



IPS Academy

Institute of Engineering & Science
Department of Chemical Engineering
Annual Magazine 2023-24

B'Reactive

Dear Readers

In continuation of our endeavors to inform, educate as well as provide an opportunity to deserving people.

This edition of Magazine 'B Reactive' embodies myriad of articles from IPS Academy, Institute of Engineering & Science, Department of Chemical Engineering. Newsletter through this edition attempts to diversify by dealing with various questions relating to chemical engineering, in the form of surveys which point to the general perception of people regarding these matters. Besides that it doesn't forget its primary objective that is to promote chemical engineering from its grass root levels.

We hope that this edition would be enjoyable as well as informative.

Editors...



Words from the desk of Head



This decade is a time of unparalleled growth and change for India, with the opening up of the frontiers of the world through globalization, there is a need for efficient competence in the global scenario. This need for competence is what that drives our Department to strive for the pinnacle of success. Since its inception in the year 2004, the Department has always strived to create a cadre of professionals who are technically and professionally proficient.

The Department prides itself on preparing the students for creative careers in industries, academia and Government agencies. 400 numbers of students have successfully graduated and are catering to the needs of society. Our accomplished courses and adept faculties not only endeavor to cover the complete syllabus but to motivate students to learn beyond the syllabus which definitely develops complete knowledge of the subject (practical and theoretical) and develop skill sets of students to become promising engineers in future.

As per the need of current growing trend, the department have initiated post graduation course from 2010 in Chemical Engineering with specialization “Computer Aided Chemical Process Plant Design”. The Department has been successfully carrying out testing & IEDC projects over two years.

Prof. Rajesh Kaushal

Head

IPS Academy

Institute of Engineering & Science

Chemical Engineering Department

Message from the Principal



Technical Education is the most potential instrument for socio-economic change. Presently, the engineer is seen as a high-tech player in the global market. Distinct separation is visible in our education between concepts and applications. Most areas of technology now change so rapidly that there is a need for professional institutes to update the knowledge and competence.

Institute of Engineering and Science, IPS Academy is a leading, premium institution devoted to imparting quality engineering education since 1999. The sustained growth with constant academic brilliance achieved by IES is due to a greater commitment from management, dynamic leadership of the president, academically distinctive and experienced faculty, disciplined students and service oriented supporting staff.

The Institute is playing a key role in creating an ambiance for the creation of novel ideas, knowledge, and graduates who will be the leaders of tomorrow. The Institute is convinced that in order to achieve this objective, we will need to pursue a strategy that fosters creativity, supports interdisciplinary research and education. This will also provide the students with an understanding and appreciation not only of the process of knowledge creation, but also of the process by which technology and knowledge may be used to create wealth as well as achieve social economic goals.

I am delighted to note that the engineering graduates of this institute have been able to demonstrate their capable identities in different spheres of life and occupied prestigious position within the country and abroad. The excellence of any institute is a measure of achievements made by the students and faculty.

Dr. Archana Keerti Chowdhary
Principal
IPS Academy
Institute of Engineering & Science



IPS Academy Indore
Institute of Engineering & Science
(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)
DEPARTMENT OF CHEMICAL ENGINEERING

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INTERNET OF THINGS

The Internet of Things refers to the network of physical objects or "things" that are embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the internet. This allows for communication and interaction between objects, making them "smart" and capable of performing tasks or providing information without human intervention. IoT applications range from smart homes and wearables to industrial automation and healthcare systems. It has the potential to revolutionize various industries and aspects of daily life. Is there something specific you'd like to know



Anuj Singh 1st year

An IoT ecosystem-consists of web-enabled smart devices that use embedded systems such as processors, sensors and communication hardware to collect, send and act on data they acquire from their environments.

ROBOTICS & DRONES

Robotics and drones are exciting fields that have seen rapid advancements in recent years. Robotics involves the design, construction, operation, and use of robots, while drones refer to unmanned aerial vehicles (UAVs) that can be remotely piloted or autonomously operated.

Both fields have a wide range of applications across various industries. In robotics, applications include manufacturing automation, healthcare (surgical robots), agriculture (agribots), and even exploration in space and underwater. Drones find use in areas like aerial photography and videography, agriculture (precision farming), search and rescue operations, environmental monitoring, and more.



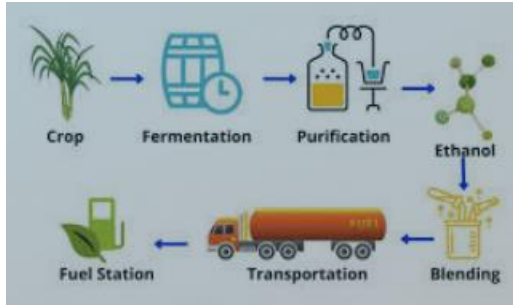
Prathviraj Singh 1st Year

Robotics is the study of robots, which are machines that can be programmed to perform a variety of tasks. Drones, also known as unmanned aerial vehicles (UAVs), are a type of robot that can be controlled remotely and used for a variety of purposes, such as aerial photography, surveying, and delivery.

These technologies have the potential to greatly impact industries, making tasks more efficient, cost-effective, and safer. However, there are also important considerations regarding ethics, privacy, and regulations that need to be addressed as these technologies become more widespread.

ETHANOL BLENDING

ETHANOL BLENDING is the practice of mixing ethanol, often derived from corn, barley, rice or sugarcane, with gasoline to create a blend of fuels. Common ethanol-gasoline blends include E10 (10% ethanol) and E85 (85% ethanol). Ethanol blending is done for various reasons, including reducing greenhouse gas emissions and dependence on fossil fuels.



Yashasvi Jhade 1st year

- Ethanol Blends The most common ethanol gasoline blends include E10 & E85.
- Environment Benefits : Ethanol is considered a more environmentally friendly fuel because it is derived from renewable sources.
- Energy Independence : Ethanol blending can reduce a nation's dependence on imported oil by promoting the use of domestically produced ethanol.
- Flexible fuel Vehicles (FFVS): Some Vehicles are designed to be [FLEX-FUEL] , Which means they can run on a range of ethanol - gasoline blends , including E85.
- Ethanol production : It is typically produced through the fermentation and distillation of crops like corn, barley, rice or sugarcane.
- The government has set a target of achieving 20% ethanol blending with petrol by 2025

Management of Industrial Waste

Management of Industrial Waste
Management of industrial solid waste is not the responsibility of local bodies or governments. Industries which are generating these solid wastes should manage such wastes by themselves. They need to take authorization from the pollution control board as well. Different procedures and methods are used to manage industrial waste. Although some basic steps involved in all processes are the same. Those basic steps are as follows:
Analysis or Separation
Collection Transportation
Recovery Recycling Disposal
Analysis or Separation - Industrial waste is separated or analysed, and some biodegradable wastes or recyclable material are kept separately. Industries should separate waste materials in different categories such as biodegradable, non-biodegradable, hazardous waste etc.
Collection and Transportation - Industrial waste must be collected and transported to waste management plants.
Recovery - In waste management plants recovery



Sujal Pathak 2nd Year

should be done. It means useful materials should be recovered from industrial wastes during treatment in waste management plants. Recycling and Disposal - If during recovery we get any useful materials then recycling should be done and disposal should be done of waste and harmful materials. Conclusion
Industrial waste is any substance that is rendered unusable during a production process such as that of factories, mills, or mining activities, and it is produced by industrial activity. Dirt and gravel, masonry and concrete, scrap metal, oil, solvents, chemicals, scrap lumber, and even vegetable waste from restaurants are examples of industrial waste. Industrial waste might take the shape of solid.

Introduction to rotating detonation rocket Engine

The Rotating Detonation Rocket Engine (RDRE) stands at the forefront of aerospace propulsion innovation, offering a transformative leap in efficiency and power. Unlike conventional rocket engines that rely on deflagration, a slow combustion process, the RDRE harnesses supersonic detonation. What makes it exceptional is the use of a rotating detonation wave, spiraling around the combustion chamber, a concept that maximizes fuel consumption efficiency and generates unprecedented thrust. This translates to cost-effective space missions, conservation of vital resources, and reduced environmental impact. Furthermore, RDRE's compact design and impressive power-to-weight ratio address weight constraints, enabling larger payloads and cost-effective launches. The potential for reusability adds another layer of economic and ecological benefit, as it aligns with the growing trend of reusable spacecraft. The RDRE is a versatile option, adaptable for missions ranging from orbital payload delivery to ambitious interplanetary endeavors. While technical challenges remain, extensive research and development efforts from renowned



Krishna Ojha
1st year

The RDRE achieved its primary test objective by demonstrating that its hardware – made from novel additive manufacturing, or 3D printing, designs and processes – could operate for long durations while withstanding the extreme heat and pressure environments generated by detonations. While operating at full throttle, the RDRE produced over 4,000 pounds of thrust for nearly a minute at an average chamber pressure of 622 pounds per square inch, the highest pressure rating for this design on record.

Additional milestones achieved during the test include the successful performance of both deep throttling and internal ignition. This successful demonstration brings the technology closer to being used with future flight vehicles, enabling NASA and commercial space to move more payload and mass to deep space destinations, an essential component to making space exploration more sustainable. Because of NASA's recent success with the RDRE, follow-on work is being conducted by NASA engineers to develop a fully reusable 10,000-

space agencies and research institutions worldwide signify a promising future, where the RDRE technology may propel us toward uncharted celestial horizons and redefine the possibilities of space exploration.

Engineers at NASA's Marshall Space Flight Center in Huntsville, Alabama, and primary collaborator IN Space LLC, located in West Lafayette, Indiana, are confirming data from RDRE hot fire tests conducted in 2022 at Marshall's East Test Area. The engine was fired over a dozen times, totaling nearly 10 minutes in duration.

The RDRE incorporates the NASA-developed copper-alloy GRCop-42 with the powder bed fusion additive manufacturing process, allowing the engine to operate under extreme conditions for longer durations without overheating

pound class RDRE to identify performance benefits over traditional liquid rocket engines.

Renewable Energy and Alternative Fuels: Shaping Sustainable Future



Anushka Mishra 1st Year

In a world facing the dual challenges of climate change and diminishing fossil fuel reserves, the importance of renewable energy and alternative fuels in shaping a sustainable future cannot be overstated. The need for cleaner, more sustainable sources of power and fuel has never been more urgent. As we stand at the crossroads of environmental crisis and energy security, the adoption of renewable energy and alternative fuels offers a beacon of hope.

Alternative Fuels: A Sustainable Transition

While renewable energy is transforming the electricity sector, the transportation sector faces its own set of challenges. Traditional gasoline and diesel fuels remain dominant, contributing to air pollution and greenhouse gas emissions.

To combat these issues, alternative fuels are becoming increasingly important. Biofuels, such as ethanol and biodiesel, are made from renewable resources like crops and waste materials. They can be used in conventional internal combustion engines with minimal modification. Electric vehicles (EVs) are another game-changer, using electricity from renewable sources to power our transportation. Hydrogen fuel cells also hold promise for long-range and heavy-duty transportation. The adoption of alternative fuels is not only an environmental choice but also an economic one. With fluctuating oil

Government Support and Policies

The transition to renewable energy and Alternative fuels is significantly accelerated by government support and policies. Incentives, tax breaks, and regulations that encourage the development and adoption

of clean energy technologies play a pivotal role. Governments worldwide are setting ambitious targets for renewable energy adoption and emission reduction. Moreover, international agreements like the Paris Agreement are driving global efforts to limit global warming. These agreements set the stage for nations to collaborate in the fight against climate change, spurring innovation and investment in renewable energy and alternative fuels.

A Sustainable Future Beckons

As we look ahead, it's clear that renewable energy and alternative fuels are pivotal in shaping a sustainable future. The path to a cleaner, more secure, and prosperous world involves embracing these technologies. The energy transition won't be without its challenges, but the rewards are undeniable: reduced emissions, improved air quality, stable energy

prices and concerns about energy security, diversifying the transportation fuel mix is crucial. By transitioning to alternative fuels, we can reduce our dependence on fossil fuels and create a more stable and resilient energy system

prices, and a healthier planet for future generations. In conclusion, the adoption of renewable energy and alternative fuels is no longer a choice but a necessity. It's a call to action that not only mitigates environmental damage but also offers new economic opportunities. By embracing these technologies, we can navigate the path toward a sustainable and resilient

Water Demineralization: Purifying the Liquid of Life

Introduction

Water is one of the most precious resources on our planet, essential for life, agriculture, industry, and countless other applications. However, not all water is created equal. In many cases, the natural composition of water contains impurities, including minerals and ions that can be detrimental to various processes and systems. To address this issue, water demineralization has become a crucial process in modern water treatment. In this article, we will explore the concept of water demineralization, its methods, applications, and its importance in ensuring access to clean and pure water.

Understanding Water

Demineralization

Water demineralization, often referred to as deionization or ion exchange, is a process that removes minerals, salts, and other impurities from water. The primary goal is to produce high-purity water with minimal concentrations of dissolved solids, making it suitable for various industrial, medical, and scientific applications. The impurities found in natural water sources include calcium, magnesium, sodium, potassium, sulfate, chloride, and other ions. While some of these minerals are essential for human health, they can have adverse effects in certain industrial processes and equipment. For instance, the buildup of scale deposits in boilers and pipelines can reduce energy efficiency and damage



Mohini Bhagat 1stYear

Power Generation: In power plants, demineralized water is used in boilers and cooling systems to prevent scale formation and corrosion, improving energy efficiency and prolonging equipment life. **Pharmaceuticals:** The pharmaceutical industry relies on demineralized water for drug manufacturing and quality control to ensure product purity.

Electronics Manufacturing: Ultra-pure water is essential in semiconductor and microelectronics manufacturing to prevent contamination and ensure high-quality products.

Laboratories: Research and analytical laboratories use demineralized water for precise and consistent experiments and instrument calibration.

Food and Beverage: Demineralized water is used in food and beverage processing to maintain product quality and safety.

Healthcare: Hospitals and

equipment. In laboratories, the presence of impurities can affect experimental results and compromise the accuracy of measurements.

Methods of Water Demineralization

Several methods are employed for water demineralization, with ion exchange and reverse osmosis being the most common techniques employed for water demineralization, with ion exchange and reverse osmosis being the most common techniques

Ion Exchange: In this process, water flows through a bed of resin beads that are saturated with ions of hydrogen (H⁺) and hydroxide (OH⁻). As water passes through the resin, cations (positively charged ions) like calcium, magnesium, and sodium are exchanged for H⁺ ions, and anions (negatively charged ions) like sulfate and chloride are exchanged for OH⁻ ions. The exchanged ions combine to form pure water (H₂O) molecules, while the unwanted ions are retained in the resin. Over time, the resin becomes exhausted and requires regeneration or replacement.

Reverse Osmosis (RO): RO is a membrane-based filtration process that uses a semi-permeable membrane to separate ions, molecules, and particles from water. Water is forced through the membrane at high pressure, allowing only water molecules to pass through while rejecting larger ions and particles. RO is highly effective at removing a wide range of contaminants, including minerals and ions. It is often used in combination with other treatment methods for achieving high-purity water

medical facilities use demineralized water for dialysis, sterilization, and other medical applications.

Water Recycling:

Demineralization is a crucial step in treating wastewater for reuse in various processes and for environmental protection.

Conclusion Water demineralization is a crucial technology that helps provide clean and pure water for a wide range of applications. Whether it's to protect industrial equipment, ensure the quality of pharmaceutical products, or support scientific research, the removal of minerals and ions from water is essential. By employing methods like ion exchange and reverse osmosis, we can ensure the availability of high-purity water, promoting efficiency, sustainability, and safety in various sectors. As the world grapples with water scarcity and the need for sustainable resource management, water demineralization continues to play a pivotal role in our journey toward a more water-secure future.

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मैं भारत हूँ मैं भारत देश हूँ,
मैं भारत देश हूँ, अलग भाषा, अलग भेष, अलग अलग
प्रदेश हूँ,

विविधता में एकता का देता मैं संदेश हूँ
, मैं भारत देश हूँ, मैं भारत देश हूँ।

सोने की चिड़िया से मेरा नाम विख्यात
है,
धन-धान्य से परिपूर्ण, विश्व भर में
प्रख्यात है।

ज्ञान का मैं सागर हूँ, विश्व गुरु कहलाता
हूँ,

नालंदा जैसी विश्व विद्यालयों से ज्ञान
विश्व को पहुँचाता हूँ।

सोचो जरा जो नालंदा जली तीन माह
तक, अपने में कितना ज्ञान समाती थी,

आज अगर वो होती तो कितनी प्रगति थी
मानव जातिकी।

जब विश्व जीना सीख रहा, ढूंढ रहा
तकनीक है,

तब अंतरिक्ष को मैं समझने लगा,
कितना आधुनिक है।



Anuj Laad 4th year

आदि से मैंने वसुधैव कुटुंबकम् का दिया संदेश है,

पुरे विश्व को एक परिवार कहा, चाहे अलग-
अलग यहाँ देश है।

अफगानिस्तान से म्यांमार हूँ मैं,
एकता की पहचान हूँ मैं,

अफगानिस्तान क हो या क हो म्यांमार,
अखण्ड भारत सबकी एक पहचान,
अखण्ड भारत सबकी एक पहचान।

COMPARATIVE STUDY OF PETROLEUM

Production and Reserves:

Compare petroleum production rates and reserves across different countries or regions. Analyze the factors influencing production levels, such as geology, technology, and investment.

2. Consumption Patterns:

Examine how different countries or regions consume petroleum. Look at transportation, industrial, and residential sectors to identify variations in energy usage.

3. Environmental Impact:

Compare the environmental impact of petroleum extraction, refining, and consumption, including greenhouse gas emissions, air and water pollution, and habitat disruption. Evaluate efforts to mitigate these impacts.

4. Economic Significance:

Analyze the economic importance of the petroleum industry in different regions, including job creation, revenue generation, and its role in national and global economies.

5. Energy Transition: Investigate how various regions are transitioning from petroleum to alternative energy sources and the policies and technologies driving these changes.

6. Geopolitical Factors: Explore the geopolitical implications of petroleum dependence and the strategies countries employ to secure access to oil reserves.



Kushagra Jain
first year

7. Price Trends: Compare petroleum price trends over time and assess the factors affecting price fluctuations, such as supply and demand dynamics, geopolitical events, and market speculation.

8. Technological Advancements: Study innovations in petroleum extraction and refining technologies and how they impact the industry's efficiency and environmental footprint.

9. Alternative Energy Sources: Evaluate the adoption of alternative energy sources (e.g., renewables, electric vehicles) as potential substitutes for petroleum.

10. Regulatory Frameworks: Compare the regulatory and policy frameworks governing the petroleum industry in different regions, including taxation, safety, and environmental regulations.

Advancements in Sustainable Processes: A Deep Dive into Green Chemistry in Chemical Engineering

In recent years, the field of chemical engineering has witnessed a paradigm shift towards sustainability, driven by the pressing need to mitigate environmental impact and address global challenges such as climate change and resource depletion. At the forefront of this movement is the emergence of green chemistry, a discipline that focuses on designing chemical processes and products that are environmentally benign, economically viable, and socially responsible. This article explores the advancements in sustainable processes through the lens of green chemistry in chemical engineering.

Understanding Green Chemistry:

Green chemistry, also known as sustainable chemistry, seeks to minimize or eliminate the use and generation of hazardous substances throughout the entire life cycle of a chemical product or process. It encompasses a set of principles and practices that promote the design of safer chemicals, the use of renewable feedstocks, energy efficiency, waste reduction, and the development of eco-friendly processes.

Key Principles of Green Chemistry:

Prevention: The best way to eliminate waste and pollution is to prevent them from occurring in the first place. Green chemistry emphasizes the importance of designing processes that minimize the generation of hazardous substances.

Atom Economy: Maximizing the efficiency of chemical reactions by ensuring that all atoms in the reactants are incorporated into the final product, thereby minimizing waste and improving resource utilization.



AMIT SINGH
4TH YEAR

Energy Efficiency: Promoting the use of energy-efficient processes and renewable energy sources to reduce energy consumption and greenhouse gas emissions associated with chemical manufacturing.

Renewable Feedstocks: Encouraging the use of renewable raw materials derived from biomass, agricultural waste, or other sustainable sources, reducing reliance on finite fossil resources. Implications for the Future:

The adoption of green chemistry principles and practices holds immense potential to revolutionize the chemical industry and pave the way for a more sustainable future. By prioritizing environmental and social responsibility, chemical engineers can drive innovation, foster economic growth, and contribute to the transition towards a circular and low-

Designing Safer Chemicals: Green chemistry advocates for the development of chemicals and products that are non-toxic, biodegradable, and environmentally benign, reducing the risk to human health and the environment.

carbon economy.

In conclusion, advancements in sustainable processes through green chemistry are reshaping the landscape of chemical engineering, offering solutions to global challenges while promoting resource efficiency, environmental stewardship, and human well-being. As we continue to push the boundaries of innovation, collaboration, and education, the vision of a greener and more sustainable chemical industry becomes increasingly attainable.

Through concerted efforts and collective action, chemical engineers have the opportunity to lead the charge towards a brighter and more sustainable future for generations to come.

Unleashing the Potential of the Fourth Industrial Revolution

The Fourth Industrial Revolution, often referred to as Industry 4.0, is ushering in an era of unprecedented technological advancement, transforming the way we live, work, and interact with the world around us. Characterized by the fusion of digital technologies, artificial intelligence, robotics, and the Internet of Things (IoT), this revolution is reshaping industries, economies, and societies at an unprecedented pace.

A New Era of Connectivity

At the heart of the Fourth Industrial Revolution lies connectivity. The proliferation of smart devices and sensors, coupled with the power of cloud computing and big data analytics, is enabling seamless communication and collaboration across physical and digital realms. This connectivity is bridging the gap between the physical and digital worlds, opening up new possibilities for innovation and efficiency across industries.

Transforming Industries

Industry 4.0 is revolutionizing traditional sectors, from manufacturing and healthcare to agriculture and finance. In manufacturing, smart factories equipped with advanced robotics and automation are optimizing production processes, reducing costs, and increasing productivity. In healthcare, wearable devices and telemedicine empowering



Tushar Tiwari 4th Year

Addressing Societal Challenges

Industry 4.0 has the potential to address some of the most pressing societal challenges, from climate change and resource scarcity to healthcare access and urbanization. Smart technologies and data-driven solutions can enable more sustainable and resilient systems, optimizing resource allocation, reducing waste, and mitigating environmental impact. In healthcare, digital health solutions have the potential to improve access to care, enhance patient outcomes, and lower healthcare costs, particularly in underserved communities.

Conclusion

The Fourth Industrial

patients and healthcare providers alike, enabling remote monitoring and personalized care. In agriculture, precision farming techniques driven by IoT sensors and data analytics are revolutionizing crop management and resource optimization.

Empowering Workforce

While the rise of automation and artificial intelligence may raise concerns about job displacement, Industry 4.0 also presents opportunities for workforce empowerment and upskilling. By automating repetitive tasks and augmenting human capabilities with advanced technologies, workers can focus on higher-value tasks that require creativity, critical thinking, and emotional intelligence. Lifelong learning and continuous skill development are becoming essential for navigating the evolving job market in this revolution

Revolution is not just about technological advancement; it's about harnessing the power of innovation to create a more inclusive, sustainable, and prosperous future for all. By embracing emerging technologies, fostering collaboration across sectors, and prioritizing ethical considerations, we can unlock the full potential of Industry 4.0 to address global challenges and shape a better world for generations to come.

HYDROTHERMAL LIQUEFACTION (HTL)

Hydrothermal Liquefaction (HTL) represents a promising pathway for bio-crude oil production from a high variety of wastes (i.e., sludge, food waste, certain plastic material, etc.). During the process, a complex aqueous by-product phase is produced containing valuable chemicals, but which also poses significant disposal challenges. The treatment of this aqueous phase, the recovery of valuable products, and understanding the downstream implications are crucial for the sustainable deployment of HTL. This article collection focuses on these critical areas, aiming to provide insights and solutions to optimize process efficiency, reduce waste, and enhance product value. The goal of this collection is to highlight the latest research, technologies, and methodologies that address the complexities of the aqueous phase. By exploring strategies to recover valuable compounds and minimize environmental impact, this edition aspires to promote sustainable practices in HTL. This Research Topic will bring together diverse voices and perspectives in the field of HTL aqueous phase treatment. We will invite authors from industrial perspectives, including those exploring HTL at Water Resource Recovery Facilities (WRRF) such as the Great

Uday Dhakad 1st year



- Anaerobic digestion of HTL aqueous phase
- Impact of HTL aqueous phase i Uday Dhakad 1st Yr upstream/downstream Lakes Water Authority, and those processes involved in building demonstration projects like Metro of Vancouver, Arbios, Steeper, and Lidea International of various technologies will be solicited to discuss the economic and greenhouse gas implications of various technologies. This unique blend of contributors ensures a comprehensive examination of the subject, bridging practical applications, innovative research, and broader societal implications. We welcome the submission of Original Research, Review, Mini-Review and Perspective articles on themes that include, but are not limited to:
 - Life cycle and/or techno-economic analysis of HTL aqueous phase treatment