Organized by Department of Energy and Environment

Thapar Institute of Engineering and Technology, Patiala

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Prof N Tejo Prakash
Prof Amit Dhir
Dr Shilpi Verma
Dr Gaurav Goel
Dr Nishu Joshi

Abstract book designed and formatted by Glostem

Message from the Director

On behalf of the organizing committee, I am delighted to welcome you to the ***National Conference on Sustainable Practices for Environmental Remediation (NCSPER – 2025),*** *taking place on* ***February 19-20, 2025,*** *at* ***Thapar Institute of Engineering & Technology, Patiala, India.***

This conference serves as a vital platform for bringing together experts, practitioners, and policymakers from around the world to explore sustainable solutions for environmental remediation. As this field continues to evolve with groundbreaking innovations, NCSPER– 2025 aims to foster meaningful discussions, share state-of-the-art technologies, and promote best practices that support eco-friendly and sustainable remediation methods.

Our objective is to advance knowledge, encourage interdisciplinary collaboration, and facilitate the exchange of ideas to address the pressing challenges of environmental contamination. The conference will cover a diverse range of topics, including ***Green Remediation Technologies, Bioremediation Strategies, Renewable Energy, Circular Economy, Risk Assessment,*** *and more. These discussions will provide invaluable insights to drive practical, scalable, and sustainable solutions.*

We hope that all delegates find this event enriching and inspiring, with opportunities for valuable networking and collaboration. Your participation is key to shaping a cleaner, healthier, and more sustainable future.

We look forward to engaging discussions and a rewarding experience for all.

Warm regards,
Prof Padmakumar Nair
Director
Thapar Institute of Engineering & Technology, Patiala, India.

Message from HOD

It gives me immense pleasure to welcome all participants to the National Conference on ***Sustainable Practices for Environment Remediation (NCSPER – 2025),*** *at Thapar Institute of Engineering & Technology, Patiala. This conference serves as a vital platform for researchers, academicians, industry professionals, and policymakers to exchange knowledge, share innovative solutions, and discuss emerging trends in environmental sustainability.*

In the face of increasing environmental challenges, it is imperative to adopt sustainable practices that ensure a cleaner and greener future. This conference aims to foster interdisciplinary discussions and encourage collaborative efforts toward innovative and practical solutions for environmental remediation. I sincerely appreciate the dedication and enthusiasm of all contributors who have made this event possible.

I extend my best wishes to all participants for fruitful discussions and meaningful outcomes.

May this conference pave the way for new insights and advancements in sustainable environmental practices.

Warm regards,
Prof. Anoop Verma
Head, Department of Energy and Environment
Thapar Institute of Engineering & Technology, Patiala, India.

Message from the Organizing Secretaries

It is our great honour and privilege to welcome you all to the National Conference on Sustainable Practices for Environment Remediation (NCSPER – 2025) at Thapar Institute of Engineering & Technology, Patiala. This conference is a significant step toward addressing the pressing environmental challenges of our time by bringing together distinguished researchers, academicians, industry experts, and policymakers on a common platform.

NCSPER – 2025 is designed to facilitate meaningful discussions, encourage interdisciplinary collaborations, and showcase innovative approaches to environmental sustainability. Through this conference, we aim to explore practical solutions that can contribute to a cleaner, healthier, and more sustainable future for all.

We extend our heartfelt gratitude to all the speakers, participants, and organizers whose dedication and efforts have made this event possible. We hope this conference inspires new ideas, fosters valuable collaborations, and drives impactful advancements in environmental remediation.

Wishing you all an insightful and enriching experience!

Warm regards,
Dr. Shilpi Verma
Dr. Gaurav Goel
Dr. Nishu Joshi

Organizing Secretaries, NCSPER – 2025
Thapar Institute of Engineering & Technology, Patiala, India.

Technical Program of NCSPER – 2025 (Day 1)

Day 1: 19 February 2025		
Time Slot	**Program**	
8:30-10:00 AM	**On Spot Registration**	
10:00-11:00 AM	**Inauguration**	
11:00-11:30 PM	**High Tea**	
11:30-1:30 PM	**Keynote Lectures**	
	KS 1: Prof. I. M. Mishra, IIT Roorkee	
	KS 2: Prof. Sharath Kumar Pallerla, MoEFCC	
	KS 3: Prof. Vimal C Srivastava, IIT Roorkee	
1:30-2:30 PM	**Lunch**	
2:30-3:30 PM	**Industry-academia Meet close-door (Auditorium)**	
2:30-4:00 PM	Tracks in Parallel Sessions and **Posters Presentation Session (PS1)** **Poster Session Jury:** Dr. Priyankar Dey, TIET and Dr. Arpit Goyal, TIET **Poster Numbers** - SWM01, SWM02, SWM03, SWM04, SWM05, SWM06, LC03, EM01, EM02, EM03, EM04, EM05, EM06, WM01, WM02, EM07	
2:30-4:00 PM	**Oral Tracks in Parallel Sessions**	
Venue	**LT 201**	**LT 202**
Topic	**Water And Wastewater Management**	**Clean Air**
15 min	**IT1**: Prof. S. K. kansal, PU Chandigarh (Session Chair) Co-chair: Prof. Soumen Basu, TIET	**IT2**: Prof. Manpreet Singh Bhatti, GNDU Amritsar (Session Chair) Co-chair: Dr. Prof. Dwarka Nath, TIET
30 min (5min+2min each)	**ORAL SESSION (OS1)** **Oral Presentation** WM01, WM02, WM03, WM04	**ORAL SESSION (OS2)** **Oral Presentation** CA01, CA02, CA03, CA04
30 min	**KS4**: Prof. Sri Harsha Kota, IIT Delhi	
4:30-5:00 PM	**Tea**	
5:00-6:30 PM	**Oral Tracks in Parallel Sessions**	
Venue	**LT 201**	**LT 202**
Topic	**Water And Wastewater Management**	**Solid And Hazardous Waste Management**
30 min	**KS5**: Prof. Sanjeev Bedi, University of Waterloo, Canada	**KS6**: Prof. Sunil Kumar, CSIR-NEERI, Nagpur
15 min	**IT3**: Dr. Vikas Sangal, MNIT Jaipur (Session chair) Co-chair: Dr. Neetu Singh, TIET	**IT4**: Prof. G.S Kocher, PAU Ludhiana (Session Chair) Co-chair: Dr. Avinash Chandra, TIET
45 min	**ORAL SESSION (OS3)** **Oral Presentation** WM05, WM07, WM08, WM09, WM10, WM11, WM13	**ORAL SESSION (OS4)** **Oral Presentation** SWM01, SWM02, SWM03, SWM04, SWM05, SWM06, SWM07, SWM08, SWM16, SWM17
6:30 PM Onward	**Cultural program** (Venue: Institute Auditorium) **and Gala Dinner**	

KS=Keynote; IT= Invited Talk

Technical Program of NCSPER – 2025 (Day 2)

Day 2: 20 February 2025			
Time	**Program**		
9:30-11:00 AM	Tracks in Parallel Sessions and **Posters Presentation Session (PS2)** **Poster Session Jury**: Prof. Sanghmitra Barman (TIET) and Prof. Manoj Baranwal (TIET) **Poster Numbers** – LC01, LCO2, WM03, WM04, WM05, WM06, WM07, WM08, WM09, WM10, WM11, WM12, CA01, CA02, CA03		
9:30-11:00 AM	**Oral Tracks in Parallel Sessions**		
Venue	**LT 201**		**LT 202**
Topic	**Life Cycle Assessment and PP**		**Energy Management**
30 min	**KS7**: Prof. Rajeev Mehta, TIET, Patiala		**KS8**: Prof. Ajay Kalamdhad, IITG
15 min	**IT5**: Dr. Raj Kishor Singh, CPCB (Session Chair) Co-chair: Prof. B C Mohanty, TIET	30 min	**KS9**: Prof. O P Pandey, TIET (Session Chair) Co-chair: Dr. Vivek Gupta, TIET
45 min	**ORAL SESSION (OS5) Oral Presentation** LC01, LC02, LC03, LC04	30 min	**ORAL SESSION (OS6)** **Oral Presentation** EM01, EM02, EM03, EM04
11:00-11:30 PM	**Tea Break**		
11:30-1:00 PM	**Public Policy, Standardization, And Legislation (LT201) by Bureau of Indian Standards**		
1:00-2:00 PM	**Lunch**		
2:00-4:00 PM	**Oral Tracks in Parallel Sessions**		
	Waste Management (LT 201)		**Miscellaneous (LT 202)**
15 min	**IT6**: Prof. Nirmal Kumar, ISTAR Gujrat		**IT7**: Prof. Amrit Pal Toor, PU Chandigarh (Session Chair)
15 min	Session-chair: Prof B. Chudasama, TIET **IT8:** Dr. Malkeet Singh		**IT9:** Dr. Pawan Kumar, CU Jammu Co-chair: Prof. Diptiman Choudhury, TIET
60 min	**ORAL SESSION (OS7)** **Oral Presentation** SWM09, SWM10, SWM11, SWM12, SWM13, SWM14, SWM15, SWM18 WM12, WM13, WM06		**ORAL SESSION (OS8)** **Oral Presentation** PP01 EM05, EM06, EM07, EM08, EM09, CA05, CA06, CA07, CA08
4:00-4:30 PM	**Valedictory and Tea**		

KS=Keynote; IT= Invited Talk

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- ***Oral Presentation - CA01:*** Drone-Based Monitoring of Particulate Matter in Pollution Hotspot of the National Capital Region
  Ravi Kumar, Amit Dhir and Hardeep Singh
- ***Oral Presentation - CA03:*** Assessment of Particulate Matter Variations Across Diverse Micro-Environments in Thar Region of Rajasthan: Insights from Residential and Educational Spaces
  Harshita Karri, Abhijeet Mondal, Anjali and Rajyalakshmi Garaga
- ***Oral Presentation - CA05:*** Bioaerosol Presence in Pm_{10} And $Pm_{2.5}$: A Seasonal Study Along a Gujarat State Highway
  Abhishek Gupta, S Jonathan K Browne II, Miatta B Goss and Amit Dhir
- **Oral Presentation - CA06: I**ntegrating Photocatalysis into Sustainable Construction Materials Made from Industrial Wastes for Voc Abatement
  Amandeep Singh, Anoop Verma and Nishu Joshi
- **Oral Presentation - CA07:** Toward a Role in GA-SVM Effect-Based Air Quality Control Prediction
  Dharmendra Kumar, Alok Kumar Shukla, Shubhra Dwivedi and Sushma Kumari
- **Oral Presentation - CA08:** Data-Driven Engine Diagnostics: Classifying Bike Engines via Exhaust Emissions
  Dharmendra Kumar, Ashutosh Mishra and Navin Singh Rajput
- **Poster Presentation - CA02:** Air Quality Monitoring by Acetone Sensing using Chromium-Doped ZnO Thin
  Anil Arora and Arti
- **Poster Presentation - CA03:** A Comprehensive Assessment of Air Pollution and Environmental Impacts of Steel Manufacturing: Insights from Eia
  Anchal Aggarwal, Gaurav Goel and S K Singh
- **Oral Presentation - SWM01:** Impact on E-waste generation due to increasing popularity of E-vehicles: A review
  Sonali Agarwal, Deepak Kumar Soni, Hemant Singh and Vivek Gaur
- **Oral Presentation - SWM02:** Management of Waste PV Solar Panel with Recourse to Recycling and recovery of Valuable Material
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- **Oral Presentation - SWM03:** Integrated Waste and Sanitation Management for Climate-Resilient Urban Development in the Narmada River Basin
  Adarsh Singh and Mayur Shirish Jain
- **Oral Presentation - SWM04:** Fermentative Processing Of Non Table Purpose Kinnow For Producing Debittered Wine
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- **Oral Presentation - SWM05:** E-Waste Management Scenario in India: Recent Perspectives and Challenges
  Vivek Gaur, Deepak Kumar Soni, Hemant Singh and Sonali Agarwal
- **Oral Presentation - SWM06:** Remediation Of Microplastic Using Biochar: A Mini Review
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  Mini Sharma and Dhamodharan
- **Oral Presentation - SWM11:** Biological conversion of keratin rich waste by A*spergillus gorakhpurensis* for industrial applications
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SPEAKERS

Prof I M Mishra
IIT Roorkee

Prof Vimal C Srivastava
IIT Roorkee

Mr Sharath K Pallerla
MoEFCC

Prof Adarsh Pal Vig
PPCB

Prof Ajay Kalamdhad
IIT Guwahati

Prof Sunil Kumar
CSIR – NEERI Nagpur

Prof O P Pandey
TIET, Patiala

Prof Rajeev Mehta
TIET, Patiala

Prof Sri Harsha Kota
IIT Delhi

Prof Sanjeev Bedi
University of Waterloo, Canada

ORGANIZING COMMITTEE

S. No.	Name	Designation	Affiliation
1.	Prof Padmakumar Nair	Chief Patron	TIET, Patiala
2.	Prof Ajay Batish	Patron	TIET, Patiala
3.	Prof Anoop Verma	Chairperson	TIET, Patiala
4.	Prof N Tejo Prakash	Convener	TIET, Patiala
5.	Prof Amit Dhir	Convener	TIET, Patiala
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14.	Prof Bonamali Pal	Organizing Committee Member	TIET, Patiala
15.	Prof BC Mohanty	Organizing Committee Member	TIET, Patiala
16.	Prof Bhupendra K Chudasama	Organizing Committee Member	TIET, Patiala

ORGANIZING COMMITTEE

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25.	Dr Atul Upadhyay	Organizing Committee Member	TIET, Patiala
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27.	Dr Ashutosh Kumar	Organizing Committee Member	TIET, Patiala
28.	Dr Vivek Gupta	Organizing Committee Member	TIET, Patiala
29.	Dr Vivek Pawar	Organizing Committee Member	TIET, Patiala
30.	Dr Himali Horo	Organizing Committee Member	TIET, Patiala

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3.	Prof Amrit Pal Toor	Advisory Committee Member	Panjab University, Chandigarh
4.	Prof Ajay Kalamdhad	Advisory Committee Member	IIT Guwahati
5.	Prof Adarsh Pal Vig	Advisory Committee Member	PPCB
6.	Prof. Banu Ormeci	Advisory Committee Member	Carleton University, Ottawa
7.	Prof Dhiraj Sud	Advisory Committee Member	SLIET
8.	Dr Gurvinder Singh Kocher	Advisory Committee Member	PAU Ludhiana
9.	Prof HadasMamamne	Advisory Committee Member	TAU, Israel
10.	Prof I M Mishra	Advisory Committee Member	IIT Roorkee
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12.	Prof Sushil Kumar Kansal	Advisory Committee Member	Panjab University, Chandigarh

ADVISORY COMMITTEE

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15.	Prof S K Mahla	Advisory Committee Member	PTU Hoshiarpur Campus
16.	Prof Surjit Singh Katoch	Advisory Committee Member	NIT Hamirpur
17.	Prof S K Behera	Advisory Committee Member	VIT Vellore
18.	Dr Sanjay Pant	Advisory Committee Member	Bureau of Indian Standards
19.	Prof Urška Lavrenčič Štangar	Advisory Committee Member	University of Ljubljana, Slovenia
20.	Prof Vimal Srivastava	Advisory Committee Member	IIT Roorkee
21.	Dr Vikas Sangal	Advisory Committee Member	MNIT Jaipur
22.	Prof Vidyadhar V Gedam	Advisory Committee Member	IIM Mumbai
23.	Prof Vasundhara Singh	Advisory Committee Member	PEC, Chandigarh
24.	Prof Zulfaquer Ahmed	Advisory Committee Member	IIT Roorkee

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Speakers Abstract

Keynote Speaker

REDEFINING SUSTAINABILITY: THE POWER OF LIFE CYCLE ASSESSMENT AND CIRCULAR ECONOMY

Sunil Kumar
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Sustainability thrives best when the lifecycle of products and services in the economy is analyzed with a focus on resilience and regeneration. The increasing challenges of resource depletion, waste generation, and environmental degradation necessitate a shift from the traditional linear economy to a more sustainable model. Life Cycle Assessment (LCA) and Circular Economy (CE) provide a more scientific and strategic approach towards sustainability. LCA evaluates the environmental impact of products and processes throughout their lifecycle from raw material extraction to disposal. CE focuses on extending the value of materials and resources in the economy through reuse, recycling, and regeneration. The integration of LCA and CE helps in designing sustainable products, optimizing waste management, and minimizing environmental footprints. However, challenges, such as data limitations, economic barriers, and regulatory gaps hinder their widespread implementation. Technological advancements like AI, block chain, and IoT can support circular economy initiatives. By leveraging LCA and CE, businesses and policymakers can drive sustainability, reduce environmental impacts and contribute to global goals, such as the EU Green Deal and UN Sustainable Development Goals (SDGs). The synergy between LCA and CE, their role in sustainable development and strategies for effective implementation has been attempted in this paper.

Keynote Speaker

WASTE TO ENERGY: A COMPREHENSIVE STUDY ON BIOGAS IN INDIA

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Fossil fuels and other conventional energy sources are scarce and harmful to the environment. Thus, the only option for achieving sustainable growth is to use renewable energy. Among the different alternative energy sources accessible, biomass-based energy is one of the most affordable while simultaneously tackling the pressing issues related to the management of waste. Estimating the potential is essential to making the most of the biomass. State-by-state biomass databases are useful for implementing regional bioenergy policies. A biomass resource database at the state level does not exist in India, though. The potential for producing biogas at the state level from a variety of sources, such as crop residues, animal and poultry wastes, municipal solid wastes, and wastewater (both industrial and sewage) was evaluated. India's potential for producing biogas from organic waste is estimated to be 74795 million m^3 per year. In India, digesters capable of producing 3635 million m^3 per year are now operational. This demonstrates the enormous disparity between potential and actual use. Although it is believed that biogas plants are environmentally benign, the frequent leaks and purposeful releases of biogas from badly maintained digesters raise doubts about any potential environmental advantages. It was determined how important biogas is as a fuel for energy, cooking, and bio-CNG. According to the research, biogas generation can cut India's household cooking emissions by 1/5 th . It also shows that biogas-derived power and bio-CNG produce fewer greenhouse gases (GHGs) across their value chain than other fuels. However, there remain obstacles to the widespread use of large-scale biogas facilities, both technological and non-technical. Therefore, for the deployment of a large-scale biogas plant in India to be successful, multiple mitigating strategies must be developed. The rise of bioenergy generation will be accelerated by the successful installation of biogas facilities, which will also address urgent waste management challenges.

Keynote Speaker

INNOVATIVE APPROACHES TO VALORIZING INDUSTRIAL WASTE: A FEW CASE STUDIES

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The increasing growth of various industries, particularly in sectors such as chemicals, textiles, pulp and paper, limestone, iron ore, thermal power plants, and automotive manufacturing, has led to a surge in the generation of industrial solid waste, including sludge from wastewater and effluent treatment plants. This sludge poses significant challenges due to its heterogeneous composition and the presence of hazardous compounds, making its management complex.

Current thermochemical methods, including incineration, pyrolysis, and gasification, are employed to convert municipal solid waste (MSW), lignocellulosic biomass, and certain industrial wastes into energy. However, there is a gap in established technologies and techniques for the efficient handling and valorization of diverse industrial sludges.

At IIT Roorkee, our research group has been investigating the thermal degradation characteristics of various industrial sludges, such as those from distilleries and textile industries, using Thermogravimetric-Fourier Transform Infrared (TG-FTIR) analysis. This comprehensive study has revealed promising pathways for the valorization of industrial sludge. For instance, the biochar produced from these sludges has shown excellent potential for the adsorptive removal of pharmaceutical compounds like ofloxacin and tetracycline from aqueous solutions.

Moreover, we have successfully valorized hazardous industrial sludge by extracting pure sulfur, demonstrating the feasibility of converting waste into valuable resources and mitigating environmental and health hazards.

DECARBONISATION OF ENERGY SYSTEMS

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Ministry of Environment, Forest and Climate Change, India

As India strives to achieve a developed nation status by 2047 under its 'Viksit Bharat 2047' initiative, it is committed to provide clean, reliable and affordable energy to all its citizens. However, energy sector which is currently dominated by fossil fuels, accounts for 75 percent of total Greenhouse Gas (GHG) emissions. This underscores the urgent need to transform energy production and the consumption patterns to achieve net-zero emissions and effectively mitigate the climate change impacts. India plans to implement a multi-layered strategy in order to achieve its ambitious climate targets, through a combination of conducive policy environments, improved data regimes, and greater collaboration amongst stakeholders.

Climate change is a global collective action problem of dealing with the consequences of greenhouse gas emissions leading to global warming, mainly precipitated by excessive historical and current emissions of the developed countries. India is an emerging economy where Greenhouse Gas emissions are set to increase, in pursuit of its development and poverty eradication goals. India's historical cumulative emissions from 1850 to 2019 amount to less than 4 percent of cumulative carbon dioxide emissions of the world from the pre-industrial era, despite being home to 17 per cent of the world's population. Hence, India's responsibility for global warming has been minimal and even today its annual per capita emissions are only about one-third of the global average.

Nevertheless, India is committed to combating climate change by making development choices that ensure the growth and development of the economy along low-carbon pathways toward net zero by 2070. India is committed to addressing the challenge with firm adherence to multilateralism based on equity and the principle of common but differentiated responsibilities and respective capabilities (CBDR-RC), as enshrined in the United Nations Framework Convention on Climate Change (UNFCCC).

The transition towards cleaner energy sources is crucial to India's energy strategy. While fossil fuels like Coal and Oil dominate the energy mix, there is also a growing emphasis on Renewable Energy Sources (RES) such as Solar, Wind, and Biomass along with battery energy storage and new technologies like green hydrogen, green ammonia towards greening the energy mix. Policies promoting tripling RES & doubling Energy Efficiency (EE) coupled with technological advancements, market transformation and investment incentives, play a crucial role in accelerating this transition. Several government-led policies and strategies for decarbonization have been implemented to address climate change. The LT-LEDS and initiatives such as the National Action Plan on Climate Change (NAPCC) provide a roadmap for achieving net-zero emissions by 2070.

Electricity Demand

India has witnessed a substantial rise in the electricity consumption across all sectors over the years. The total electricity consumption reached 1,543 TWh in 2023-24, with a 7 percent increase from the last year. Further, India's per capita electricity consumption has risen to 1,395 kWh (one-third of the global average) as of 2023-24, nearly doubled over the past decade. The increase in electricity consumption is driven by the burgeoning demand from residential, commercial, and industrial sectors.

- **Building Sector: Residential and Commercial Buildings**

The combined residential and commercial building sectors currently account for approximately 32% of India's total electricity consumption. Projections suggest a substantial increase in electricity demand, expected to rise from 421 terawatt-hours (TWh) in 2022 to 2,421 TWh by 2047. By that year, buildings are anticipated to contribute to 55% of the total electricity demand in the country.

Industrial Energy Use:

The industrial sector accounts for 42% of the total electricity consumption, rising from 440 TWh in 2016-17 to 645 TWh in 2023-24. Coal consumption in industry increased from 302 MT (2016-17) to 366 MT (2023-24), with a 3% CAGR. Natural gas consumption surged 28% from 2018-19 to 2023-24, driven by the fertilizer sector, which accounted for 31% of total gas consumption

Transportation Energy Demand:

India's passenger-bus-kilometers (BPKMs) are projected to increase 3.6 times by 2047 and 4.5 times by 2070 from the baseline figure of 5,695 BPKMs in 2023. The capacity of freight transportation is expected to grow by 3.8 times in 2047 and 4.7 times in 2070 compared to 2023, which had 4,144 billion tonne-kilometers (BTKMs). Additionally, the number of cars per 1,000 population is anticipated to rise to 100 by 2070, up from 32 in 2023.

Challenges:

Several challenges confront India's development agenda across different sectors. Challenges in the power sector include gaps in grid management research and limited innovation in battery storage, while sector-specific benchmarks for energy-saving technologies remain underdeveloped. In transportation, low R&D investment in electric vehicle (EV) technology, sustainable charging infrastructure, and limited studies on low-emission public transport systems present significant challenges. It is imperative that key challenges like high costs of emerging mobility technologies, the need for integrated multimodal transport, and the growing demand for non-motorized options like cycling needs to be addressed. Whereas, the industrial sector faces barriers such as high costs and limited access to advanced low-carbon technologies, with insufficient R&D in Carbon Capture and Storage (CCS) and cleaner production processes.

Policy Level Initiatives and Strategies towards Net-Zero future

1. **Expanding Renewable Energy:** In line with Hon'ble Prime Minister's announcement at COP26, India has made remarkable strides in renewable energy, achieving over 200 GW of installed capacity.

The government's push for 500 GW of non-fossil fuel capacity by 2030 is a clear signal to global and domestic investors.

As on 31.12.2024, a total of 209.44 GW renewable energy capacity has been installed in the Country with the share of non-fossil fuel-based power generation capacity in the country at 47.1%.
The total avoided emissions from renewable energy sources in 2023-24 (up to December) amount to 135.61 million tons of CO2, with 57.47 MtCO2 from wind, 69.40 MtCO2 from solar, 2.09 MtCO2 from biomass, and 6.66 MtCO2 from small hydro.

2. Promoting Clean Energy: The Government has introduced several initiatives to promote green energy in urban areas. In February 2024, PM Surya Ghar- Muft Bijli Yojana was launched to transform the country's energy landscape through the harnessing of solar energy. Further, the Waste to Energy Programme in India seeks to support the establishment of waste-to-energy projects for the generation of biogas/bioCNG/power/producer or syngas from urban, industrial, and agricultural wastes/residues.
Initiatives such as the Production Linked Incentive (PLI) scheme for solar modules are pivotal. The Government of India is implementing the Production Linked Incentive (PLI) Scheme across the nation, with an allocation of ₹24,000 crores for High Efficiency Solar PV Modules.
Electrification of public **transport** along with advancements in energy efficiency, can significantly lower carbon footprints. To promote electrification of public transport, the Government has launched "PM-eBus Sewa Scheme" on 16th August 2023 with the aim to augment bus operations by deployment of electric buses on PPP model and development of associated infrastructure in urban areas with central assistance of ₹ 20,000 crore. As per census 2011, 169 cities falling in the range of 3 lakh to 40 lakh population size, are eligible to participate in this Scheme.
Small Modular Reactors (SMRs) can also play a critical role in India's decarbonization strategy due to their flexibility, scalability, and potential to address unique energy challenges. SMRs use nuclear fission to generate electricity without emitting greenhouse gases, making them a reliable alternative to coal-fired power plants. SMRs provide consistent power generation, complementing intermittent renewable energy sources like solar and wind.

3. Targeting Energy Efficiency and Conservation: Initiatives such as the Perform, Achieve, and Trade (PAT) scheme, which targets energy efficiency in selected 239 Thermal Power Stations, has led to energy savings of 7.72 million tonnes of oil equivalent and avoided emissions of about 28.74 million tonnes of CO2 till FY 2021-22.
The Indian government has established minimum share of consumption of non-fossil sources by designated consumers as energy or feedstock and different share of consumption for various types of non-fossil sources for different designated consumers in respect of electricity distribution license and other designated consumers, to be in effect till March 2030 under the Energy Conservation Act, 2001.

In 2024-25, 29.91% of total electricity is mandated to be purchased from renewable energy sources, increasing to 43.33% of total electricity from renewable energy sources till 2029-30.

4. Energy Storage: To support renewable energy growth, we need advanced battery storage to promote EVs and improve reliability. The government has introduced policies like the National Energy Storage Mission and schemes for modernizing power distribution to promote investment in these areas. Strengthening energy storage and grid infrastructure is key to ensuring India's energy security, reducing carbon emissions, and achieving its ambitious renewable energy targets.

5. Green Mobility: To promote sustainable mobility, the Indian government has approved a new Electric Vehicle (EV) Policy, offering a range of incentives to attract investments from global EV companies and position India as a prime manufacturing hub for state-of-the-art EVs. Additionally, the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme aims to reduce pollution and dependence on fossil fuels.

In a significant move to enhance urban bus services, the Indian government has approved the "PM-eBus Sewa" scheme. This initiative aims to deploy 10,000 electric buses across 169 cities through the PPP model. The scheme focuses on augmenting the number of buses and emphasizes the modernization of infrastructure in 181 cities under the Green Urban Mobility Initiatives.

6. Leveraging Technologies: Innovations such as green hydrogen and carbon capture, utilization, and storage (CCUS) can play a transformative role in cutting emissions from industries. Initiatives like Mission Innovation (MI) and the International Solar Alliance (ISA) highlight India's global leadership in clean energy. Mission Innovation 2.0 facilitates funding for clean energy innovations through Public-Private Partnerships, accelerating the pace of innovation.

The National Green Hydrogen Mission, launched in 2023, aims to establish India as the global hub for production, usage and export of Green Hydrogen and its derivatives. The National Green Hydrogen Mission was launched in 2023, with an investment of ₹19,744 crore, aims to make India a global hub for green hydrogen production. By 2030, we plan to produce 5 million metric tonnes of green hydrogen annually, reducing our dependence on fossil fuels. It is expected to reduce a cumulative ₹ 1 lakh crore worth of fossil fuel imports by 2030.

Industries like steel, cement, and transportation contribute significantly to emissions. Promoting green hydrogen, carbon capture, utilization, and storage (CCUS), and electrification of transport can achieve significant emission reductions. Collaboration between ministries and private stakeholders is essential for scaling these technologies.

7. Finance, Technology transfer & Capacity Building: India has consistently highlighted the need for enhanced international financial support for climate action, especially from developed countries under the CBDR principle.

At the 29th Conference of the Parties (COP29) held in Baku, Azerbaijan, India expressed strong dissatisfaction with the climate finance agreement reached by developed nations. The pact aimed to channel at least $300 billion annually by 2035 to assist developing countries in combating climate change.

However, India criticized this amount as insufficient and the approval process as hasty. India had advocated for a more ambitious climate finance goal, proposing $1.3 trillion in annual funding by 2035, with $600 billion coming from grants and grant-equivalent resources. The final agreement fell significantly short of these expectations.

Mobilizing climate finance through green bonds, international funds, and private investments will address financial constraints. The government's commitment to innovative financing instruments can attract global capital and encourage domestic investment.

While technology transfer is a critical component of climate change mitigation and adaptation that faces both demand and supply-side challenges. On the demand side, access to relevant, affordable, and scalable technologies is often limited due to high costs, lack of infrastructure, and regulatory barriers. On the supply side, Intellectual Property Rights (IPR) regimes can act as a barrier to technology transfer, restricting access to technologies, especially for developing countries like India.

Building technical expertise and raising awareness are crucial to achieving decarbonization goals. Government-led programs to train professionals, educate citizens, and foster innovation will strengthen India's decarbonization ecosystem.

Conclusion

India's decarbonization journey is as challenging as it is inspiring. It requires innovative thinking and collaborative efforts from all stakeholders. The government is committed to driving this transformation while balancing economic growth, social equity, and environmental stewardship. As we forge ahead, let us remember that the actions we take today will define the world we leave behind for future generations. Together, we can build a sustainable, resilient, and prosperous India.

Keynote Speaker

APPLICATION OF WASTE POLYMERS FOR ENERGY APPLICATIONS

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Polymers are good source of carbon and hydrogen. Most of the Polymeric materials like Polythene bags become the main cause of pollution. These materials are generally disposed in open after their use. However, some of these disposed polymers are now utilized in the different infrastructure projects. But with time it also starts degrading. Polymers used in buildings and road construction are some of the examples where they undergo into water system during rainy season. This not only causes environmental problem but are highly dangerous to our aquatic system. Moreover, they also contaminate the underground drinking water. Most importantly the life of living bodies under sea water have come to dangerous stage as they consume the polymeric containing items while searching for food in it. Indirectly its effect also come to human being when they consume sea food. Lot of work is going on to solve this problem. In order to utilise these waste polymers, we have developed a technique where these polymers are used for the development of a suitable product for energy generation. In this work the waste polymer is used as a source of carbon and hydrogen to develop many carbides in the nano size range. It is noted that noble metals like platinum, rhodium etc. are the good catalyst for water splitting to get hydrogen form water. However, these are very costly and cannot be used in industries. In order to replace Platinum, we require a low-price catalyst having similar electronic configuration as that of Platinum. This has opened an area to search a new class of material where it can provide better catalytic properties. Considering their electronic structure many carbides satisfy these criteria. This includes WC, Mo_2C etc. Moreover, these carbides can be used as basic source for achieving MAX phase. These MAX phases after etching with suitable reagents can be converted to MXene phases. In our laboratory we have worked on these Carbides. The current talk is focused on development of many carbides including Mo_2C as this has shown better catalytic property as compared to other carbides. The carbides have been developed in a closed chamber at high pressure using waste polymers and their catalytic properties have been studied. Here carbon from waste polymer gets deposited on the surface of oxide / ore and hydrogen produced helps to reduce and break the particle to Nano size. The talk will focus on synthesis of the carbides, MAX and MXene phases. The structural variation under different processing parameters will be discussed. The catalytic properties of these carbides have been compared with otherdeveloped products like MAX and MXene. All these results will be presented and discussed in this talk.

Keynote Speaker

URBAN, INDUSTRIAL AND RURAL AIR QUALITY IN INDIA: INADEQUACY OF DISPERSION PARAMETERS

I M Mishra,
Pt. G. B. Pant Chair Professor, and Dean, Saharanpur Campus, IIT Roorkee, Uttarakhand

Air quality in India is measured to assess the compliance of national air quality standards (NAAQS). Out of the 12 pollutants included in the NAAQS, 7 most prominent pollutants are included in the air quality index estimation. The standard for each pollutant is the value which should not exceed so as to protect the public health, vegetation and animals. For the general public, an index known as the air quality index (AQI) has been created which indicates quantitatively and qualitatively the combined value representing the effect of the pollutants on human health. Seven major air pollutants , viz. Particulate matter - PM(both PM 10 and PM 2.5), CO, SO_2, NO_2, CO, and lead are included in the calculation of the AQI.

For the prediction of the concentration of a particular pollutant, mathematical modelling is resorted to. Modeling for air pollutant dispersion requires the input parameters of the source strength of the pollutant (or the release rate), source elevation (ground surface or elevated position, meteorological parameters such as wind vector, temperature, vertical temperature gradient (lapse rate), mixing depth(or height), humidity , etc., terrain conditions, surface roughness, receptor coordinate, etc. For point sources, generally Gaussian distribution of pollutant concentration is assumed for steady state conditions. Concentration is found to be inversely proportional to wind velocity and is intrinsically related to pollutant spread in a complex manner. Pollutant spread in cross current horizontal and vertical directions is dependent on the atmospheric stability, as defined and calculated in terms of wind velocity, day time solar Insolation, and cloud condition during night time. Stability evaluation is generally subjective and is erroneous under calm conditions.

It must be noted that the validity and accuracy of modelling depends on the dispersion parameters which have been calculated and validated with the data obtained from Prairi grass experiments.

These parameters have not been tested with the data of Indian conditions. No wind tunnel experiments were run for Indian conditions. In the Indian peninsular region, except for the coastal region, atmosphere remains calm for a substantial period of the time, varying in different seasons of the year. Stability class for the first wind speed which is less than 2 m/s during day time is considered to be unstable while it is taken as stable during night time. The severity of instability and stability is a function of solar insolation during day time and cloud condition during night time. The values of sigma y and sigma z, signifying the deviation of spread from the mean are highly subjective under these conditions. If the wind speed anemometer threshold is near zero, in the range of say 0.1m/s to 1m/s, the pollutant concentration at the receptor point is found to be quite in accurate.

The present talk explains the salient features of pollutant transport and dispersion modeling and indicates the inadequacy of the dispersion parameters in the estimation of receptor point pollutant concentration under typical Indian conditions. The talk highlights the importance of conducting experiments and validating the values of dispersion parameters.

Keynote Speaker

SUSTAINABLE PRACTICES FOR ENVIRONMENTAL REMEDIATION

Adarsh Pal Vig
Punjab Pollution Control Board, India

Punjab, one of India's key agricultural states, is facing severe environmental pollution, threatening public health and sustainability. The main environmental concerns, along with possible solution for environmental remediation includes:

Air Pollution: Urban areas like Ludhiana, Amritsar, and Patiala experience significant air pollution, especially in winter due to high particulate matter (PM) and toxic gases. Efforts to improve air quality include adopting cleaner technologies, promoting electric vehicles, enforcing stricter regulations for industries and agriculture, and incentivizing green technologies. The Punjab Pollution Control Board (PPCB) plays a key role in monitoring air quality and raising public awareness.

Waste Management: With industrial growth and a rising population, Punjab struggles with solid waste management, including improper disposal, inadequate segregation, and overburdened landfills. The state is slowly improving waste management by enforcing the Waste Management Rules, focusing on better segregation, recycling, and waste-to-energy solutions. Hazardous waste from industries such as textile dyeing and chemicals also requires effective disposal methods, which PPCB is addressing.

Water and Wastewater Management: Punjab's agriculture-centric economy leads to significant water concerns, such as groundwater depletion and pollution from industries and untreated sewage. The PPCB is working on conserving water resources through rainwater harvesting, recycling wastewater, and enforcing stricter regulations on industrial water use.

Energy Management: The state's energy needs are largely met by coal-based power plants, contributing to high carbon emissions. To address this, Punjab is developing solar energy projects and promoting energy efficiency through initiatives like LED lighting and energy-efficient appliances, in line with national renewable energy targets.

Sustainability and Circular Economy: Life Cycle Assessment (LCA) is being applied to assess environmental impacts in industrial and agricultural sectors, encouraging sustainable practices. The circular economy model, focused on reducing, reusing, and recycling resources, is also gaining traction to tackle growing waste issues. PPCB promotes Mission Life activities which encourages sustainable living, aligning with India's deep-rooted culture of recycling, where waste reduction and resource reuse have always been part of traditional practices.

Legislation and Public Policy: Punjab has enacted various environmental policies, complementing national laws like the Environment Protection Act. The PPCB enforces regulations on air and water quality, waste management, and industrial pollution, aiming for a sustainable future.

In conclusion, Punjab is addressing its environmental challenges through technological innovation, regulatory frameworks, and public awareness. These efforts, along with clean air strategies, effective waste management, water conservation, renewable energy initiatives, and circular economy practices, are guiding the state towards a cleaner and more sustainable future.

By reducing waste, reusing resources, and recycling materials, we can create a sustainable future for generations to come.

Invited Speaker

SOLAR PHOTOCATALYTIC PURIFICATION OF PESTICIDE POLLUTED WATER USING ECOFRIENDLY SUPPORT MATERIALS

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Pesticide pollution of water resources is a critical issue, posing a threat to both aquatic ecosystems and human health by disrupting the biodiversity and contaminating drinking water sources. It is important to address this issue for environmental sustainability and the well-being of future generations. Advanced Oxidation Processes, particularly solar photocatalysis, has emerged as a promising method for reclaiming contaminated water. Slurry-based photocatalytic systems have been widely studied but the challenges in catalyst recovery limits their commercial viability. To overcome these challenges, immobilization of catalyst on an inexpensive, easily available, inert, environmentally safe, and nontoxic solid support like clay has been extensively explored. Industrial waste derived support materials offer a sustainable and effective strategy for not only mitigating environmental contamination but also promote the utilization of industrial waste materials, contributing to broader environmental sustainability goals. Herein, industrial waste materials such as foundry sand, red Mud and blast sand have been incorporated into clay and molded into spherical beads. The photoactivity of these beads immobilized with TiO_2 and doped TiO_2 was tested under solar irradiation for the degradation of Paraquat, a class II- moderately hazardous-herbicide associated with Parkinson's disease. The beads exhibit dual activity due to the simultaneous occurrence of photocatalysis and the photo-Fenton process. The presence of an iron source in the beads supports the leaching of iron into the solution, facilitating the photo-Fenton process. The entire process becomes economical as well as environmentally considerate working with the utilization of freely available sunlight as the energy source. Tto facilitate the real-time application, a fixed bed recirculation type continuous reactor was also designed for treating a high volume of pollutants.

Invited Speaker

STATUS AND DISTRIBUTION OF NEW EMERGING ORGANIC CHEMICALS IN FOUR DIFFERENT ENVIRONMENTS, INDIA

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New Emerging Organic Pollutants ubiquitously distributed in hydrosphere, lithosphere, biosphere and atmosphere of the environment, have paid more attention in present day due to industrialization and urbanization activities leading to Air Pollution and causing Climate Change. Huge emissions of these pollutants into the environment often leads to the direct exposure to all components of the environment, especially human populations in urban areas where the humans and pollutants are in close contact. New Emerging organic Chemicals also called Persistent Organic Pollutants POPs ("Dirty Dozens") are long range transport, bio-accumulated and bio-magnified in living organisms including human beings. They are liberated from cosmetics, food-packaging materials, clothing, household products, fire-fighting foams, Dyes, pesticides, plastics, polymers, synthetic industries, personal care products, municipal, hazardous, medical waste incineration, paper pulp, textile industries. It is first of its kind in India that Organic Chemicals Polyfloro Alkyle Substances (PFAS) in human hairs, road dust collected from different cities, as well as Bisphenols in various rivers, wastewaters in India compared with the status in China, Korea and Japan and atmospheric organic gaseous pollutants from Industrial, Urban heat Islands and Rural areas of Ahmedabad and Surat cities will be discussed.

Invited Speaker

INDUSTRIAL WATER SUSTAINABILITY: POLICIES AND STRATEGIES FOR REUSE & RECYCLING OF TREATED WASTEWATER

Raj Kishore Singh
Central Pollution Control Board, Delhi, India

The Charter, a voluntary programme implemented in five major industrial sectors; Pulp & Paper, Sugar, Distillery, Textile, and Tannery for adoption of cleaner technology, waste minimization practises, upgradation of ETP, water conservation through re-use/recycle. These industrial sectors contribute about 70% to total effluent discharge and 88% to total pollution load in Ganga basin. These industries were encouraged to implement water conservation strategies, including the recycling of treated effluent and the installation of advanced treatment technologies. These initiatives led to significant reductions in effluent discharge and Biological Oxygen Demand (BOD), with effluent discharge decreasing by 28.6% from 349 MLD in 2017 to 249.31 MLD in 2023, and BOD load reducing by 47.2%. Over this period, the compliance rate of GPIs improved from 39% in 2017 to 82% in 2023, reflecting the positive impact of wastewater recycling initiatives. Furthermore, industry-specific charters promoted the reuse of treated water, resulting in substantial groundwater savings of 719.6 MLD, along with energy conservation of 1277 MW and a reduction in the carbon footprint by 1162.6 tons CO_2e annually. The study also highlights the importance of regulatory measures, such as self-monitoring, third-party assessments to ensure effective implementation of wastewater reuse practices and implementation of cleaner technology to further enhance the reuse and recycling of wastewater, contributing to sustainable water management.

Invited Speaker

PRETREATMENT APPROACHES FOR LIGNO-CELLULOSIC COMPOUNDS- A CRITICAL STEP IN BIOETHANOL PRODUCTION

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Lignocellulose biomass is an abundant cellulose rich structural component of all plant matter thus a potential source of fermentable sugars for bioethanol production. However, biomass recalcitrance due to lignocellulosic complexes hinders enzymatic hydrolysis of cellulose. Hence, pre-treatment is essential for altering the structure of lignocellulosic biomass in order to enhance enzymatic digestibility and achieve efficient bioethanol conversion. Various pre-treatment techniques have been developed during last decades which increase cellulose accessibility by modifying chemical compositions or cell wall structures. Among chemical treatment protocols, dilute or concentrated acid hydrolysis (H_2SO_4, HCl, HNO_3, TFA and H_3PO_4) is the most common method at the moment. However, it is often accompanied with environmental hazards, no solvent recovery and production of furfurals that affect fermentation process. Organosolv pre-treatment is a promising green technology that relies on the solvent penetration in the pores of biomass polymer leading to lignin solubility thus promoting physical deconstruction of the lignocellulose structure. Compared with other pre-treatments, organosolv pre-treatment has inherent advantages, which include (1) possibility of utilizing the high-quality lignin isolated from organosolv pre-treatment in the synthesis of several co-products, (2) easy recovery of organic solvents by distillation, leading to their recycling and hence low capital investment and (3) almost pure form of recoverable lignin. In our studies, the relative efficacies of single organosolv acid pre-treatments, consisting of acetic and propionic acids, H_2O_2 for delignification,of corn lignocellulose have been optimized with H_2O_2 as the best option. The biological pretreatment of Lignocellulosic biomass using ligninolytic enzyme cocktail, obtained from an insitu consortium culture of *Pleurotus ostreatus* and *Phanerochaete chrysosporium* under solid state fermentation conditions resulted in about 80% delignification, along with good cellulose and hemicellulose recoveries.

Invited Speaker

DATA VISUALIZATION FOR SETTING INPUT VARIABLE RANGE FOR SMART EXPERIMENTAL DESIGN: A CASE STUDY OF DYE TREATMENT USING ADVANCED OXIDATION PROCESS (AOP)

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Data visualization plays a pivotal role in smart experimental design by enabling researchers to set optimal input variable ranges efficiently. By leveraging graphical tools such as 3D scatter plots, heatmaps, bubble charts and convex hull plots, complex datasets can be intuitively analysed to identify trends, correlations, and boundaries. Visualizing input variables helps in understanding their interactions and constraints, ensuring that experiments are designed within feasible and impactful ranges. This approach minimizes trial-and-error, reduces resource waste, and enhances the precision of experimental outcomes. Ultimately, data visualization empowers researchers to make informed decisions, fostering innovation and efficiency in scientific and industrial experimentation. The study is innovative in terms of grouping of two dozen dyes by binding categorical variables (electrode type) in colour code and third variable represented by size of the circle through a visual distribution of data. In the last, multi-dimensional plots using convex hull graph showing the effect of current density on colour removal efficiency along the size of the circle representing current density and colour of the circle representing electrode type with reference on a single graph is an efficient way to propose the best operating conditions for advances oxidation process (AOP) treatment.

Invited Speaker

EXPLORATION OF BIOPOLYMER MATERIALS AS A NEW AGE SUSTAINABLE TOOL FOR ENVIRONMENTAL SENSING AND REMEDIATION

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Environmental sensing and remediation technologies based on biodegradable natural polymers offer an efficient greener platform for monitoring and treatment of wastewater / industrial effluent. Recently, a paradigm shifted towards the development of sustainable approach in finding solutions, led to the diverse essential applications of biopolymers in wastewater treatment, biotechnology, and medicine industries because of their outstanding structure divergence, rheological features, and biodegradability. Natural polymers, the abundantly available macromolecules in nature, are extensively explored in the field of cosmetics, pharmaceutical industries and wastewater treat mentas a green and safe material for cleanup of environmental matrices and reduction in environmental pollution. Natural polymers exhibit weak mechanical properties which led to the formation of frail materials in comparison to synthetic polymers. The superiority of maneuvering the natural polymers over their synthetic counter parts lies in their potential to mimic the chemistry prevalent in nature, thereby acquired the innate non-toxicity, biocompatibility, biodegradability, and bio adhesivity. Among the natural biodegradable materials, chitin and chitosan are the second most abundant biopolymers after cellulose on earth and have emerged as functional biomaterials of high potential in various applications including water treatment. The characteristics properties of chitosan which are responsible for its prominent practical applications are low toxicity, biodegradability, high biocompatibility and existence in cationic form over a wide range of physiological pH. The incorporation of inorganic materials such as metal/metal oxide particles, zeolites and silica systems in the polymer matrix resulted in improvement in material properties along with enhancement in permeability and selectivity. In the present talk, discussion will be on biopolymer chitosan-based material- viz semi- interpenetrating networks, grafted, hybrid and modified materials for their potential applications for sensing of environmental pollutants as well as removal of organic/inorganic pollutants from aqueous solutions/ industrial effluents.

Invited Speaker

ADVANCED POROUS MATERIALS FOR ENVIRONMENTAL APPLICATIONS

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Exposure to commonpollutantsis a major concern throughout the world due to their potential impacts on human health and the environment. Recently, advanced porous materials (APMs). With intrinsically tunable chemical structure and multifunctional properties have attracted great interest with respect to the capture of diverse hazardous pollutants. In fact, afforded significant enhancements in adsorption capacities, catalytic degradation, and removal of diverse airborne pollutants and other vapors make them excellent choice for real world applications. A diverse range of APMs was investigated for separation, capture, and storage of greenhouse gases and other pollutants (including volatile organic compounds (VOCs), sulfur compounds, and chemical warfare agents (CWAs)). Finally, this talk described the future prospects for the research and development in materials for environmental applications based on porous material technology.As such, we hope to provide future directions such that APMscan make a bright contribution to air quality control.

Invited Speaker

WATER SCARCITY AND QUALITY: CHALLENGES AND OPPORTUNITIES

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Freshwater resources are limited, with only 2.5% of the Earth's water being freshwater and less than 1% available for human consumption. Two major problems that humanity faces in the current era are water contamination and energy shortages. Regarding water, major problems are related to water quantity and quality. Rapid urbanization and industrialization have further contributed to deteriorating water quality. Further, poorly treated wastewater is becoming one of the major environmental issues worldwide. Addressing these challenges requires an interdisciplinary approach integrating advanced water treatment technologies, innovative resource management strategies, robust policy frameworks and public awareness. Efficient household water consumption and conservation strategies, such as rainwater harvesting and reducing wastage, play a crucial role in mitigating water stress. This presentation explores the root causes of water scarcity, quality and degradation, highlighting innovative technologies and conservation practices and opportunities to ensure sustainable water security and management.

Delegates Abstract

Clean Air

DRONE-BASED MONITORING OF PARTICULATE MATTER IN POLLUTION HOTSPOT OF THE NATIONAL CAPITAL REGION

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Conventional methods of pollutant monitoring employ stationary sensing elements placed at fixed locations and fixed altitudes. However, pollution is a dynamic phenomenon since the concentration profile of the pollutants changes continuously in both vertical and horizontal directions. An accurate assessment of the variation of pollutants is essential to understand their concentration build-up over time. This paper reports a novel endeavor where drone based monitoring of PM 10 and PM 2.5 was carried out in a pollution hotspot of the National Capital Region (NCR) of Delhi. The drone, mounted with low cost optical sensors was flown in autonomous mode at varying heights and spatio-temporal changes in the concentration profile were studied for a period of forty-six days. The abovementioned study was carried out during a period of intense pollution which typically occurs every year at the onset of winter. Statistical analysis of the obtained data reveals a significant stratification of PM 10 at different heights, with an evident build-up of the pollutant at a height of 40m-50m. PM 2.5 concentration build-up, however, was found to be less stratified. It is hypothesized, based on the obtained monitoring results, that the stratification of PM 10 at an altitude higher than ground level contributes significantly to the worsening AQI in Delhi NCR.

ABSTRACT ID - NCSPER/0051

ASSESSMENT OF PARTICULATE MATTER VARIATIONS ACROSS DIVERSE MICRO-ENVIRONMENTS IN THAR REGION OF RAJASTHAN: INSIGHTS FROM RESIDENTIAL AND EDUCATIONAL SPACES

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The study evaluates particulate matter (PM) concentrations in various micro-environments of the arid region of Rajasthan, focusing on PM1.0, PM2.5, and PM10 levels to understand their variability and potential health impacts. Measurements were conducted using a low-cost air quality sensor in residential and educational, including hostel rooms, classrooms, office spaces, school compounds, libraries at IIT Jodhpur, and kitchens in Ghadav Village, where biomass burning is prevalent. The results reveal significant variations in PM levels across locations and environments. In classroom of first-grade students, PM10 levels reached 132 µg/m³ due to increased physical activity, while in smaller classrooms, the levels were lower at 74 µg/m³. Outdoor areas like school premises near NH-62 exhibited higher PM10 levels, peaking at 150 µg/m³, indicating the influence of outdoor activity on air quality. Residential kitchens using biomass fuels showed alarming PM2.5 levels, averaging 66.4 µg/m³, exceeding the 24-hour NAAQ standard. This exposure is linked to health issues, with 36% of individuals reporting coughing, 28% headaches, 14.6% from asthma, and 21.4% from eye irritation. These findings highlight the need for targeted biological and chemical interventions to mitigate PM concentrations in arid regions significantly. Enhanced air quality management, cleaner cooking, and awareness campaigns are essential in reducing PM-related health risks.

ABSTRACT ID - NCSPER/0061

BIOAEROSOL PRESENCE IN PM_{10} AND $PM_{2\cdot5}$: A SEASONAL STUDY ALONG A GUJARAT STATE HIGHWAY

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Bioaerosols, an emerging class of airborne pollutants of biological origin, pose significant environmental and public health concerns due to their potential impact on air quality and respiratory health. This study investigates the presence of bioaerosols in resuspended PM_{10} and $PM_{2\cdot5}$ dust near a state highway connecting Rajkot and Morbi in Gujarat. A total of 16 samples for each particulate matter fraction were collected using a fine dust sampler across three seasons: Pre-Winter (October 2023), Winter (November–December 2023), and Post-Winter (January 2024). Temporal and seasonal variations in pollutant concentrations were analyzed using the Air Quality Index (AQI) to determine responsible pollutants. Microbial characterization involved colony count analysis, Gram staining, and fungal screening. The highest colony count was observed during winter, likely due to increased moisture and favorable meteorological conditions. Additionally, fungal presence was detected in select samples during Pre-Winter and Winter. These findings highlight the seasonal influence on bioaerosol composition and underscore the potential health risks for individuals residing or working near highways. Continued research on bioaerosol characterization can provide critical insights into their health implications and contribute to the development of effective air pollution monitoring and management strategies.

ABSTRACT ID - NCSPER/0065

INTEGRATING PHOTOCATALYSIS INTO SUSTAINABLE CONSTRUCTION MATERIALS MADE FROM INDUSTRIAL WASTES FOR VOC ABATEMENT

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In present study, a photo-catalytically active construction material derived from industrial waste products has been manufactured. Major advantage of using industrial waste products is to minimize environmental pollution due to their disposal in landfills. Fly ash and blast furnace slag were used among waste materials in addition to normal cement sand mixture to promote sustainability and circular economy in construction. The new mix design optimized not only enhanced civil properties of construction material but also enhanced optical activities of photocatalyst employed in the experiment. The study experiments were performed to reveal the effectiveness of this material in degrading hazardous pollutants, such as benzene and toluene— model VOCs used for experimental trials. The efficacy of the material is determined by its capacity to decompose these contaminants into less harmful substances during its reaction time. A static bioreactor is designed to test photocatalysis for the degradation of various concentrations of these pollutants over time, illuminated with visible light. The conditions like light intensity, humidity and flow rate are optimized inside reactor for better degradation results. The Langmuir–Hinshelwood kinetic model applied to experimental findings to find degradation rate. The degradation rate appeared high for initial low concentration of VOCs while it decreases with increased sample concentration. These findings thus indicated the potential of this study for reducing harmful VOCs from air and provide safe and clean environment.

ABSTRACT ID - NCSPER/0079

TOWARD A ROLE IN GA-SVM EFFECT-BASED AIR QUALITY CONTROL PREDICTION

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Nowadays, air pollution is currently one of the largest hazards to the environment and public health. It has a negative impact on human health, climate, and the ecological system. For monitoring air pollution, several techniques have been introduced and refined over a period of time. Additionally, existing forecasting models have been used to estimate the concentration of polluting gases in the IIoT. Therefore, to overcome the aforementioned issues, in this study, we analyze the air quality index dataset that is powered by a multimodal device and apply a nature-inspired algorithm utilizing the SVM technique, called GASVM. In addition to that, our prediction study aims to monitor air pollution quality and steps to mitigate its effects. Firstly, we pre-processed the used dataset to normalize it, and then we applied GA to find the best number of attributes that contribute to measuring the different air quality gases. After that, we constructed a model based on SVM for measuring the concentration of different gases. An air quality multimodal device with five metal oxide chemical sensors has generated multiple examples of hourly averaged data for the collection. It was located on the field, at road level, in a particularly dirty part of the city. The UCI machine learning repository makes the examined dataset openly accessible. Our experiment showed that GASVM outperforms other nature-inspired approaches and traditional machine learning techniques.

ABSTRACT ID - NCSPER/0085

DATA-DRIVEN ENGINE DIAGNOSTICS: CLASSIFYING BIKE ENGINES VIA EXHAUST EMISSIONS

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An inventive method of tracking engine performance, identifying issues, and enforcing environmental regulations is provided by the classification of motorcycle engines based on the examination of exhaust smoke. Using the chemical and particle makeup of exhaust smoke as input data, this study investigates the use of machine learning algorithms to reliably categorize various bike engine types. Under carefully monitored circumstances, smoke samples were taken from a variety of motorcycle engines and examined for important chemicals such as particulate matter (PM), nitrogen oxides (NO_x), hydrocarbons (HC), and carbon monoxide (CO). To enhance the dataset's quality, preprocessing methods such as feature scaling and noise reduction were used. To create classification models, a number of machine learning techniques were used, including Decision Trees, Support Vector Machines (SVM), K-Nearest Neighbours (KNN), Multi-layer Perceptron (MLP), and Neural Networks. The models were assessed using F1-score, recall, accuracy, and precision. Findings showed that Decision Tree performed better than previous models, obtaining high classification accuracy in differentiating between different bike engines, four-stroke and five-stroke engines, etc.

ABSTRACT ID - NCSPER/0086

AIR QUALITY MONITORING BY ACETONE SENSING USING CHROMIUM-DOPED ZNO THIN

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This study investigates the potential of chromium (Cr)-doped zinc oxide (ZnO) thin films as acetone gas sensors for air quality monitoring. ZnO thin films were synthesized with varying Cr doping concentrations (1%, 3%, and 5%) using the sol-gel method and deposited via spin coating. The structural, morphological, and optical properties were characterized using X-ray diffraction (XRD) and and UV-Vis spectroscopy. Gas sensing performance was analyzed for acetone, a volatile organic compound (VOC) that significantly affects indoor and outdoor air quality, at different operating temperatures. Results indicate that 3% Cr-doped ZnO exhibited the highest sensitivity, selectivity, and rapid response-recovery time, demonstrating its potential for effective acetone detection in air quality monitoring applications.

ABSTRACT ID - NCSPER/0078

A COMPREHENSIVE ASSESSMENT OF AIR POLLUTION AND ENVIRONMENTAL IMPACTS OF STEEL MANUFACTURING: INSIGHTS FROM EIA

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India, as the world's second-largest steel producer, heavily depends on its steel industry for economic and infrastructural growth. However, air pollution remains the most critical environmental challenge associated with steel manufacturing units. This study evaluates the air quality impacts of a steel production unit using insights from the Environmental Impact Assessment (EIA) report. The primary concern is the emission of particulate matter (PM) and gaseous pollutants such as sulfur oxides (SO_x) and nitrogen oxides (NO_x), which contributes to ambient air pollution, smog formation, and respiratory hazards. To quantify the dispersion of pollutants and assess their environmental impact, air pollution modelling was conducted using AERMOD software. The study includes major emission sources during project operation such as capacity, duct height and diameter, flue gas temperature, gas exit velocity and emission rates of PM, SOx and NOx. Additionally, the construction of wind barriers and regular air quality monitoring ensure the compliance with environmental standards. Findings suggest that integrating cleaner production technologies, such as low-emission combustion systems and alternative fuels, can significantly reduce air pollution in steel manufacturing. This research provides crucial insights for policymakers and industry leaders, advocating for stringent air quality regulations and the adoption of sustainable steel production practices.

ABSTRACT ID - NCSPER/0095

Solid and Hazardous Waste Management

IMPACT ON E-WASTE GENERATION DUE TO INCREASING POPULARITY OF E-VEHICLES: A REVIEW

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As the world is struggling to curb with the vehicular pollution, Electric vehicles are gaining popularity and the governments across the globe are making policies to promote electric vehicles. Undoubtedly E-vehicle will be a boon to control the increasing pollution but this raises a concern of end-of-life Vehicles (ELVs), where management of ELVs sector is a matter of great concern. With the advancement in the technologies the motorized vehicles are being equipped with modern features, encouraging the use electronic components like semi-conductors, ionic and polymer batteries, etc. Therefore, after end-of-life, the safe and sustainable disposal is becoming a huge task for the environment monitoring agencies. Electronic waste is becoming a major environmental issue for the most of the developed countries due to lack of policies, infrastructure, and guidelines. Most affluent countries have found a non-sustainable way of exporting their waste to developing countries in a bid for more cost-effective alternative to treating it. In this review e-waste generation, management, and disposal from the scrapped vehicle, environmental concerns, regulations, and a way sustainable forward have been discussed.

ABSTRACT ID - NCSPER/0021

MANAGEMENT OF WASTE PV SOLAR PANEL WITH RECOURSE TO RECYCLING AND RECOVERY OF VALUABLE MATERIAL

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The explosive growth of the human population and its need for energy has put tremendous strain on existing non-renewable natural resources. To mitigate the adversities of non-renewable energy production, Governments have taken many initiatives to increase the renewable energy production options, of which Solar Photovoltaic (PV) installation is the major one. At present, India's solar power generation is 94.17 GW (MNRE, Nov. 30, 2024). However, the indiscriminate use and installation of PV solar panel may result in serious environmental challenges including its End- of-Life management issues, as it is bulky and voluminous, and also contains hazardous materials such as Pb, Hg, Cr, etc. therefore need to be disposed of scientifically. Further, the valuable metals such as Ag, Si, Cu, Al etc. need to be recovered from it and reuse to meet the future demand. The Encapsulant polymer sheet, mostly Ethylene Vinyl Acetate (EVA) present in it, is the main concern for its disposal, and also for recovering valuable metals from the EOI solar PV panels. The various thermal as well as chemical processing using various Organic solvents are studied. Further, characterization studies and solubility studies using different solvents for separations are carried out to understand the behavior of the encapsulant EVA with solvents for recovering valuable metals.

ABSTRACT ID - NCSPER/0015

INTEGRATED WASTE AND SANITATION MANAGEMENT FOR CLIMATE-RESILIENT URBAN DEVELOPMENT IN THE NARMADA RIVER BASIN

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Rapid urbanization in the Narmada Basin and climate change have intensified waste management and equitable sanitation challenges. This study assesses the generation and management of solid, plastic, hazardous, biomedical, electronic, and construction & demolition (C&D) waste alongside sanitation infrastructure such as tap connections and household toilets across urban local bodies (ULBs). Using a mixed-methods approach, primary data from surveys and interviews, combined with secondary municipal and climate records, reveal critical gaps in waste segregation, recycling, and disposal and inequities in sanitation access, particularly in underserved areas. Spatial GIS analyses highlight waste hotspots and sanitation vulnerabilities, while waste audits and infrastructure assessments classify waste streams and evaluate sanitation coverage. Systems dynamics modeling underscores the interconnectedness of waste and sanitation systems, showing that improved sanitation infrastructure can reduce untreated waste, and effective waste management can mitigate pollution linked to inadequate practices. The study proposes climate-resilient solutions to address these challenges, including decentralized waste treatment, sustainable sanitation expansion, community-driven initiatives, and circular economy principles. These strategies aim to build urban resilience by reducing environmental pressures, enhancing public health, mitigating climate impacts, and paving the way for sustainable, cleaner cities in the Narmada Basin.

ABSTRACT ID - NCSPER/0019

FERMENTATIVE PROCESSING OF NON TABLE PURPOSE KINNOW FOR PRODUCING DEBITTERED WINE

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Kinnow, a mandarin hybrid of *Citrus nobilis* and *Citrus deliciosa*, is produced extensively in Punjab. Due to its perishable nature, Kinnow suffers considerable harvest and post-harvest losses, estimated at 25–30%, necessitating processing. However, it is accompanied with juice bittering due to limonin and naringenin which thus acts as a hurdle for processing. The fermentation of Kinnow using specialized yeasts is an important means to limit juice bittering. In the present study, non table purpose Kinnow fruit was utilized for wine production as part of an integrated waste-to-energy approach. The wine produced was analysed for physicochemical properties such as pH, Titrable Acidity (TA), ethanol content, Total Soluble Solids (TSS) and limonin content. This study utilized Response Surface Methodology (RSM) to optimize Kinnow juice fermentation by varying the initial sugar concentration (15–20°Bx) with cane sugar and adjusting the inoculum size (10^7–10^9 CFU/mL) of debittering yeast, *Meyerozyma caribbica*. The RSM optimized fermentation conditions of 17.5°Bx sugar concentration and 10^8 CFU/mL inoculum size yielded a wine with 10.4% (v/v) ethanol, 1.08 g/L (TA), 3.29 (pH), 0°Bx residual sugars, and 5.9 ppm limonin content. This research integrates winemaking with sustainable waste management thus presenting a novel, eco-friendly solution for Punjab's agro-industrial sector.

ABSTRACT ID - NCSPER/0075

E-WASTE MANAGEMENT SCENARIO IN INDIA: RECENT PERSPECTIVES AND CHALLENGES

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Electronic waste (E-waste) is an emerging issues impacting both industrialized and developing countries. The rapid industrialization of E-commerce products and their usage by the common public leads to increase the E- waste. It is made up of numerous electronic components, some of which composed by hazardous elements that could be unsafe to human habitat, health and ecological system. India produced around 400 thousand tons of E-waste in year 2010, and that number could rise to 500 to 600 thousand tons by 2013–2014. In 2019, around 53600 thousand metric tons of E-waste were produced, only 17.4% of which were adequately collected and recycled, with the remaining 82.6% had not been accounted. Lack of proper facilities, machinery, and recycling procedures has had a major influence on India's e-waste management system. E-waste is often produced by two ways i.e. dumping of other countries' E-waste and the disposal of its own. The environments as well as decision-makers are faced with a new dilemma as more of these wastes are moving into landfills and recycling facilities.
Electronic waste is an indirect and unfathomable waste that harms people, animals, and the environment by contaminating resources including air, soil, and water. Long-term E-waste accumulation and pollution could negatively impact the environmental resources. India and China consume the most electronic devices and recently increasing policies for use of E. vehicles, also the main producers of waste of electrical and electronic equipment. As a result, the main focus of the current review article is a thorough explanation of E-waste managing system of India, including the environmental concerns, recycling process, its implications and future possibilities for sustainable solutions.

ABSTRACT ID - NCSPER/0022

REMEDIATION OF MICROPLASTIC USING BIOCHAR: A MINI REVIEW

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Microplastic contamination in aquatic and terrestrial ecosystems poses a significant global challenge due to their small size and resistance to degradation. Conventional remediation techniques often fail to remove microplastics effectively. This review explores the potential of biochar, a carbon-rich material derived from biomass pyrolysis, as an innovative solution to mitigate microplastic pollution. Biochar's high surface area, porosity, and active functional groups make it suitable for adsorbing microplastic particles from water and soils. The review examines mechanisms through which biochar immobilizes microplastics via adsorption and functional group interactions. It also investigates the impact of biochar modification, such as magnetization, on enhancing its removal efficiency and simplifying recovery post-treatment. Key findings from studies on batch adsorption, sorption kinetics, and external factor influences are discussed. Results indicate that biochar is a promising, low-cost, and environmentally friendly complementary treatment to conventional methods. Moreover, it aligns with circular economy principles by utilizing waste biomass for production, offering dual benefits: reducing microplastic contamination and promoting sustainable practices. This review highlights biochar's scalability and non-toxic attributes as a potential tool for microplastic remediation, emphasizing the need for further research to optimize its application across diverse environmental contexts.

ABSTRACT ID - NCSPER/0038

HARNESSING INDIGENOUS HYDROCARBONOCLASTIC BACTERIA FOR SUSTAINABLE IN-SITU BIOREMEDIATION OF PETROLEUM-CONTAMINATED SOILS: ISOLATION, CHARACTERIZATION, AND OPTIMIZATION STUDIES

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Petroleum and its products continue to serve as a principal source of energy for industries and daily life. However, their release into the environment is a worldwide concern due to their toxic, mutagenic, teratogenic and carcinogenic properties. Among disposal methods, bioremediation stands out as an environmentally friendly and cost-effective approach that uses microbes to degrade hydrocarbons into innocuous compounds. In this study, hydrocarbon-degrading bacteria were isolated and characterized from oil-polluted soils in Vijayawada, Andhra Pradesh, using Bushnell-Haas media supplemented with used engine oil. Characterization involved Gram's staining, potassium hydroxide, catalase and carbohydrate fermentation tests. Molecular identification was performed via PCR amplification and sequencing of 16S rDNA gene, with sequence compared to GenBank database. Optimization of culture conditions for three efficient degraders was performed using diesel oil with cellular growth monitored through biomass determination. GC-MS analysis confirmed significant diesel oil degradation, with optimal results at less than 1 % substrate concentration, pH 7, 37 °C and yeast extract as a nitrogen source. These bacterial isolates have potential for biotechnological applications in the cleanup of petroleum contaminants.

ABSTRACT ID - NCSPER/0030

A DETAILED INSIGHT INTO THE KINETICS FOR A BETTER UNDERSTANDING OF SOY-STRAW BIOMETHANATION

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Lignocellulosic biomass valorization has been subject to pretreatment techniques for biomethanation enhancements, considering the associated problems with natural degradation. Soybean, one of the key oil seeds, is the subject of open burning practices by the farmers in the rural areas of Madhya Pradesh. The prospects for biomethanation have been explored by some researchers, but a comprehensive analysis of the potential is yet to be explored. The study takes up the conventional pretreatment arc for lignocelluloses and explores conventional microbial process kinetics for thermal pretreatment compared to untreated counterparts. Biomethanation kinetics was simulated on 1L mesophilic batch reactors at ISR 1.5, 2 and 2.5 using the Modified Gompertz Model (MGM), Logistic Function (LF), First-Order Kinetics (FO), Cone Model (CM), and Chen and Hashimoto Model (CHM). Further, the study analyses the effects of hydraulic retention time (HRT), inoculum-to-substrate (ISR) ratio, and other operational parameters, such as volatile solids reduction, pH, and volatile fatty acid accumulation, on process efficiency. Even though a detailed microbiome study is required to understand the reactor bioprocess better, this study opens the scope for alternative options for straw pretreatment and enhanced biomethanation in the background of SDG 7.

ABSTRACT ID - NCSPER/0032

ENHANCED ETHANOL PRODUCTION FROM KITCHEN FOOD WASTE: ADDRESSING CHALLENGES THROUGH COMPREHENSIVE CHARACTERIZATION

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Food waste (FW) represents a significant global challenge with environmental, economic, and social implications. Simultaneously, the growing demand for sustainable energy sources has sparked interest in bioethanol as an alternative to fossil fuels. This study bridges these two concerns by investigating the potential of source-separated Indian household FW as a feedstock for bioethanol production through comprehensive characterization. Utilizing FW for bioethanol production offers a dual benefit: mitigating waste management issues while producing renewable energy. We employed drying and blending preprocessing techniques to address the inherent heterogeneity of FW, resulting in a homogeneous powder with a mean particle size of 407.67 µm. Physical analysis revealed 92.49% total solids, 2.83% ash, and 7.15% moisture content. Compositional analysis showed 59.12% carbohydrates, including 10.96% cellulose, 9.70% hemicellulose, and 40.5% starch, along with 10.56% protein, 17.32% fat, 2.69% crude fiber, and 5.05% lignin. The C/N ratio of 28.8 suggested favorable conditions for microbial growth during fermentation. Microstructural analysis and functional property evaluation demonstrated that preprocessing improved particle uniformity, increased surface area, and enhanced accessibility of fermentable components while also improving flowability and water absorption capacity. Autoclaving as a pretreatment method showed 6.79% (v/v) ethanol yield in production trials, demonstrating the effectiveness of this approach.

ABSTRACT ID - NCSPER/0026

UNLOCKING THE POTENTIAL OF MARIGOLD PETALS: A SUSTAINABLE APPROACH TO VALUE-ADDED PRODUCTS

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Marigold (Tagetes spp.) flowers hold significant cultural, ornamental, and medicinal value, yet their disposal as waste post-use contributes to environmental challenges. The petals of marigold flowers are a reservoir of bioactive compounds, including carotenoids, flavonoids, and phenolic acids, which offer immense potential for sustainable valorization. This review focuses on using marigold petals to develop high-value products across various domains, such as natural colorants, cosmetics, therapeutic formulations, biofertilizers, and eco-friendly packaging materials. The extraction and application of lutein, a nutritionally vital carotenoid, are emphasized for its expanding role in human health and animal feed industries. Furthermore, advancements in green extraction techniques, including enzymatic and ultrasonic methods, are explored to enhance the yield and purity of marigold-derived compounds. By integrating these approaches into circular economy models, the review underscores the transformative potential of marigold petal utilization to minimize waste, promote resource efficiency, and foster sustainable livelihoods. The article also identifies knowledge gaps and technological challenges, providing a roadmap for future research and industry adoption to unlock the full potential of this underutilized resource.

ABSTRACT ID - NCSPER/0049

BIOLOGICAL CONVERSION OF KERATIN RICH WASTE BY *ASPERGILLUS GORAKHPURENSIS* FOR INDUSTRIAL APPLICATIONS

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Chicken feathers, a keratin-rich byproduct of the poultry industry, pose a significant environmental challenge due to their complex, energy-intensive molecular structure and the increasing quantities generated on an industrial scale. Conventional disposal methods and physicochemical degradation are neither cost-effective nor environmentally sustainable. However, keratinolytic microorganisms offer a promising approach to the issue. Present study investigated the potentials of keratinase produced by *Aspergillus gorakhpurensis* in free and immobilized state via physical adsorption, entrapment, and covalent binding techniques. The enzymatic activity of both free and immobilized keratinase assessed against chicken feathers across a pH range of 3.5–9.5 and temperatures ranging from 25°C to 95°C, and the degradation assessment was further extended to other keratinous substrates such as pigeon feathers, hair, nails, hooves, horns, and egg albumin. Optimal enzyme activity was observed within a pH range of 6.5–9.5 and a temperature range of 45–65°C. Furthermore, the potential of free and immobilized keratinase (1235 U) in stain removal and dehairing applications were also evaluated. The enzyme efficiently removed the blood, ketchup, egg albumin, and chocolate stains after 30 minutes of incubation, both independently and in synergism with chemical detergents. Additionally, it facilitated the removal of hair from goat skin within two hours without compromising the surface integrity or grain structure, highlighting its potential as an eco-friendly alternative to conventional chemical treatments in the leather industry. Hence, the investigation revealed that the keratinase from *Aspergillus gorakhpurensis* exhibits significant potential for sustainable waste management, enzymatic stain removal in laundry applications, and environmentally benign dehairing processes in the leather industry.

ABSTRACT ID - NCSPER/0062

WOOD BRIQUETTES: A SUSTAINABLE SOLUTION FOR WASTE MANAGEMENT, AIR POLLUTION, AND ENERGY CHALLENGES IN DEVELOPING COUNTRIES LIKE INDIA

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Developing countries like India generate an immense amount of biomass waste annually, primarily from agricultural residues, dried leaves, and forest waste. Unfortunately, much of this waste is either left to decompose or is burned openly, contributing to severe air pollution and respiratory illnesses. In India, nearly 100 million citizens suffer from respiratory ailments, with air pollution contributing to conditions such as asthma and chronic obstructive pulmonary disease (COPD). Improper disposal of biomass waste also depletes soil quality and hinders agricultural productivity. Wood briquettes present a promising solution to these challenges. These compact briquettes, made from readily available wood residues, sawdust, and other forest waste, offer an eco-friendly and energy-efficient alternative to conventional fuels like charcoal, firewood, and coal. These briquettes reduce deforestation by decreasing reliance on firewood, help in proper waste management by converting wood waste into a valuable fuel source, and lower greenhouse gas emissions. This sustainable energy alternative aligns with global efforts to mitigate climate change and promotes carbon neutrality, a state where human activities do not contribute additional greenhouse gases to the atmosphere. However, large-scale adoption of wood briquettes requires optimization of production processes to improve efficiency, affordability, and accessibility. Investing in research, improving manufacturing, and promoting adoption can make wood briquettes a key solution for energy challenges, environmental impact, and sustainability.

ABSTRACT ID - NCSPER/0068

CAN MUSHROOMS CULTIVATED ON SELENIUM ENRICHED AGRI-RESIDUES ELICIT INCREASED ANTI-OXIDANT PROPERTIES AND SYNTHESIS OF BIO-ACTIVE COMPOUNDS?

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Selected varieties of edible mushrooms were cultivated on selenium (Se) rich post-harvest agricultural waste to examine their potential to mobilize selenium from the residues. The Se content and Se-induced anti-oxidant activity of the fruiting bodies were quantified using variety of techniques. Modulations in antioxidant properties of various varieties of edible mushrooms viz., Volvariella volacea, Agaricus bisporus, Pleurotus florida, P.sajor-kaju, P.djamor, P.citrinopileatus, P.ostreatus cultivated on selenium-rich paddy and wheat straw from the seleniferous belt of Punjab (India) were examined in comparison to the mushrooms cultivated on normal straw. Selenium (Se) uptake by Se-fortified mushrooms were significantly higher than control ($P<0.001$). The antioxidant activity as depicted by 2,2-diphenyl-1-picrylhydrazyl scavenging, metal chelation and lipid peroxidation inhibiting activity of extracts from Se-fortified mushrooms were significantly higher ($p<0.05$ to $p<0.001$) than control mushrooms. The increased anti-oxidant activity is attributed to be expressed as a function of Se hyperaccumulation of selenium by these species of mushrooms. Further, preliminary studies carried out on search of seleno-ergothioneine, an analog of ergothioneine commonly found in mushrooms, indicated generation of this molecule in Se rich mushrooms. Thus, the present study demonstrates the use of Se hyperaccumulated agricultural residues as substrates for producing Se-rich mushrooms as potential sources for Se supplementation/nutraceutical applications.

ABSTRACT ID - NCSPER/0013

SYNTHESIS OF FE_3O_4/CAO NANOMAGNETIC CATALYST FOR BIODIESEL PRODUCTION FROM WASTE VEGETABLE OIL: A SUSTAINABLE APPROACH TO CLEANER FUELS

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Biodiesel is a promising renewable fuel that produces lower emissions and is environmentally friendly. This research investigated the potential of a Fe_3O_4/CaO nanomagnetic catalyst synthesized from steel industry iron waste (Magnetite) by precipitation method and calcium oxide from Chicken Eggshell for the production of biodiesel from Waste Vegetable Oil (WVO). The catalyst morphology, crystallinity, surface area, porosity, calcination temperature and magnetization of the nano-magnetic catalyst were confirmed by using XRD, FTIR, FESEM/EDX and VSM and the maximum Biodiesel yield was achieved at 1.5% or 2.0 wt.% catalyst at a calcination temperature of 550oC and with the methanol-to-oil ratio of 6:1 or 9:1 at 60oC for 2 h. An external magnetic field achieved the separation of the catalyst from the Biodiesel. The biodiesel physicochemical parameters like acid value, iodine value, density and cloud point were also determined for the optimized fuels and found within a specified range in ASTM D6751 and EN 14214, where applicable. This study highlights the effectiveness of Fe_3O_4/CaO nanomagnetic catalysts for sustainable biodiesel production from waste feedstock, presenting a promising method for waste management and cleaner fuel alternatives.

ABSTRACT ID - NCSPER/0083

BIOHYTHANE PRODUCTION FROM WASTE: A SUSTAINABLE APPROACH TO CLEAN ENERGY

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Biohythane is a renewable energy fuel comprising biohydrogen and biomethane. Biohythane is produced through two successive biological processes: dark fermentation (DF) and anaerobic digestion (AD). After China, India has the highest Agricultural waste production in India. Agricultural wastes of high lignin and cellulose content undergo DF, which converts carbohydrates into biohydrogen and volatile fatty acids (VFAs). The VFAs produced during DF are used in AD by methanogens for biomethane generation. A number of pretreatment techniques, including thermal, chemical, and enzymatic hydrolysis, improve the digestibility of the substrate, resulting in higher biohythane yields. This review focuses on the various processes and substrates utilized for sustainable biohythane production and its application in sustainable energy systems. Biohythane, a sustainable energy alternative to conventional fuels, has lower greenhouse gas emissions, contributing to a low-carbon economy. Moreover, integrating biohythane into our existing infrastructure paves the way for the sustainable transition from conventional energy resources to cleaner energy.

ABSTRACT ID - NCSPER/0088

ECO-FRIENDLY SENSING: HARNESSING 3D PRINTING FOR SUSTAINABLE ENVIRONMENTAL SOLUTIONS

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3D printing has rapidly evolved as a groundbreaking technology for production of sensors, offering advantages such as customization, rapid prototyping, and the ability to create complex geometries. This technology has significant implications for environmental remediation, enabling the production of sensors with reduced material waste, the potential for using sustainable materials, and localized on-demand production. This paper explores the key 3D printing techniques used in sensor fabrication, highlights relevant applications in health monitoring, and focuses on the sustainability aspects of this approach. Additionally, it addresses the challenges and future directions in the sustainable implementation of 3D printing for sensor fabrication. By enabling the production of sensors with a lower environmental footprint and supporting applications that directly or indirectly benefit environmental health, 3D printing is poised to play a crucial role in advancing sustainable environmental remediation practices

ABSTRACT ID - NCSPER/0100

ANAEROBIC DIGESTION OF PIG DUNG: A BMP STUDY ON MONO-DIGESTION AND CO-DIGESTION WITH FOOD WASTE AND WATER HYACINTH

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Pig farming generates a substantial amount of dung, posing serious environmental challenges due to its high organic content and potential for greenhouse gas emissions. Effective waste management strategies are crucial to mitigate these impacts while harnessing the energy potential of pig dung. Among various treatment options, anaerobic digestion (AD) is recognized as a sustainable biological approach for converting organic waste into biogas, offering both waste reduction and renewable energy generation. This study focuses on a biochemical methane potential (BMP) assessment of pig dung under mono-digestion and co-digestion scenarios with food waste and water hyacinth. The mono-digestion experiment was conducted by optimizing total solids (TS) content, while the co-digestion trials were performed by varying the food-to-microorganism (F/M) ratio. Results indicated that for pig dung alone, the highest daily and cumulative methane yields of 287 mL and 3.34 L, respectively, were obtained at 9% TS. Co-digestion with food waste at an F/M ratio of 1.5 resulted in a maximum daily methane yield of 275 mL and a cumulative yield of 3.21 L. Meanwhile, the inclusion of water hyacinth led to enhanced methane production, with peak values of 305 mL and 3.42 L, respectively. These findings highlight the potential of co-digestion in improving biogas yields, demonstrating the viability of integrating pig dung with other organic substrates for enhanced anaerobic digestion performance.

ABSTRACT ID - NCSPER/0102

SUSTAINABLE MATERIALS FOR SLURRY SEAL AND MICRO-SURFACING: A REVIEW

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Sustainable pavement preservation techniques, such as slurry seal and micro surfacing, have gained attention for their environmental benefits and resource efficiency. Traditional materials contribute to environmental concerns like resource depletion, prompting research into industrial by-products as alternative fillers. Studies have explored the use of steel slag filler (SSF), waste glass powder (WGP), basalt, and chemically treated fibers to enhance slurry seal performance. SSF (75%) improved bitumen cohesion by 45%, reduced displacement by 50.8%, and enhanced abrasion resistance by 48.3%. WGP (75%) reduced displacement, increased cohesive energy by 43%, and lowered greenhouse gas emissions by 18%. Basalt filler (75–100%) achieved superior adhesion, reducing rutting and abrasion loss. Additionally, chemically treated cotton straw fibers improved micro surfacing durability, increasing shear resistance by 41.13% and reducing rut depth by 10.07%. The use of fly ash, slag, kiln dust, and marble dust as cement replacements further minimized environmental impact. Research confirms that these sustainable materials enhance pavement durability while reducing reliance on natural resources. This review highlights the potential of alternative materials in slurry seal applications, promoting cost-effective, eco-friendly infrastructure solutions that improve road performance and longevity

ABSTRACT ID - NCSPER/0103

INTEGRATING ALGAE-BASED SUBSTRATE WITH ADVANCED ANAEROBIC DIGESTION FOR IMPROVED BIOGAS YIELDS

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Anaerobic digestion (AD) is an effective method for managing organic waste and generating renewable energy, but its efficiency faces several critical challenges such as substrate limitations, microbial instability and process inefficiencies that can affect the optimal biogas production. This review explores how *Phylum Charophyta, Chlorella and Spirogyra* can improve AD performance. *Phylum Charophyta* is mainly found in freshwater areas with low to moderate salinity, especially in temperate and tropical climates. *Chlorella*, a widely available microalgae found in freshwater and soil, is rich in protein and lipids which makes it a good substrate for biogas production. *Spirogyra* is a filamentous macroalgae commonly found in freshwater habitats and has high carbohydrate content which boosts methane production. These algae enhance AD by overcoming the critical challenges. This review emphasizes their availability and potential, highlighting their need for further research to make their use practical on larger scale. AD can become more efficient and advancing sustainable energy solutions by incorporating with these algae.

ABSTRACT ID - NCSPER/0025

ENSEMBLE LEARNING WITH EXPLAINABLE AI FOR ENHANCED FORECASTING IN SOLID WASTE MANAGEMENT: A CASE STUDY FROM SINGAPORE

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This research develops a stacking ensemble model framework to predict the recycling rates in the solid waste management system of Singapore. The model incorporates Decision Trees, Random Forests, and Support Vector Regression for portraying the non-linear multi-dimensional intricacies associated with the generation and recycling of waste. The Singapore National Environment Agency data (2003-2016) was processed using z-score normalization and then segmented into stratified training and testing partitional sets. The ensemble was evaluated on its performance very rigorously with metrics such as Mean Absolute Error, Mean Squared Error, Root Mean Squared Error, and, Mean Bias Error alongside the Coefficient of Determination (R^2). The ensemble achieved an outstanding bias adjusted R^2 of 0.96 in comparison to single models. To improve interpretability, SHapley Additive exPlanations (SHAP) were used, which showed the great effect of food and metal waste streams over the efficiency of recycling. These results provide evidence that the application of ensemble learning along with explainable AI not only enhances the accuracy of forecasting but may also lead to better urban waste management and optimal sustainable policy formulation and decisions.

ABSTRACT ID - NCSPER/0041

UTILIZATION OF CONSTRUCTION AND DEMOLITION WASTES IN ASPHALT PAVEMENTS: A REVIEW

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Construction industry in India generates about 150-500 million tonnes of C&D waste annually. C&D waste comprises materials such as recycled concrete aggregates (RCA), ceramic tiles, bricks, and glass. C&D waste has immense potential for bulk application in civil engineering, particularly in pavement construction. This study is a review of previous research efforts on the use of C&D wastes in design and construction of asphalt pavements. RCA has shown promise in base and subbase layers, enhancing load-bearing capacity and durability. Porous asphalt mixtures can be made entirely from RCA, making them suitable for pedestrian and cyclist pathways, while RCA-modified hot-mix asphalt can be effectively used for base courses in pavements. The use of RCA in cement-treated bases has also been optimized through response surface methodology to maximize its strength and durability. In flexible pavements, crushed bricks, tiles, and glass enhance the mechanical properties of asphalt mixtures, though concerns such as water absorption and rutting resistance require further characterization. Studies highlight that ceramic tile waste improves the California bearing ratio of soil but reduces its unconfined compressive strength, indicating its potential in subgrade stabilization. However, certain challenges remain. There is high water absorption of red brick aggregates affecting the water stability, and glass-modified base courses show comparatively lower shear strength. The use of RCA in pavement layers can lead to increased water absorption, higher porosity, and reduced strength compared to natural aggregates. Furthermore, the presence of adhered mortar in RCA affects its durability, leading to potential issues such as increased fatigue damage in asphalt pavements. Studies have also shown that while RCA-enhanced flexible pavements can meet standard performance criteria, they may require additional treatments such as chemical stabilization to enhance their mechanical properties. Future studies should focus on optimizing mix designs to address the limitations of RCA, investigating new modification techniques for the maximum allowable replacement of natural aggregates with recycled materials.

ABSTRACT ID - NCSPER/0072

EXPERIMENTAL INVESTIGATION ON STRENGTH PROPERTIES OF CONCRETE UTILIZING INDUSTRIALS BY-PRODUCTS AS SUSTAINABLE CEMENT ALTERNATIVES

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The construction industry is increasingly challenged by sustainability concerns and waste management of industrial by-products, particularly cementitious materials. To address these challenges, this study explores the effect of silica fume and fly ash on the compressive strength and workability of concrete. Silica fume contents were incorporated at 10%, 15%, and 20% by weight of cement with and without 20% of fly ash content. A water-cement ratio of 0.42 and a target slump of 100 mm were maintained throughout the experiment. A comprehensive series of laboratory tests were conducted to evaluate the compressive strength and workability of concrete. As indicated by the results of this study, the concrete mixture containing 15% silica fume achieved a 33% increase in compressive strength, making it the optimal mixture among the tested samples. However, this mixture also reduced the workability of the concrete. Furthermore, when 15% silica fume was combined with 20% fly ash, the compressive strength increased by 27.3% while maintaining workability. These improvements were attributed to the spherical shape of fly ash particles, the pozzolanic reaction, and the filler effects of both silica fume and fly ash.

ABSTRACT ID - NCSPER/0084

EFFECT OF CULTURE INOCULATION AND SUBSTRATE LOADING ON BIOENZYME PRODUCTION FROM KINNOW PEELS

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Citrus processing industry produces around 50% waste as peel which is rich in soluble sugars, polysaccharides and many bioactive compounds. Bioenzymes are complex organic compounds produced through fermentation of fruit waste like citrus and have a range of applications as disinfectants, detergents, etc. so far, the bioenzyme fermentation is a crude let alone process which takes around 3 months thus needing refinement. This can be shortened if the waste is inoculated by a suitable consortium of microorganisms. Hence, in the present study different cultures in the form of *Bacillus cereus, Saccharomyces cerevisiae* and *Trichoderma* were used to inoculate kinnow waste having two different C:N ratio of 25:1 and 30:1 and incubated at room temperature. Bioenzyme was periodically analysed for physical characteristics such as colour, odour, pH, total dissolved solids (TDS) and acidity. The colour varied from light brown to dark brown. The odour was noted to be citrusy. The pH had a decreasing trend varying from 3.62 to 2.55. the total dissolved solids (TDS) exhibited a decreasing trend with final readings varying between from 2.55°Bx to 3.39°Bx from 7°Bx. The acidity varied from 0.24 to 0.79, with 30:1 treatments having higher acidity. The enzymatic activities, namely pectinase, cellulase and amylase, were measured using plate assay. The loading ratio did not have a significant effect on enzymatic activities. All activities gradually increased but amylase and cellulase activity decreased at day 60. The present study thus infers that culture treatment as well as a loading ratio of 25:1 invariably inferred bioenzyme activities.

ABSTRACT ID - NCSPER/0077

OPTIMIZING OPERATING CONDITIONS OF PILOT-SCALE ANAEROBIC BI-PHASED BAFFLED REACTOR FOR DIFFERENT SUBSTRATES

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Reactor instability in anaerobic digestion (AD) critically impedes the efficient utilization of biomass potential energy, affecting biogas yield and economic viability while contributing to environmental pollution and resource wastage. Optimizing the operational conditions of AD systems is critical for evaluating the thresholds and thus maximizing reactor efficiency. The efficiency of a novel pilot-scale anaerobic baffled reactor (ABBR, 10 m^3) was assessed in terms of substrate removal, methane yield, and energy balance across varying hydraulic retention times (HRT) with two substrates: *Hydrilla verticillata* (HV) and kitchen waste (KW). For HV, HRT20 (20 days) at an organic loading rate (OLR) of 2.25 kg-VS/m^3-day showed the highest cumulative biogas production of 85.802 m^3 and a methane yield of 121.04 mL/g-VS. Similarly, for KW, HRT16 at an OLR of 2.06 kg-VS/m^3-day showed the highest cumulative biogas production (174.667 m^3) and methane yield (108.12 mL/g-VS-day), with an average substrate removal efficiency of 85.81%. Higher HRTs exhibited superior effluent characteristics with higher substrate removal rates. Kinetic evaluation revealed that ABBR performed well, even at low organic loads, fitting excellently with the Grau-second-order and Modified Stover-Kincannon models. The reactor achieved positive energy balances at different HRTs for both the substrates, indicating its potential for sustainable energy recovery. These findings highlight the importance of HRT management in maximizing biogas yield and effluent quality.

ABSTRACT ID - NCSPER/0073

Water and Wastewater Management

EcoOxo⁺: A SUSTAINABLE SOLUTION FOR ADVANCED WATER TREATMENT

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EcoOxo⁺, a Reactive Nano Bubble Fusion Technology, introduces an efficient treatment approach to water and wastewater management by utilizing oxygen and ozone-enriched nanobubbles in an innovative switching mode. This advanced treatment system creates highly-effective oxidation zones that decompose pollutants, neutralize pathogens, and escalate dissolved oxygen levels, resulting in a self-sustaining purification process. This advanced oxidative technology is versatile, addressing critical challenges in water treatment across sectors such as agriculture, aquaculture, food processing, car washing, and water/wastewater management. Validated by IIT Ropar and recognized by the Ministry of Food Processing Industries (Government of India), for its water use efficiency, EcoOxo+ provides a scalable, eco-friendly, and cost-effective solution to improvise water quality while reducing environmental impact. It can be seamlessly integrated with existing infrastructure, supporting pollutant removal and water reuse initiatives. By aligning with sustainable remediation practices and the circular economy, EcoOxo+ contributes significantly to achieving climate-resilient water management goals and Sustainable Development Goals (SDGs). Thus, highlighting EcoOxo⁺ as a transformative technology designed to promote a cleaner and more sustainable future.

ABSTRACT ID - NCSPER/0024

HYDRODYNAMIC AND SHAPE STUDIES ON MOTION OF NANOFLUID DROPS OF CHLOROBENZENE THROUGH WATER AND ETHYLENE GLYCOL SYSTEMS

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This experimental study was conducted to observe the motion of nanofluid drops moving through immiscible liquid of varying interfacial tension. A set of data in terms of terminal velocity were obtained using three different systems of varying interfacial tension (chlorobenzene/water, chlorobenzene/water + ethylene glycol with varying volume concentration). To illuminate the effect of the addition of nanoparticles on hydrodynamic parameters nanoparticle TiO_2 has been taken. It is noticed that with the addition of nanoparticles, the terminal velocity increases up to an optimum concentration of nanoparticles, beyond which it starts to decrease. This behavior could be due to Brownian motion, internal circulation and Marangoni effect. The eccentricities of the droplets are also being compared with the eccentricity equations available in the literature. The eccentricity is observed to change with the addition of nanoparticles.

Based on the observed data, correlation has been proposed as function of Flow number (F), $F_{modified} = F[1+0.542\times5.8]$ to consider the effect of nanoparticles in terms of volume fraction of nanoparticles. The correlation predictions are in good relation with the generated data with MRQE (Mean relative quadratic error) % and AARE (Absolute average relative error) % of 12.9 % and 6.73 % respectively for terminal velocity.

ABSTRACT ID - NCSPER/0029

ALGAL STIMULATION FOR PHYCO REMEDIATION OF LARGE FLOWING WASTEWATER DRAINS

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Phyco-remediation using Nano Nutrient Activator was sprayed on a daily basis, in wastewater drain to activate the native pre-existing micro algae. The micro algae multiply rapidly and photosynthesize generating 100% concentrated oxygen for the bacteria to absorb rapidly, without floating away. This work is being carried out in partnership with Thapar Institute of Engineering and Technology, Patiala at the project site, Jayanti Ki Rao, 44 MLD Drain at Kharar, Punjab.

Comparative analysis of the "Untreated" (A) segment & the treated Segment (B) the JKR drain highlights significant improvements in various water quality parameters and microalgal diversity following bio stimulation by Aquaritin and Bioritin Nano nutrients. The COD dropped from 292 mg/l to 62 mg/l, marking a remarkable 78.8% reduction indicating a decrease in organic and inorganic pollutants due to enhanced aeration by 'Micro Algal' growth. The BOD_3 at 27°C also showed an 85% improvement, reducing from 121 mg/l to 18 mg/l, suggesting a notable reduction in biodegradable organic matter, facilitated by higher dissolved oxygen levels allowing for probable rapid bacterial activity. The population of microalgae basis cell count was 1.3×10^4 cells/ml in the untreated segment (A). After treatment, the segment (B) microalgae population surged nearly tenfold to 10.4×10^4 cells/ml, as confirmed through hemocytometer analysis. Improvement across other parameters including Heavy Metals can be seen in the detailed preliminary reports prepared by the Thapar team, indicating room for improvement.

These improvements align with environmental standards and demonstrate the suitability of treated water for agricultural and ecological purposes. The findings highlighted the potential for adopting such treatments for sustainable wastewater management. Based on the results, it is recommended to continue the application of the treatment process while conducting regular monitoring to ensure long-term sustainability. Further studies could assess the scalability of the treatment for broader implementation across similar waterbodies using specially derived inoculum of the native Micro Algae and customizing the treatment for their rapid growth.

ABSTRACT ID - NCSPER/0003

MICROPLASTICS IN AQUATIC ECOSYSTEMS: A CRITICAL REVIEW ON DETECTION METHODS AND QUANTIFICATIONS

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Plastics, synthetic polymers widely used across various industries, degrade into smaller fragments known as microplastics (MPs) which are typically less than 5 mm in size. MPs have become pervasive in the environment, contaminating freshwater and drinking water sources and raising significant environmental and public health concerns. Recent studies emphasize the need for effective detection and monitoring methods to identify MP distribution, sources, and impacts in aquatic systems. Advanced analytical techniques, such as Raman spectroscopy and Fourier-transform infrared spectroscopy, have been utilized to determine the chemical composition of MPs in diverse water bodies, including rivers, lakes, and wastewater. Commonly detected polymers include polystyrene (PS), polyethylene terephthalate (PET), polyethylene (PE), and polypropylene (PP). Despite these advancements, challenges such as extended analysis times, high costs, and non-standardized sampling protocols limit accurate assessments of MP concentrations. Emerging optical detection technologies, including probes and sensors, demonstrate potential for real-time monitoring of micro- and nano-plastics (M/NPs), offering improved efficiency over conventional methods. This paper underscores the need for standardized methodologies and enhanced quality assurance in MP detection to support robust public health risk assessments and informed environmental policy development. Advancing detection techniques is essential to address the growing threat of MPs in freshwater and drinking water systems.

ABSTRACT ID - NCSPER/0044

PHYTOREMEDIATION: A SUSTAINABLE APPROACH TO WASTEWATER TREATMENT

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Clean water is a basic necessity of human life along with air, food and shelter. The major sources of clean water include surface and underground water. But with the rapid increase in industrialisation and human demands, many fresh water resources have become highly polluted. Conventional water treatment methods are not effective in removing wastewater pollutants such as heavy metals, hydrocarbons and phenols. The use of phytoremediation technique, a biotechnological approach using plants, can be a best alternative in present world for the remediation of polluted water. Phytoremediation involves an integration of plant and bacteria. Plants together with their associated microorganisms form a symbiotic relationship to cleanse wastewater. Phytodegradation, phytoextraction, phytostabilization, phytovolatilization, phytoaccumulation and rhizofiltration are some of the techniques that can be used to significantly lower the concentration of pollutants in the wastewater. There is an increasing interest in this part of the research towards the utilization of genetically engineered plants and microbes and plant microbe interaction to enhance the efficiency of the remediation process. This phytoremediation technique is economical, ecofriendly and has long-lasting applicability. Aquatic plants have the ability to remove both organic and inorganic pollutants present in water. This review study primarily covers the potential and effectiveness of aquatic plants in treating the pollutants present in the wastewater.

ABSTRACT ID - NCSPER/0002

EFFECT OF CERIUM DOPING ON THE DEGRADATION OF 2,4-DICHLOROPHENOL THROUGH BI_2WO_6 PHOTOCATALYST

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This study investigates the degradation of 2,4-dichlorophenol (2,4-DCP), a toxic contaminant in wastewater from industries like dyes, pesticides, and pharmaceuticals. Known for its adverse effects on human reproductive and endocrine systems, 2,4-DCP necessitates effective removal methods. This research explores the degradation of 2,4-DCP using a UV-activated Bi_2WO_6 photocatalyst doped with cerium (Ce), synthesized via a modified hydrothermal method. Structural and spectral characteristics were analyzed using XRD, SEM-EDS, and UV-DRS. The doping of Ce altered the bandgap, enhancing photocatalytic activity. Degradation experiments were conducted in a custom photoreactor, and 2,4-DCP levels were quantified using HPLC. Samples were collected at intervals with a PTFE syringe filter, and HPLC-grade methanol acted as a quencher. Results showed ~10% degradation under UV irradiation alone, which increased to ~53% with Ce-doped Bi_2WO_6. The addition of H_2O_2, a hydroxyl radical generator, further improved degradation to over 92%. Components of the water matrix influenced degradation rates, with some enhancing and others inhibiting the reaction. This study demonstrates the significant potential of Ce-doped Bi_2WO_6 photocatalysts in removing 2,4-DCP, particularly when combined with oxidative additives. The findings contribute to sustainable approaches for wastewater treatment and highlight the importance of tailoring processes to specific water matrix conditions.

ABSTRACT ID - NCSPER/0046

MEASURING AND COMPARING WATER EFFICIENCY IN PADDY RICE CULTIVATION: INSIGHTS FROM KHARIF 2024 IN PUNJAB, INDIA

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Water management is a cornerstone of sustainable agriculture, particularly for water-intensive crops like paddy rice, as the vast majority of farmers irrigate their rice farm with the traditional water intensive Transplanting Rice (TPR) technique. Empirical evidence was collected across 160 paddy farms, employing PVC pipe measurements and water meters to monitor water levels and consumption This study investigates water usage efficiency during the Kharif season of 2024 in Punjab, India.We have used 3 ways to shed light into water usage (i) Compared existing farmer that practice Direct Seeded Rice (DSR) (ii) Set-up cash-incentive scheme to shift farmers into Alternate Wetting drying (AWD) and (iii) Installed remote controllers in tubewells to enable remote activation. Our study suggests that DSR in fact does not have a water saving element whereas AWD practice is water efficient despite mixed results across our measuring tools. Moreover, implementing remote-control, albeit at the later stage of the season, suggests there is a water saving potential. This research highlights the effectiveness of combining traditional measurement tools with structured incentive programs to promote water-efficient farming practices. Insights from this study can guide policymakers and stakeholders in implementing scalable and sustainable irrigation strategies for paddy rice cultivation.

ABSTRACT ID - NCSPER/0067

ADSORPTIVE DECONTAMINATION OF OFLOXACIN USING DEEP EUTECTIC SOLVENT FUNCTIONALIZED ACTIVATED CARBON

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Deep eutectic solvents (DESs) have attracted the attention of scientific community of different areas due to their distinctive physicochemical properties. In this study, an ammonium-based DES was synthesized containing tetramethylammonium chloride (TMAC) as hydrogen bond acceptor and glycolic acid as hydrogen bond donor. Further, the synthesized DES was evaluated as a functionalization agent for commercial activated carbon (AC) to form a novel adsorbent (DES–AC). To ensure the formation of DES and to recognize the modifications occurred due to the functionalization process, FESEM and FTIR spectroscopy characterizations were performed. Such prepared DES–AC was evaluated for the removal of ofloxacin (OFL) from its aqueous solution. The central composite design (CCD) model, based on response surface methodology (RSM) design expert software, was adapted for this study. Under suggested experimental conditions, the influence of initial OFX concentration (C_0), DES-AC dose (m), contact time (t) and pH were evaluated on % OFL removal and sorption capacity (mg/g). The 3D response surface graphs were also obtained for both the responses, and the polynomial quadric model was fitted with higher coefficient values of R^2. Very high adsorptive performance was recorded of this new adsorbent DES–AC for OFL antibiotic. The optimum experimental condition was obtained for the maximum decontamination of OFL.

ABSTRACT ID - NCSPER/0076

AQUA CHECK: THE WATER QUALITY ASSESSMENT SYSTEM FOR PUBLIC HEALTH AND ENVIRONMENTAL STABILITY

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Water quality assessment and monitoring is the important task for public health and environmental stability. In the search for advancing water quality measurement, the proposed system "AQUA CHECK" is an initiative to build an efficient system to assess quality of the water. The proposed system is designed and developed by integrating the technologies such as machine learning and, the Internet of Things to address the critical need for precise water quality information. It consists of three phases, designing and developing a sensory inputs-based monitoring system, utilizing machine learning models such as variants of regressions such as as elastic net, lasso least angle and ridge for quality assessment, and developing a user-friendly interface to display information. The proposed system utilizes optimal models for physical as well as chemical parameters that are validated and selected based on suitable performance evaluation metrics such as RMSLE, AUC, precision, recall, etc.

ABSTRACT ID - NCSPER/0081

EVALUATION OF INFILL DENSITY OF THE BIOFILM CARRIERS FOR THE EXPLORING ITS BIOREMEDIATION POTENTIAL IN DOMESTIC WASTEWATER

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Considering the threat of water scarcity, the continuous available water source for irrigation is reclaimed water. Traditional treatment techniques are not a sustainable solution. Microalgae-bacterial mediated treatment strategies are more feasible than existing biological treatments. Biofilms mediated Microalgae-bacterial systems have been increasingly considered of great potential in bioremediation of wastewater due to the advantages of synergistic pollutants removal and recovery, CO_2 sequestration, and cost-effective biomass-effluent separation. The study investigates the effect of infill density of the designed carriers for biofilm development and their potential role in wastewater treatment. 10%, 15% and 20% of the infill densities have been studied to evaluate their bioremediation potential. The pre-assessed microalgae-bacterial consortium was used for the development of biofilm on in-house designed carriers. The study was conducted in two phases: enrichment phase (8 days) and treatment phase (4 days). The carriers used for the biofilm development were dipped in low-strength domestic wastewater containing 5% (v/v) microalgae-bacterial consortia under the illumination of 6000 lux with 12:12 light-dark period at the temperature of 28°C ± 4°C with aeration at 2.0 liters per hour (lph). The enriched carriers were dipped in the primary treated wastewater to assess their bioremediation potential. The study found that the 15% infill shows 82% and 86 % reduction of tCOD and sCOD respectively where as 10% and 20% infill density carriers provide 63% and 72% removal for tCOD and 70-75% removal of sCOD with the HRT of 4 days. Nitrogen removal rate of carriers with 20% infill density is much higher w.r.t 10% and 15%.

ABSTRACT ID - NCSPER/0096

FE-TIO_2 CEMENTITIOUS COMPOSITE: A SUSTAINABLE AND PHOTOCATALYTIC MATERIAL FOR ENVIRONMENTAL APPLICATIONS

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The current research investigation presents an innovative and cost-effective approach to utilize cementitious materials that incorporate iron-rich industrial waste products (FWPs) to enhance nano-photocatalysts such as Titanium dioxide (TiO_2). The aim is to develop a visibly active Fe–TiO_2 cementitious composite with photocatalytic and antibacterial properties. The study introduces a novel approach by establishing a natural and inherent doping concept, compared to conventional techniques, to enhance the photocatalytic properties of the proposed sustainable construction material. The stability and efficacy of the Fe–TiO_2 cementitious composite were assessed through FESEM, UV–vis DRS, EDS with elemental mapping, and XRD analysis. The analytical examinations verified the formation of iron-titanium (ITO) bonds, indicating a shift of TiO_2 from the UV to the visible light spectrum (Eg = 2.52 eV). The photocatalytic efficiency of the Fe–TiO_2 cementitious composite was assessed by examining the degradation of methylene blue (MB) in aqueous solutions under UV and visible spectrum of light. The photocatalytic results demonstrated that TiO_2 exhibited the highest photocatalytic discoloration of MB under UV light, while the photocatalytic discoloration of MB under visible light was enhanced in the presence of Fe–TiO_2 cementitious composite. The antibacterial efficacy of the Fe–TiO_2 cementitious composite was also evaluated using an aliquot of *E. coli* bacterial suspension. The composite attained an *E. coli* count of about 0.541 log reduction at the end of 45 min and thus, exhibited bacterial disinfection quality. Hence, the Fe–TiO_2 cementitious composite material presents an innovative approach which aims to address different environmental challenges and promote a sustainable, low carbon footprint future.

ABSTRACT ID - NCSPER/0045

EFFICIENT LEVOFLOXACIN DEGRADATION USING 3D FLOWER-LIKE BI_3O_4CL/BIOCL P-N HETEROJUNCTION NANOCOMPOSITE

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A novel Bi_3O_4Cl/BiOCl heterostructure was synthesized via the precipitation method and characterized using XRD, FTIR, FESEM, TEM, BET, and EDX techniques. Its photocatalytic activity was evaluated under visible light for the degradation of levofloxacin over 180 minutes. Under optimal conditions (1 g/L catalyst dose, pH 11, 10 mg/L drug concentration), the heterostructure achieved 87% degradation, significantly outperforming bare BiOCl (32%) and BiOBr (57%). The enhanced performance was attributed to efficient charge carrier separation at the heterojunction interface. Antibacterial studies against Escherichia coli revealed zero inhibition, while TOC analysis indicated 55% mineralization. These results highlight Bi_3O_4Cl/BiOCl as a promising catalyst for pharmaceutical wastewater treatment.

ABSTRACT ID - NCSPER/0055

MICROPLASTIC POLLUTION IN AQUATIC SYSTEMS: SOURCES, DISTRIBUTION, AND DETECTION

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With the increasing use of non-biodegradable plastics, addressing their environmental impact and behaviour has become crucial. Plastics have emerged as the dominant form of marine debris, undergoing processes like weathering, degradation, and fragmentation. These processes breakdown plastics into smaller particles, typically less than 5 mm in size, known as microplastics (MPs). MPs exist in numerous forms, including pellets, fibres, fragments, foams, and films, and are now frequently found in different environmental matrices, such as marine ecosystems, the atmosphere, and agricultural soils. This extensive distribution significantly enhances their chances of entering the food web. The presence of MPs in air and food, could pose serious health risks to humans through ingestion or inhalation, often carrying hazardous contaminants. Given their ubiquity and potential dangers, researchers are intensifying efforts on investigating their distribution, measurement, and movement across global aquatic habitats. This research seeks to elucidate the sources and dispersion of MPs in water, their detrimental effects on living organisms, and the application of advanced characterization techniques such as microscopy, spectroscopy, and thermal analysis to accurately identify their type, shape, abundance, colour, and particle size.

ABSTRACT ID - NCSPER/0050

A PILOT- SCALE IMPLEMENTATION OF DUAL ADVANCED OXIDATION PROCESSES FOR WASTEWATER TREATMENT

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A viable approach to enhance wastewater treatment via a combination of photocatalysis and photofenton is through the complementary generation of reactive oxygen species (ROS). The process behind and practical implications of this dual system are examined in this study. Photocatalysis produces electron-hole pairs that result in the formation of ROS, while photofenton uses Fe^{2+}/ H_2O_2 interactions under irradiation to produce hydroxyl radicals (OH•, E° = 2.8V), which depicts rapid non-selective oxidation with pH-dependent efficiency. Thus, compared to individual AOP systems, the synergistic method allows for faster degradation over a wider range of contaminants. A novel composite was fabricated by the use of clay and industrial byproducts. The bandgap was lowered due to Fe-TiO_2 interactions displayed by immobilized TiO_2. The implementation of this duality on scaled up prototype led to a significant removal of chromophores depending upon the optimisation of parameters like pH, reaction time H_2O_2 dosing. The binary system offers enormous potential for industrial-scale installation, providing an efficient way to remove pollutants and allowing treated wastewater to be safely released into water bodies or reused. Thus, utilizing effective treatment procedures, minimized use of chemicals, and less sludge production, this novel approach promotes sustainable wastewater management, protecting the environment, and helping industries meet their water conservation goals. The project's upcycling of industrial waste to form catalytic composites complies with SDGs 6 (Clean Water and Sanitation) and 12 (Responsible Construction and Consumption). Through catalyst recovery and reuse, the circular economy's principles remain intact, and solar-powered operation ensures low environmental impact and a lower carbon footprint.

ABSTRACT ID - NCSPER/0070

INACTIVATION OF BACTERIA IN SIMULATED AND SECONDARY MUNICIPAL WASTEWATER EFFLUENT USING THE HYBRID EFFECT OF FE–TIO2 CATALYST

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This study examines a cost-effective solution for bacterial inactivation in water using a waste-driven iron-titanium oxide composite. By utilizing waste foundry sand and waste fly ash as a natural iron source, these composite beads were coated with a thin layer of TiO_2 to create a hybrid effect of photocatalysis and photo-Fenton process. Two targeted experiments addressed simulated and municipal wastewater under optimized conditions.

In the simulated wastewater, the composite attained a log reduction of 6.2 in *E. coli* in 90 min. of treatment time, demonstrating a 26% improvement in synergy over individual processes. For the municipal wastewater, 100% inactivation of bacteria is observed within 60 min. At 0.9 gL^{-1} H_2O_2, pH 5.5, and full catalyst coverage. The study also showed a 54% and 40% reduction in BOD and COD respectively. Potassium ion efflux and FE-SEM analysis corroborated the impairment of the bacterial cell wall. The composite exhibited stability even after 85 cycles, highlighting its scalability and durability for extended use, which was further verified through SEM, EDS, XRD, FTIR, and DRS analyses. The research underscores the potential of waste-derived composites as an efficient solution for water treatment.

ABSTRACT ID - NCSPER/0031

PHOTONIC ENHANCEMENT OF SPHERICAL SILVER-DECORATED GRAPHITIC CARBON NITRIDE FOR SUNLIGHT-DRIVEN DEGRADATION OF ORGANIC POLLUTANT

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Photocatalysis is a promising advanced oxidation technique (AOP) that offers a practical and sustainable method for breaking down organic pollutants in aquatic environments. However, advancing photocatalysts for the degradation of pollutants is challenging due to rapid recombination. Silver-doped graphitic carbon nitride (Ag/GCN) photocatalyst is considered a key to enhanced generation of reactive oxygen species (ROS) for efficient photocatalytic degradation. The prepared Ag/GCN photocatalyst was characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FT-IR), UV-diffuse reflectance spectroscopy (UV-Vis DRS) and High-Resolution Transmission Electron Microscopy (HR-TEM). This confirms the decoration of silver nanoparticles with spherical morphology over the surface of GCN nanosheets and the bandgaps of Ag-GCN and pristine GCN were found to be 2.73 eV and 2.65 eV. The maximum photocatalytic degradation of crystal violet dye was 93.9% under optimized conditions following first-order reaction with rate constant k_r = 0.476 mg L^{-1} min^{-1}. The developed photocatalyst has the potential to be beneficial for sustainable and energy-saving wastewater treatment.

ABSTRACT ID - NCSPER/0034

PHOTOCATALYTIC DEGRADATION OF PESTICIDE SOLUTION IN SLURRY MODE AND FIXED MODE USING DIFFERENT CATALYSTS (TIO_2, $FE\text{-}TIO_2$, $SI\text{-}TIO_2$)

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Increased water and land pollution calls attention for techniques to handle increased pesticide available in the environment. There are considerable methods available to degrade pesticides, cost still remains an important factor. Hence, in this study degradation of Carbendazim (CBZ) and Propiconazole (PCZ) was carried out under different light conditions such as dark, sunlight and UV using clay bead based catalysts. The clay beads were coated with TiO_2 (P 25) to carry out degradation in the aqueous solution using slurry reactor and FPPR. The amount of degradation was determined initially by UV-Visible spectrophotometer and later with mineralization studies, with COD -vario-photometer. TiO_2 offers lot of application in photocatalysis but its effect Is limited under UV light only. TiO_2 cannot be used under sunlight as it requires light radiations below 387 nm (mainly under UV light) for enough electron excitation. Hence, doping of TiO_2 was carried out using Fe (metal) and Silicon (non -metal) precursor using surface impregnation method. The catalyst optimum load was then optimized using various dopant loadings, temperature of calcination and pH of the reaction solution and initial concentration of CBZ/PCZ. The prepared catalyst was found to be very efficient against degradation of fungicides under sunlight conditions.

ABSTRACT ID - NCSPER/0035

ECO FRIENDLY PINE WOOD SAWDUST FOR BIOREMEDIATION OF NON-BIODEGRADABLE SYNTHETIC DYES

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Synthetic dyes released as toxic industrial wastes or effluents from textile and other industries constitute one of the major hazardous water pollutants. Dyes have complex aromatic molecular structures making them stable and difficult to biodegrade by both biotic and abiotic agents. There is a constant pursuit for economical, non-toxic and eco-friendly methods to remediate dye-containing wastewater especially those which are. Adsorption of dyes on agricultural and green wastes is a superior technique to tackle both biodegradable and non-biodegradable waste (dyes). The bio-adsorbent used in the present study was fine saw dust of pine wood. Two cationic dyes (methylene blue and malachite green) and two anionic dyes (Congo red and methyl orange) were studied. Batch and column studies were carried out using pure pine saw dust at normal pH (6.5 – 7.0). Absorbance was measured using a digital colorimeter before and after adsorption at the respective λ_{max} of the respective dye. Batch studies were carried out with 0.2 g of saw dust for dye solution concentrations for 1, 5, 10 and 25 ppm and 0.5 g for 25 and 50 ppm dye concentration for contact times of 15, 30 and 60 minutes. Column adsorption of a mixture of the dyes was carried out. FTIR analysis was carried to help explain the mechanism of adsorption. Significant adsorption of the cationic dyes methylene blue and malachite green was observed in both batch and column studies. While the adsorption increased on increasing the shaking time to 60 minutes for malachite green, methylene blue was completely adsorbed in 30 minutes at all concentrations (1- 25 ppm). Out of the anionic dyes, Congo red showed better adsorption especially in the column studies. Methyl orange was not adsorbed under the present conditions but it could be eluted and recovered in its pure form in the column studies. Shifting, change in intensity and extra peaks were observed in the IR spectrum for dyes adsorbed on saw dust especially for methylene blue and malachite green dyes due to formation of chemical bonds between functional groups present on the saw dust. Congo red showed less prominent changes while methyl orange showed negligible changes. The negative charge of the surface of the adsorbent at the pH of study favoured the adsorption of positively charged cationic dyes while Congo red had an inherent affinity for cellulose. This method has lot of potential and needs to be standardized and then tested on real samples.

ABSTRACT ID - NCSPER/0042

UNLOCKING THE NUTRIENT REMOVAL POTENTIAL OF *PSEUDOMONAS AERUGINOSA* STRAIN NGNS-04: MICROBIAL CHARACTERIZATION AND PERFORMANCE ANALYSIS

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Nitrogen and phosphorus, vital macronutrients for living beings, trigger eutrophication when excessive levels enter water bodies due to pollution. Traditional nutrient removal methods are inefficient, expensive, and challenging to maintain. To address this issue, a biological removal process, involving heterotrophic nitrification and aerobic denitrification with specific microorganisms, has gained attention. Heterotrophic nitrifying, aerobic denitrifying, and denitrifying-phosphorous removal (HNADPR) bacteria have emerged as a solution, as they can simultaneously perform nitrification, denitrification, and phosphorous removal, simplifying the process. In this study, the HNADPR feature of a newly isolated strain from the sewage treatment plant (STP) of the Thapar Institute of Engineering and Technology (TIET), Patiala (30º21'23.6" N and 76º21'54.2" E) has been explored. The strain with HNADPR feature was identified as *Pseudomonas aeruginosa* NGNS-04 and the nutrient removal performance of the strain was optimized. The optimal conditions for nutrient removal include using sodium acetate as a carbon source, maintaining a C/N ratio of 7.5, a pH of 6.5, a temperature of 35°C, and an rpm of 125. Under the optimal experimental condition, the strain demonstrated impressive efficiency in removing NO_3^--N (96%) and PO_4^{3-} -P (92%) when initial concentrations were 100 mg/L and 25 mg/L, with removal rates of 4.02 mg/L/h and 3.98 mg/L/h, respectively. This strain holds promise for biological nutrient removal in wastewater treatment.

ABSTRACT ID - NCSPER/0020

MAPPING RESEARCH TRENDS IN DISTILLERY WASTEWATER UTILIZATION

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The increasing global emphasis on sustainability has led to significant research on the utilization of distillery wastewater for fertigation, a practice with potential to transform agricultural and environmental management. This study presents a bibliometric analysis to map the scientific landscape of this emerging field, offering insights into its thematic evolution, key contributors, and future research opportunities.

Leveraging data from Scopus and Web of Science, the analysis identifies influential authors, institutions, and collaborations while highlighting geographical and disciplinary trends. Co-occurrence network analyses of keywords such as bio-remediation, fertigation, and nutrient recycling reveal emerging technologies and knowledge clusters driving innovation. Citation and co-citation analyses shed light on the foundational works shaping the field and emerging themes like advanced treatment technologies, soil health impacts, and circular economy models.

The study contextualizes these findings within the broader frameworks of the Blue Economy and Vision Viksit Bharat @2047, emphasizing their relevance to water-scarce regions and sustainable development goals. By identifying knowledge gaps and underexplored areas, this review provides a roadmap for future interdisciplinary collaboration, technological innovation, and policy development in wastewater utilization for agriculture.

ABSTRACT ID - NCSPER/0043

TI_3C_2 MXENE-BASED ELECTRO CATALYSTS FOR SUSTAINABLE WATER SPLITTING TECHNOLOGIES

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Ti_3C_2 MXene-based electro-catalysts are emerging as a game-changing advancement for sustainable water-splitting technologies. In this work the potential of Ti_3C_2 MXene in enhancing overall water splitting performance with a focus on its catalytic efficiency, stability, and scalability has been studied. Exceptional electrical conductivity, high surface area, layered structure and hydrophilic nature of Ti_3C_2 enhance catalytic activity for both hydrogen evolution reaction (HER) and oxygen evolution reaction (OER). The results of a series of electrochemical tests demonstrate that Ti_3C_2 MXene-based catalysts achieve remarkable performance, showing superior activity as compared to conventional catalysts. The study delves into the underlying mechanisms of Ti_3C_2 MXene catalytic action and its impact on water splitting efficiency. Our research indicates that Ti_3C_2 MXene shows great potential for enhancing water-splitting technologies, which could lead to more sustainable and efficient energy generation. This work lays the groundwork for future research and development in the field of electro catalysis and sustainable energy systems.

ABSTRACT ID - NCSPER/0097

FUNGAL-MEDIATED BIOMINERALIZATION FOR EFFECTIVE HEAVY METAL REMEDIATION IN CONTAMINATED ENVIRONMENTS

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Biomineralization is a remarkable natural process whereby living organisms precipitate minerals, often exhibiting intricate shapes and specific functions. While biomineralization is prevalent across various life forms, including molluscs, diatoms, and vertebrates, its application in environmental engineering remain underexplored, particularly concerning fungal-mediated processes. Fungal biomineralization presents innovative solutions for environmental challenges by immobilizing heavy metals in contaminated soils and waters. By investigating the mechanisms of fungal interactions with minerals and metals, this research aims to contribute to sustainable engineering practices that harness biological processes for environmental protection. Fungal strains were isolated by serial dilution method from the sample obtained from the concrete walls. Among the isolated strains, fungal strain having ability to produce highest amount of urease as well as its ability to produce high amount of $CaCO_3$ was carried further to check its ability to immobilize heavy metal ions in water. Morphological characterization along with DNA isolation and ITS sequencing was performed for the identification of fungal strain, which was found to be *Trichoderma harzianum*. Lead and Cadmium were the metals that were chosen for the study. Determination of minimal inhibitory concentration (MIC) was done by growing the fungus on PDA plates with different concentrations of $Pb(NO_3)_2$ (1 to 8 mM) and $CdCl_2.H_2O$ (20 to 120 µM) for 5-7 days at 25°C. It was observed that the fungus did not show any growth on PDA plates containing 4.5 mM and above concentrations of Pb and 130 µM and above concentrations of Cd. Furthermore, tests for urease activity and $CaCO_3$ precipitation by fungus under metal stress were performed. SEM-EDX confirmed the precipitation of $CaCO_3$ by the fungus and AAS analysis showed that the metal ion concentration was reduced by ~99.2% and ~98.5% for Pb and Cd respectively.

ABSTRACT ID - NCSPER/0101

Energy Management

ENGINEERING CHICKEN FEATHER CARBONS AS ELECTROCATALYST FOR OER

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Hydrogen (H_2) production from electrocatalytic water splitting is one of the major contenders for green fuel production. Oxygen evolution reaction (OER) is a crucial rate determining reaction at the anode during electrocatalytic water splitting for H_2 production at the cathode. Due to the sluggish kinetics of OER, highly efficient electrocatalysts are required. Owing to their large surface area, high stability in acidic and alkaline conditions, inert nature and strong bonding, carbon-based electrocatalysts are highly preferred. This study reports the synthesis of OER electrocatalysts from chicken feather (CF) biomass-waste. CF hydrochar (CFH) synthesized hydrothermally was further treated in Argon atmosphere (CFH350). CF was also subjected to low-temperature pyrolysis with (CFMA) and without (CFM) activation. FESEM and XRD measurements were conducted for analyzing the morphology and crystal structure respectively. The OER activity was analyzed in 1M KOH. All synthesized samples exhibited a low overpotential (455-634 mV) at 10 $mAcm^{-2}$ and Tafel slope values either lower or comparable to traditional benchmark electrocatalysts. This study highlights the potential of CF biomass-waste as a promising precursor for the synthesis of electrocatalysts for OER catalytic activity, paving the way for developing green and efficient materials for renewable energy technologies.

ABSTRACT ID - NCSPER/0056

ANALYSIS OF LOW POWER AND HIGH-PERFORMANCE MOSFET-BASED BIOSENSORS

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Before any device development, there is a crucial step which is a simulation process. The process involves the use of the TCAD technique for any simulation and analysis process. Today's devices are the result of miniaturization which are used in many fields, especially in the biomedical field where semiconductor-based biosensors are used to detect biomolecules by utilizing the change in the electrical characteristics of the biomolecules. Junctionless MOSFET-based (Metal Oxide Semiconductor Field Effect Transistor) biosensors provide better results in the detection process of biomolecules since they detect the changes in the electrical characteristics of the biomolecules. Unlike conventional MOSFET and ISFET (Ion Sensitive Field Effect Transistor) biosensors, Junctionless MOSFET operates efficiently at subthreshold voltages, reducing power consumption while maintaining high sensitivity and a low detection limit. This is a comparative analysis of the devices that use either the dielectric constants of the biomolecules or their concentrations for detection emphasizing their low-power operation and enhanced electrostatic control. The devices have been analyzed based on their performance parameters such as subthreshold voltage, threshold voltage, ON current, OFF current and ON-to-OFF current ratio along with their effect on channel potential, electron concentration, conduction and valence band energy. The tool used for the simulation purpose is SILVACO TCAD.

ABSTRACT ID - NCSPER/0064

DATA CENTER SUSTAINABILITY: ANALYSIS OF FACTORS INFLUENCING ENERGY CONSUMPTION, WATER USAGE AND LAND FOOTPRINT

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The rapid expansion of the IT industry has led to significant consumption of energy, water, and land resources by data centers. To make data centers more sustainable, the key target is to reduce their environmental impact by optimizing energy consumption, water usage, and land footprints. Various factors must be considered to achieve these objectives. For example, maximizing the use of green energy in data centers can help reduce greenhouse gas emissions, implementing efficient cooling techniques can lower water usage, and optimizing hardware utilization can decrease land requirements. Existing studies primarily focus on energy consumption in data centers, often overlooking other environmental impacts, such as water and land footprints. This article conducts a systematic review that examines the environmental impact of data centers by considering various factors influencing energy consumption, as well as the water and land footprints caused by data center deployments. The key finding of this work is that adopting a comprehensive and holistic approach towards data center sustainability has significant potential to minimize the use of brown energy, water, and land footprints in data centers.

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DESIGN AND ANALYSIS OF A MECHANICAL FOOTSTEP ENERGY HARVESTING SYSTEM USING BOND GRAPH MODELING

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The increasing demand for sustainable energy solutions necessitates innovative approaches to energy harvesting. This research explores a mechanical footstep power generation system designed to harness kinetic energy from pedestrian movement. The system utilizes a gear-based mechanism to convert foot pressure into rotational motion, driving a generator. The results demonstrate that with an input force of 500 N, the system generates a stable voltage of 1.21 V. A key novelty of this work lies in the integration of bond graph modeling, simulation analysis, and experimental validation to optimize system efficiency and feasibility. Bond graph techniques enable systematic energy flow analysis, while simulation studies evaluate system performance under various conditions. Experimental validation further ensures practical implementation, addressing challenges related to scalability, cost-effectiveness, and energy output stability. The findings highlight the potential of mechanical footstep energy harvesting systems as a viable solution for urban energy sustainability.

ABSTRACT ID - NCSPER/0074

AN EXPERIMENTAL CASE STUDY FOR ENERGY MANAGEMENT AND UPSCALING OF HAND TOOLS CLUSTER IN PUNJAB, INDIA

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The energy needs of the world are increasing at an exponential rate. The known sources of conventional energy are decreasing fast. Developed countries use more than 50% of the available energy for production tasks, whereas developing countries find it hard to meet their energy demands. Because of this, it becomes imperative to make efficient and judicious use of available energy resources. Small-scale industries are major consumers of power. Even industries located in clusters are not aware of the energy-efficient technologies. This is because most small-scale businesses operate on a single ownership basis and work in firefighting mode. The 9.6% increase in Punjab's energy consumption in April 2024 (compared to April 2023) indicates that industries, including SMEs, are experiencing higher energy costs. This paper presents a practical case study of a hand tools cluster located in Jalandhar, Punjab, India. This study was done as per the recommended guidelines of the United Nations Development Programme (UNDP) project for energy management, and results showed that with proper hand-holding, small-scale industries can become more energy efficient, sustainable and hence more profitable.

ABSTRACT ID - NCSPER/0087

ROLE OF CARBIDE BASED BIMETALLIC CATALYST IN ENHANCING THE CONVERSION OF CARBON DIOXIDE AND HYDROGEN ENRICHED BIOGAS PRODUCTION VIA THE DRY REFORMING ROUTE

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Dry reforming of biogas is one of the promising reforming routes in which methane and carbon dioxide are transformed into hydrogen-enriched biogas in the absence of water. The advantageous aspect of this route lies in its utilization of two important greenhouse gases. This reforming route is facilitated by a metallic catalyst, which provides stability, reactivity and selectivity. In recent times, transitional metal carbides-based catalysts have been widely explored because of their tunable electronic properties, strong metal-support interactions, high surface area and resistance to carbon deposition. This study compares the carbide-based bimetallic nickel-molybdate catalysts with and without support to evaluate their impact on the conversion and production of hydrogen-enriched biogas. Aluminium oxide is used as the support for catalyst in this work. It is found that catalyst with support was influential, delivering 81% and 85% of methane and carbon dioxide conversion as compared to catalyst without support which stands at 64% and 76%, respectively. The effectiveness of both catalysts was evaluated based on its ability to efficiently catalyze the conversion of reactants while maintaining thermal stability as substantiated by XRD, FESEM, TGA and RAMAN characterization techniques.

ABSTRACT ID - NCSPER/0092

IN-SITU EXTRACTION AND (TRANS) ESTERIFICATION OF HIGH-FREE FATTY ACID RICE BRAN OIL USING SYNTHESIZED HETEROGENEOUS CATALYSTS

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Biodiesel is an emerging alternative to primitive diesel fuel which can be transpired as an eminent sustainable and clean fuel. In this study, the production of biodiesel is proposed using simultaneous extraction and (trans)esterification where extraction of oil and esterification are done in a single unit operation, with alcohol acting both as an extraction solvent and transesterification reagent. Rice Bran due to its abundant availability in the northern plains of India is used for extraction and transesterification using the two heterogeneous catalysts, addressing the major waste management problem. The Al-doped sulphated Zirconia and sulphated carbonaceous catalyst are synthesized and a comparison between both is established. The characterization of both catalysts is done under XRD, FESEM and EDX mapping. It is concluded that higher yields can be achieved at lower energy, time, and, costs in a single unit operation by preferring the simultaneous extraction and (trans)esterification over the conventional production process.

ABSTRACT ID - NCSPER/0036

DESIGN STRATEGIES AND PRINCIPLES FOR DUAL-PATHWAY PHOTOCATALYTIC H_2O_2 PRODUCTION BY PAIRING OXYGEN REDUCTION AND WATER OXIDATION

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Hydrogen peroxide, an ecofriendly strong oxidant has garnered attention globally not only for organic synthesis and environmental remediation but also as a promising new liquid fuel due to its high energy density. Among its production methods, photocatalysis is the most ecologically friendly and sustainable technology which uses solar energy as a source of energy and semiconductor materials as catalysts. Water and oxygen are the only raw materials needed for the artificial generation of H_2O_2. However, the commercial uses of photocatalytic H_2O_2 generation are still limited by the significant recombination of electron-hole pairs, low utilization of visible light, and poor selectivity of the produced product. Nonetheless, the current efficiency for converting solar energy to H_2O_2 through photocatalysis has largely been limited to about 1–2% or less, primarily because of restricted utilization of the full solar spectrum, which hinders their practical implementation. In order to improve the efficiency of H_2O_2 generation, we provide the fundamental principles, the reaction route, design strategies for catalytic system, detection methods, and evaluation metrics. We also outline the research accomplishments over the last several years. Future environmental uses of photocatalytic H_2O_2 generation are also envisaged, along with associated problems and opportunities.

ABSTRACT ID - NCSPER/0047

AGROFOOD WASTES DERIVED GLASS SEALANTS FOR SOLID OXIDE FUEL CELL APPLICATIONS

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The increasing demand for sustainable energy solutions has driven interest in the utilization of agro-derived waste materials for advanced functional applications. Among these, agro-derived glasses synthesized from biomass waste, such as rice husk ash, wheat husk ash, and sugarcane bagasse ash, have emerged as promising candidates to synthesize glasses since sources of SiO_2, CaO, other alkaline earth and alkali oxides. Thus, these materials can be tailored to develop glasses, glass-ceramics for sealants and solid oxide fuel cell applications. These wastes are used to synthesize the glass and glass ceramics to study their sustainability as sealants for energy conversion devices.

ABSTRACT ID - NCSPER/0094

CHALLENGES IN GREEN WIRELESS COMMUNICATION: AN ALGORITHMIC PERSPECTIVE

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Green wireless communication focuses on enhancing energy efficiency and minimizing the environmental impact of wireless networks. From an algorithmic perspective, several challenges arise in achieving these objectives: energy-efficient resource allocation, cross- layer optimization, machine learning for energy efficiency and security and energy trade-offs. This paper comprehensively overviews the possible algorithmic interventions needed to ensure a sustainable wireless communication scenario. The algorithms discussed in this paper include those that dynamically allocate resources such as power, bandwidth, and time slots to optimize energy consumption while maintaining quality of service. Additionally, algorithms that effectively integrate renewable energy sources, like solar or wind, into wireless networks are discussed and compared. Apart from algorithms, the article discusses strategies for interactions between different network protocol stack layers, such as the physical, MAC, and network layers, to achieve global optimization.

ABSTRACT ID - NCSPER/0057

SYNTHESIS OF MOALB MAB PHASE FOR ENERGY APPLICATIONS

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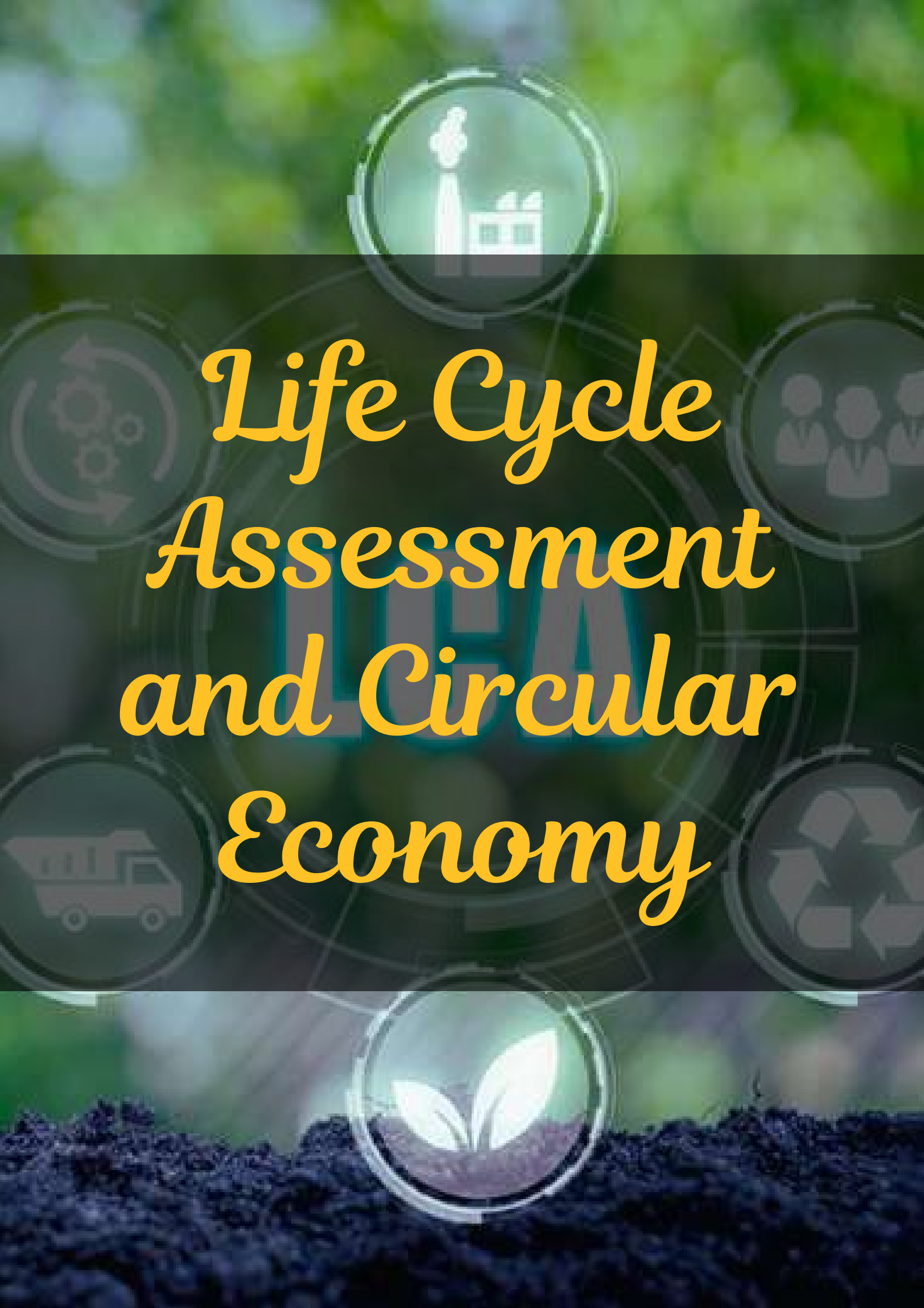
The MoAlB layered transition metal Boride is a popular material for high temperature application. It also exhibits excellent electrochemical activity towards supercapacitance. The presence of orthorhombic structure is favorable for the development of various properties such as high mechanical strength, electrical conductivity and thermal stability. Herein, we report the synthesis approach for the formation of MoAlB MAB phase. The pure MoAlB MAB phase has been synthesized by varying various parameters such as precursor composition, ball milling time and reaction temperature. The phase formation was confirmed by using X-ray diffraction (XRD) technique. The morphological features of the prepared samples were examined through Field Emission Scanning Electron Microscope (FESEM). In order to get high purity MoAlB MAB phase the processing parameter was optimized. The entire synthesis process presented in this work provides a different path way to get high purity MAB phase even at lower temperature. To explore the electrochemical performance of the MoAlB, cyclic voltammetry (CV) were carried out at various scan rates in potential window of -0.4 V to 0.4 V. It also provides a path for the synthesis of more energy-efficient and sustainable approach to MoAlB production.

ABSTRACT ID - NCSPER/0098


Life Cycle
Assessment
and Circular
Economy

EXPLORING SELF- HEALING MECHANISMS IN CONCRETE: A REVIEW

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Self-healing concrete, utilizing nanotechnology to improve the durability and resilience of concrete structures, is an innovative advancement in the world of Civil engineering. A number of variables, including age, load fluctuations, and environmental stresses, can cause traditional concrete to fracture. Nanoparticles are classified into various types on the basis of their size. With a particular goal on the use of nanomaterials including nanoparticles, nanofibers, Aluminium Oxide, Iron Oxide, Titanium Dioxide, Nano Silica, Polycarboxylates, Zirconium Oxide Nanoparticles, Silver nanoparticles along with various self-healing materials, this paper examines the processes and components involved in the creation of self-healing concrete. When fractures emerge, these materials can start healing processes. The review highlights several self-healing techniques that show great promise for self-repairing microcracks, such as the use of bacterial-based systems and encapsulated healing agents. The study also addresses the mechanical characteristics of self-healing concrete, highlighting enhancements in durability, tensile strength, and resistance against environmental deterioration. Future regulations could encourage the use of self-healing concrete in public infrastructure. By reducing waste and resource consumption, it encourages eco-friendly construction practices. Concrete that heals itself can make a structure more resilient to environmental stresses including severe weather. By reducing the need for repairs and extending the life of concrete buildings, nanotechnology not only improves the self-healing capabilities but also contributes to sustainable construction practices.

ABSTRACT ID - NCSPER/0040

A REVIEW OF DESIGN APPROACHES FOR ASPHALT PAVEMENTS IN CONTEXT OF URBAN HEAT ISLAND EFFECT

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Urban heat island (UHI) effect is a phenomenon where an urban area experiences higher temperature than its surrounding sub-urban and rural areas. This effect is due to the absorption and storage of incident solar energy by constructed man-made infrastructure, such as the asphalt pavements over the natural earthen surfaces. The heat retained by these pavements cause distress, such as rutting. To mitigate the UHI effect, many researchers have recently worked on cool asphalt pavement materials and technologies, such as reflective pavement and the use of phase change materials. The present study is focused on a review of different reflective coatings and phase change materials that have been applied in asphalt mix and its design for combating the UHI effect in asphalt pavements. Some of the reflective coatings applied over the asphalt surfaces are TiO_2, SiO_2, ZnO or Fe_2O_3. These coatings could reduce asphalt pavement surface temperature by 10 – 20°C compared to uncoated asphalt pavement depending on the type of reflective material used. The use of phase change material (PCM), such as stearic acid (SA), palmitic acid (PA), and polyethylene glycol, in modified asphalt binders also enhances the thermal properties of the asphalt pavements. Studies have shown that incorporating PCMs into asphalt pavements can significantly decrease heat retention compared to traditional pavement materials, achieving a reduction of 3 – 8°C in the pavement surface temperature. The present review highlights that continued research is needed to understand materials with a potential for reducing heat retention for future urban resilience. Moreover, economic analysis and life cycle assessments should be conducted to evaluate the cost-effectiveness and environmental impact of these materials.

ABSTRACT ID - NCSPER/0082

EXPLORING SUSTAINABLE FDM FABRICATION PRACTICES AND THEIR IMPACT ON TENSILE PROPERTIES WITH VARYING EXTRUDATE GEOMETRIES

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Refining the mechanical properties of fused deposition modeling (FDM) parts without any impact on environment always remains challenging for researchers. High-intensity polystyrene (HIPS) material has been selected as it is a low-cost, biodegradable material having excellent sustainable mechanical properties.

According to this research, it is possible to improve the tensile characteristics of FDM prints made with various extrudate geometries.Analysis of variance (ANOVA) and fractography analysis were used to determine the impact of the extrudate geometry created by combining several nozzle shapes (square, hexagonal, and circular) and diameters (0.6, 0.8, and 1.0 mm). The results indicate that specimens made of HIPS material with an extrudate that is Ø 1.0 mm hexagonal in form have the highest strength, while those with an extrudate that is Ø 0.6 mm circular have the lowest strength.

Additionally, depending on the needed application, multi-response optimisation offers potential ideal solutions.Young's modulus (YM) and maximal toughness may be achieved using a 1.0 mm hexagonal nozzle.A circular nozzle with a diameter of 0.6 mm may provide both minimum YM and maximum toughness. Additionally, the nozzle's Ø 0.8 mm hexagonal form will provide the highest YM and the lowest toughness. In order to create a link between the responses (such as breaking load, peak load, peak elongation, young's modulus, and toughness), a software program ultimately generated mathematical calculations in the form of a correlation matrix.

ABSTRACT ID - NCSPER/0099

SUSTAINABLE EXTRACTION OF CELLULOSE FROM AGRO-WASTE: A REVIEW OF TECHNIQUES AND APPLICATIONS

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Cellulose, a versatile biopolymer with diverse industrial applications, can be extracted from various agro-waste materials, offering a sustainable alternative to traditional sources. This review provides a comprehensive analysis of methods for cellulose extraction from agro-waste, including mechanical, chemical, and hybrid techniques. Herein an efficiency of each method, focusing on their environmental impact, yield, and purity of extracted cellulose has been discussed. Key agro-wastes, such as rice husks, wheat straw, sugarcane bagasse, and corn cobs are discussed in terms of their composition and suitability for cellulose extraction. Additionally, the challenges of achieving high-quality cellulose, such as the removal of lignin and hemicelluloses and silica, has been highlighted. The green extraction methods, are explored for their potential to improve extraction efficiency and reduce environmental footprints. This review also identifies the future prospects of utilizing agro-waste derived cellulose for the development of eco-friendly products, contributing to the circular economy.

ABSTRACT ID - NCSPER/0093

UPCYCLING RAMIE AGRO-WASTE INTO HIGH VALUE NUTRACEUTICALS : A SUSTAINABLE PATH TOWARDS ZERO WASTE

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The escalating issue of agricultural waste disposal demands innovative and sustainable solutions to mitigate environmental impacts. Ramie (*Boehmeria nivea*), a traditional fibre crop cultivated for its high-quality stem fibres utilized in textile industries, generates substantial agrowaste that is often left to decompose or is burned. This study explores a sustainable approach to transform Ramie agrowaste into high-value nutraceutical products, aligning with circular economy principles and advancing resource recovery. The study aimed at focusing sequential biochemical extraction involving soxhlet extraction and characterization techniques. Spectroscopic and chromatographic analyses identified a rich profile of bioactive compounds, including flavonoids, phenolic acids and tannins. The anti-oxidant, anti-inflammatory and anti-diabetic properties of extracts were assessed through DPPH radical scavenging assays, anti-inflammatory enzyme inhibition tests, and α-glucosidase inhibition assays, respectively. The results demonstrated significant bioactivity, indicating potential health benefits and industrial applicability. The study underscores the dual benefit of agricultural waste reduction and sustainable resource recovery while supporting the growing demand for plant derived nutraceuticals. By bridging the gap between waste generation and value creation, it offers a model that aligns with global sustainability goals and contributes to circular economy frameworks.

ABSTRACT ID - NCSPER/0058

Public Policy, Standardization and Legislation

THE ROAD TO PUBLIC TRANSPORT ELECTRIFICATION: A REVIEW OF TECHNOLOGICAL, ECONOMIC, AND POLICY PERSPECTIVES

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Statistical studies indicate that for every 1000 people in India, the ownership of personal cars and two-wheelers stand at 31 and 174, respectively. The low ownership of private vehicles highlights the large dependency on public transportation. Recent studies indicate that while buses meet 40 percent of the public road transportation in India, they also rely heavily on diesel energy and emit 15 percent of greenhouse gases. The transitioning of public transportation vehicles towards electric vehicles is happening, albeit at a slow pace. There are challenges due to the lack of proper charging infrastructure, high initial costs of electric buses, and limited awareness of long-term benefits. Most studies focus on private electric vehicles, with limited research on public transport electrification required for developing countries like India. The present study reviews the advantages and challenges of electrifying India's public transport system, focusing on electric buses. The findings reveal that for India to move towards increased adoption of electric buses, the technologies must be upgraded to include fast charging, battery swapping, and digital twins. From the observations, it is concluded that rapid adoption of electric public transport is imminent to help achieve sustainability goals, reduce air pollution, and improve public health.

ABSTRACT ID - NCSPER/0027

Thapar Institute of Engineering and Technology

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The Thapar Institute of Engineering and Technology (TIET) is one of India's oldest and finest educational institutions, which provides a steady source of highly skilled talent to the nation as well as overseas. Founded in 1956 with a campus spread across sprawling 250 acres, Thapar Institute of Engineering & Technology, located in Patiala, has been a pioneer in engineering education, research and innovation.

Department of Energy and Environment (DEE), sponsored by the Department of Science and Technology (DST), Government of India under the FIST Program, is a multidisciplinary department that focuses on teaching, research, and outreach activities in the domain of environment. By connecting scholars and practitioners from different disciplines, DEE seeks to raise the quality of environment research at TIET and beyond.

About Patiala

Punjab, India

Patiala is a city in southeastern Punjab, northwestern India. It is the fourth largest city in the state and is the administrative capital of Patiala district. Patiala is the erstwhile princely state of Punjab, which is situated in the Malwa region. The city covers a total area of 365 km. It is a judicious synthesis of a brilliant spectrum of Rajput, Mughal and Punjabi cultures and a fine blend of modernity and tradition. The City of Patiala is located around the Qila Mubarak (An original fort from where the city started evolving). It was constructed by chieftain 'Baba Ala Singh', who founded the royal dynasty of the Patiala State in 1763. The citizens of Patiala boastfully consider themselves the torchbearers of Punjabi culture and heritage.