Chemical Engineering Department

SCHOOL OF TECHNOLOGY
PANDIT DEENDAYAL ENERGY UNIVERSITY

NEWSLETTER

July to September - 2021
Volume 2, Issue 3

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Feature Article

HYDROGEN: THE FUEL OF FUTURE

By: Prof. Sunil Khanna (Director, SoT, PDEU)

VISION

To impart quality education in an industry research driven modules to motivate the young chemical engineers for creating knowledge wealth to help generate employability following professional ethics and focus towards a sustainable environment and benefits to the society.

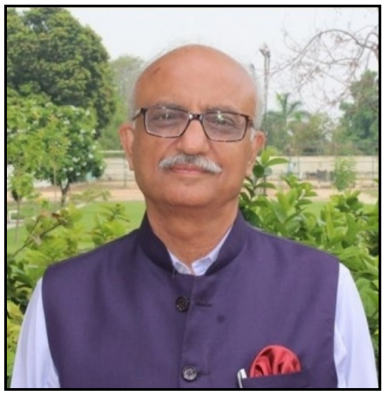
MISSION

- ♦ To facilitate the chemical engineering students with the state-of-the-art facilities with focus on skill development, creativity, innovation and enhancing leadership qualities.
- ♦ To nurture creative minds through mentoring, quality teaching & research for building a value based sustainable society.
- ♦ To work in unison with the national and international level academic and industrial partners by venturing into collaborations to tackle problems of bigger interest to society.
- ♦ To build an encouraging environment for the young faculties and staff by providing safe work culture, transparency, professional ethics and accountability that will empower them to lead the department in right spirit.
- ♦ To inculcate the culture of continuous learning among the faculties by encouraging them to participate in a professional development programs and envisage to address the social, economic and environmental problems.

EDITORIAL TEAM

Dr. Rajat Saxena (Faculty Co-ordinator)
Dr. Abhishek Yadav (Faculty Co-ordinator)
Mr. Manish Shewaramani (Staff Co-ordinator)
Mr. Kartik Popat (Student Co-ordinator)
Mr. Jimit Patel (Student Co-ordinator)
Mr. Raj Bhavsar (Student Co-ordinator)

Message from Desk...



Prof. Sunil Khanna
Director, SOT, PDEU

Director

Dear Colleagues and Students:

The advent of circular economy in Chemical systems is leading to the development of an economic system aimed at minimizing waste and making the most of resources. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models. The drivers of the circular economy would be the advances in computational modelling, data analytics, optimization tools, and next-generation bio-based catalysts to produce fuels and chemicals at scale with lower emissions.

As we @ PDEU embark on this journey of circular economy in Chemical Engineering, I am Happy to Introduce the next issue of the Newsletter which not only share with all its readers the latest news and developments in the Department of Chemical Engineering but would also be sensitizing all of us on the latest trends and developments in the adoption of the circular economy.

The limitless power of technology to do good and the conviction of my faculty colleagues and students that the golden age is ahead of us - and not behind us – brings about the best in all of us which is reflected in their achievements.

Compliments to the editorial team for their passion for perfection and unbound creativity which makes me always look forward to the next edition of the Newsletter.

Dr. Swapnil Dharaskar
HoD, Chemical Engineering

Head of the Department

It gives me immense pleasure to share newsletter of the Chemical Engineering Dept., July - September 2021. The Department of Chemical Engineering at PDEU, Gandhinagar is one of the premier departments that provides a unique educational and research environment. The primary focus of the department is to empower our students to provide them all round development. The emphasis is on building strong interdisciplinary and industrial collaborations. Our primary mission is to nurture our students with multi-dimensional skill sets. We disseminate knowledge to our undergraduate and graduate students through active research and its implementation by involving them in live projects etc.

The Department is committed to achieve excellence in these activities, and evaluates the success and leadership of its programs using the highest standards of quality, innovation, and visibility, while at the same time providing a friendly and supportive atmosphere. The students are emphasized for good academics, placements and participation in co-curricular activities. The faculty members are encouraged to publish research papers in reputed journals, participate in Faculty Development Programs and workshops through a well-supported system. The department preserves its achievements and publishes its all activities through this quarterly Newsletter. I compliment the editorial team for their creativity and hard work.

Editorial Team

Dr. Rajat Saxena
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Mr. Jimit Patel
Student Co-ordinator

Mr. Manish Shewaramani
Staff Co-ordinator

Mr. Raj Bhavsar
Student Co-ordinator

We Will Remember you!

Mr. Yash Gokani
Chemical Engineering,
PDEU (2015-2019).

Mr. Keval Makwana
Chemical Engineering,
PDEU (2017-2021).

We Convey Our Heartfelt Condolences!

Faculty Board : Publications

Journal Articles

- Pillai P, **Dharaskar S**. Zeolitic Imidazolate Framework-8 as promising nanoparticles for arsenic removal from aqueous solution. International Journal of Nanotechnology. 2021;18(5-8):414-26.
- Parmar KK, Padmavathi G, **Dash SK**. Kinetic modeling of industrial steam cracker. Journal of the Indian Chemical Society. 2021 Jul 1;98(7):100096.
- **Dharaskar S**, Desai K, Tadi KK, Sillanpää M. Synthesis, Characterization and Application of Trihexyl (Tetradecyl) Phosphonium Bromide as a Promising Solvent for Sulfur Extraction from Liquid Fuels. Industrial & Engineering Chemistry Research. 2021 Aug 1.
- Ankoliya D, Mudgal A, **Sinha M**, Philip D, Edxon Licon, Rub´en Rodríguez Alegre, Patel V,Patel J**,** Design and optimization of electrodialysis process parameters for brackish water treatment, Journal of Cleaner Production, 2021 August 19, 319, 128686.
- **Dharaskar S,** Review of membrane technology applications in wastewater treatment and biofuels.Materials Today Proceedings**.** 2021 sep.
- Mali V, **Saxena R**, Kumar K, Kalam A, Tripathi B. Review on battery thermal management systems for energy-efficient electric vehicles. Renewable and Sustainable Energy Reviews. 2021 Sep 1; 151:111611.
- Desai K, **Dharaskar S**, Pandya J, Shinde S. Ultrasound-assisted extractive/oxidative desulfurization of oil using environmentally benign trihexyl tetradecyl phosphonium chloride. Environmental Technology & Innovation. 2021 Sep 21; 24:101965.
- Bhatia P, **Dharaskar S, Unnarkat AP**. CO2 reduction routes to value-added oxygenates: a review. Environmental Science and Pollution Research. 2021 Sep 23:1-22.
- **Suriapparao DV,** Kumar TH, Reddy BR, Yerrayya A, Srinivas BA, Sivakumar P, Prakash SR, Rao CS, Sridevi V, Desinghu J**.** Role of ZSM5 catalyst and char susceptor on the synthesis of chemicals and hydrocarbons from microwave-assisted in-situ catalytic co-pyrolysis of algae and plastic wastes. Renewable Energy. 2021 Sep 29; 181:990-9.

Book Chapters

- **Swapnil Dharaskar** tilted on "Novel Applications of Carbon based Nano-materials" CRC Press (Taylor and Francis Group) July 2021.
- **Swapnil Dharaskar, Tushar Patil** titled on "Innovations in Cryogenic Carbon Capture" in Emerging Carbon Capture Technologies: Towards a Sustainable Future, Elsevier Publisher, September 2021.
- **Swapnil Dharaskar, Ashish Unnarkat** tilted on "Nanofluid based drug delivery systems" in Applications of Nanofluids in the Chemical and Biomedical Process, Elsevier Publisher, September 2021.
- Ramesh Guduru, **Anurag Gupta**, Parwathi Pillai, **Swapnil Dharaskar**, tilted on "Applications of Carbon-Based Nanomaterials for Wastewater Treatment", Environmental Applications of Carbon Nanomaterials-Based Devices, 87-133, Wiley-VCH Verlag GmbH & Co. KGaA, September 2021.
- **Swapnil Dharaskar** titled on "Emerging Technologies In Conventional And Non-Conventional Energy Sources" CRC Press (Taylor and Francis Group) September 2021.

Conference papers

- **Dr. Swapnil Dharaskar** participated and presented paper entitled on "Process intensification of ionic liquid assisted oxidative desulfurization of oil using ultrasound irradiation**"** in International Conference on Advances in Sustainable Research for Energy and Environmental Management (ASREEM-2021) organized by Chemical Engineering, SVNIT, Surat, Gujarat India during August 6-8, 2021. **(Best Paper Award).**
- **Dr. Swapnil Dharaskar** participated and presented paper entitled on **"**Trihexyl tetradecyl phosphonium bromide as an effective catalyst/extractant in ultrasound-assisted extractive/oxidative desulfurization**"** 2nd International Conference on "CHEMICAL, BIO & ENVIRONMEN held at Department of Chemical Engineering, National Institute of Technology (NIT), Jalandhar during August 20-22,2021.
- **Dr. Abhishek Kumar Gupta** participated and presented paper entitled on "Molecular Dynamics Simulations Studies of Anionic Polyelectrolytes in Divalent Salt Solutions" in the '5th Edwards Symposium - Future Directions in Soft Matter' workshop Organized by Centre of Mathematical Studies, University of Cambridge, UK, from 8th to 10th September 2021, hosted by the Newton Gateway to Mathematics.
- **Dr. Pravin Kodgire,** attended and presented paper at International Chemical Engineering Conference 100 Glorious Years of Chemical Engineering & Technology organized by Department of Chemical Engineering, Dr B R Ambedkar National Institute of Technology, Jalandhar, Punjab, India, during September 17-19, 2021. (Online Mode)

Faculty Development Programme

- **Dr. Swapnil Dharaskar** attend the international STTP on Advanced Approaches for Sustainable Environmental Management (AASEM - 2021), funded by GUJCOST, between September 20, 2021, and September 24, 2021.
- **Dr. Swapnil Dharaskar** attended webinar "Easing the Chemical Engineering Computations using MS Excel" organized by Chemical Engineering, PDEU Gandhinagar during September 03, 2021.
- **Dr. Fiyanshu Kaka** participated in FDP in Computational Methods in Chemical Engineering.
- **Dr. Fiyanshu Kaka** participated in the webinar - Augmenting Writing Skills for Articulating research organized by DST, India.
- **Dr. Fiyanshu Kaka** completed a course onPython for Data Science certification by edX.

Faculty Board : Project Details

- **Dr. Pravin Kodgire** Received a Grant for Shell Energy Project on 'Energy efficient production of biodiesel at Industrial Scale' Rs. 50 Lakhs, 2021-2024.
- **Dr. Snigdha Khuntia, Dr. Manish Kumar Sinha** submitted a project at SERB on Enhanced oxidative absorption of flue gas through ceramic membrane contactor for higher gas-liquid contact for duration of 3 years for the grant of Rs. 29,80,000.

Faculty Board Recognition

- **Dr. Pravin Kodgire** was a session chair at International Chemical Engineering Conference 100 Glorious Years of Chemical Engineering & Technology, September 17 to 19, 2021 (Online Mode) organized by Department of Chemical Engineering, Dr B R Ambedkar National Institute of Technology, Jalandhar, Punjab, India.

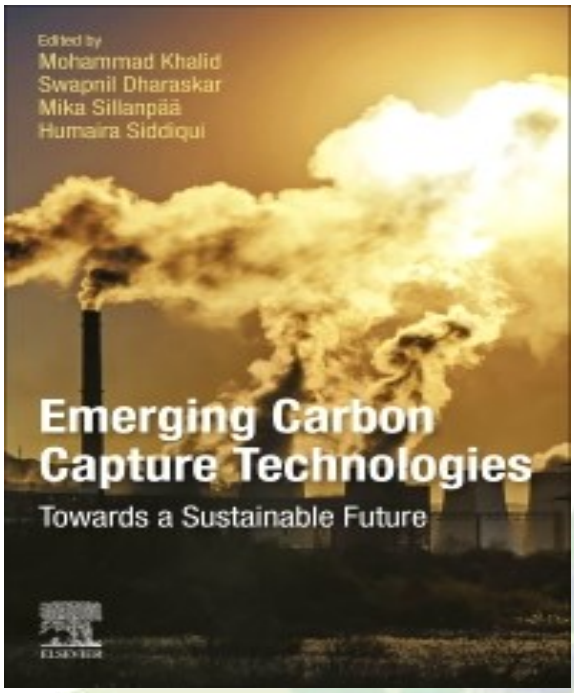
Faculty Invited as Expert

- **Dr. Swapnil Dharaskar** invited as panel expert member of Research Proposal Presentation Evaluation for Batch 2021 admission at Gujarat Technological University, Chandkheda, Gujarat during 2nd August 2021.
- **Dr. Swapnil Dharaskar** invited as Doctoral Committee expert for Ph.D proposal seminar of Ms. Rani Gupta Research Scholar, Chemical Engineering, Institute of Advanced Research, Gandhinagar, Gujarat during 6th September 2021.
- **Dr. Swapnil Dharaskar** invited as Doctoral Committee expert for Research of Mrs. Divya Tirva, Research Scholar, Chemical Engineering, Marwadi University, Rajkot, Gujarat during 28th September 2021.
- **Dr. Manish Kumar Sinha** invited as Doctoral Committee of Mr. Srijal Rana as DC member, pursuing his PhD from GTU under the supervision of Prof. Paresh Rana.

Faculty Board : Talks Delivered

- **Dr. Pravin Kodgire** Delivered a 'Popular Lecture Series' talk on "Biofuel: Current Scenario, Future Scope and Challenges" during Induction of B.Tech. 2021 batch on 23 Sept 2021.

Book Publication



Title	Emerging Carbon Capture Technologies: Towards a Sustainable Future
Editors	Mohammad Khalid, **Swapnil A. Dharaskar**, Mika Sillanpaa, Humaira Siddiqui
Publisher	Elsevier, 2022
ISBN	0323885691, 9780323885690
Length	520 pages
Subjects	Technology & Engineering, Chemical & Biochemical

Feature Article

HYDROGEN – The Fuel of the Future

In a two-part series on Hydrogen – The Fuel of the Future, the first article would draw on the demand and suitability in the various sectors of the economy in India while the second in the next issue would deal with the Hydrogen production strategies.

Hydrogen has long been the 'fuel of the future' but it is now that it is being viewed as a major player in the energy system, first due to its potential as a new low carbon fuel in context of the global climate change and second due to technology innovation in electrolysers and electricity generation from zero-carbon renewables.

In the country Hydrogen demand today is around 6 Mt per annum and would increase by at least 5-fold by 2050 to around 28 Mt, mainly driven by cost reductions in key technologies (Figure 1). This increase in demand would be largely fueled by industry sectors, such as fertilizers, refineries, steel etc. and to a lesser extent in the transport sector mainly only in heavy-duty and long-distance segments, & in the power sector as a long-term storage vector. Beyond 2050 reaching a net-zero target by 2060 could require around 40 Mt of green hydrogen, a 7-fold increase over today.

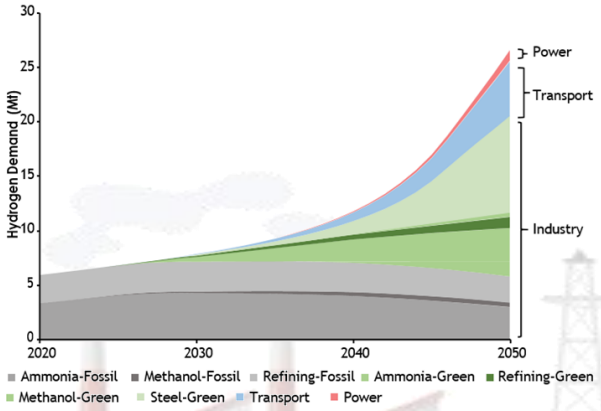


Figure 1: Hydrogen demand projection in the Low-Carbon scenario, 2020-2050

Today, hydrogen production in India is fossil fuel driven. By 2030 reduction in cost of generation from electrolysers and Solar PV the focus would shift towards green hydrogen and by 2050, nearly 80% of India's hydrogen would be 'green' – produced by renewable electricity and electrolysis.

The shift towards green Hydrogen would drive the costs of green hydrogen below Rs.150/kg by 2030 ($2/kg) – versus Rs. 300–440/kg ($4–6/kg) as of today. This reduction in price of green hydrogen will be very competitive to hydrogen produced from natural gas allowing it to make inroads into various end-use segments.

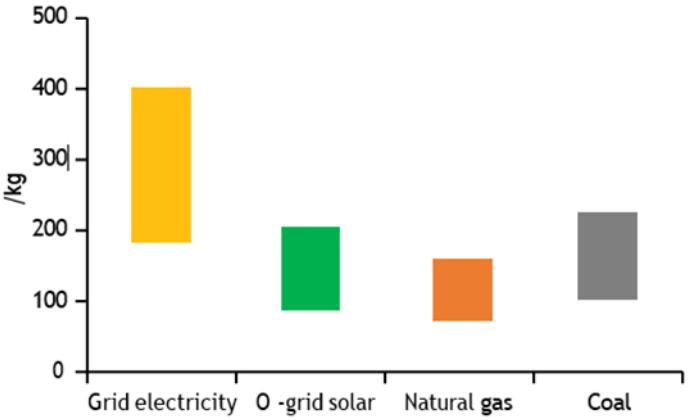


Figure 2: Levelized costs of hydrogen from different sources, 2030 range

Source: IEA, 2019; BEIS, 2018; BNEF, 2020

In India Hydrogen would play a major role as a feedstock and fuel (ammonia, steel, methanol); for high grade process heat in industry and some role as energy-dense fuels (long-duty transport and long-term electricity storage in power). Importantly, hydrogen will be competing with other low carbon technologies such as direct electrification through for example, battery electric vehicles (Table 1).

Transport: The rapid advances in the battery technologies has provided the greatest impetus towards adoption of Battery Electric Vehicles (BEVs) primarily due to lower running cost, with greater range and faster recharging times, making them more attractive to consumers. Hydrogen Fuel Cell Electric Vehicles (FCEVs) must compete with the ever-improving BEV technologies to have an impact on transport decarbonization. BEVs will dominate most of the smaller, shorter-range passenger vehicles, including two-, three-, and four- wheelers, as well as city buses and last-mile freight.

Feature Article Contd.

Sector	Use-Case	2020s	2030s	2040s
Transport	Light-duty passenger and freight transport	BEVs competitive with both FCEVs and ICEs	BEVs competitive with both FCEVs and ICEs	BEVs competitive with both FCEVs and ICEs.
	Short-distance, regular-route heavy-duty transport	BEVs becoming competitive with ICEs. FCEVs not competitive.	BEVs competitive with both FCEVs and ICEs.	BEVs competitive with both FCEVs and ICEs.
	Very long-distance heavy-duty freight transport	ICEs competitive.	FCEVs and BEVs becoming competitive with ICE.	FCEVs likely to be competitive with ICE. BEVs partly competitive.
Industry	Ammonia production	Fossil fuels competitive. H_2 becoming competitive.	H_2 competitive (ammonia and refineries) and partly competitive (steel).	H_2 from renewables competitive.
	Steel production			
	Refineries hydrogen demand			
	Methanol production	Fossil fuels competitive.	Fossil fuels competitive. H_2 partially competitive.	Fossil fuels competitive. H_2 partially competitive.
	Industrial heat	Fossil fuels competitive. Direct electrification partly competitive.	Fossil fuels competitive. Electrification increasingly competitive.	Fossil fuels likely to be competitive. H_2 and direct electrification may be partly competitive.
Electricity storage	Short-term (daily) storage	Li-ion batteries competitive.	Li-ion batteries competitive.	Li-ion batteries competitive.
	Short-term (weekly/monthly/seasonal) storage	Long-term balancing from fossil and hydro. Long-term storage needs minimal.	H_2 becoming competitive but minimal need as wind and solar still below 60-80%.	H_2 competitive. Long-term storage required in a high wind and solar system.

Table 1: The role of hydrogen across key sectors

Legend: **Brown** = fossil fuels dominate.
Yellow = direct electrification without using H_2 as an energy vector, e.g. battery electric vehicles or li-ion batteries in electricity storage.
Blue = hydrogen.
Green = mixed paradigm with several technologies including hydrogen.
Source: TERI

Featured Article Contd.

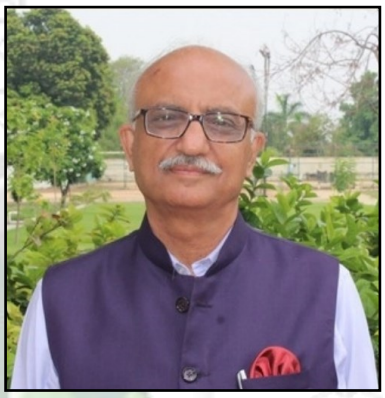
FCEVs would remain competitive in longer-distance, heavier-weight vehicle segments, such as heavy-duty trucking despite analysis from life-time emissions and environmental impact perspective, FCEVs are cleaner than BEVs and ICE vehicles due to very low requirements on raw materials, compared to the mining and heavy usage of heavy metals such as lithium and cobalt for BEVs. Further at the end of life process, FCEVs are also easier (and more economically attractive) to recycle than BEVs. Thus in transport, battery electric vehicles will be competitive across all segments and will dominate most of the smaller, shorter-range passenger vehicles, including two-, three-, and four- wheelers, as well as city buses and last-mile freight, limiting the role of hydrogen to long-distance and heavy-duty applications**.**

Power: As the role of renewable energy – solar and wind in India's electricity grid decarbonization increases more electricity storage will be required to help manage the stability of the grid. The rapid improvements in battery technologies have already been able to provide cost-effective short-term storage to manage intra-day variability. However, as the share of renewable energy in the electricity system around 2040 reaches above 60–80% of total generation hydrogen could play a role as a long-term storage vector, absorbing excess electricity during certain periods of the year, to be used again at times of sustained low renewable output.

Industry & Electricity: In industry, steel and ammonia will drive growth in hydrogen demand, followed by refineries and methanol. The decarbonization of the electric grid due to the dependence on renewables – solar and wind would require more electricity storage to help manage the variability of renewables in the stabilization of the grid. Developments in battery technologies would be able to provide cost-effective short-term storage to manage intra-day variability. Higher contribution of the variable renewables in the grid and fewer coal-fired plants to manage the longer periods of demand and supply variation, such as low wind excess electricity during certain periods of the year, to be used again at times of sustained low renewable output.

Can Hydrogen economy be the driver for the low carbon economy in the country? The jury is out in the open. Some facts. Hydrogen production is an energy-intensive process and therefore its use should be in sectors where direct electrification is not possible. Production of 1 kg of hydrogen requires 50 kWh of electricity, based on electrolysers efficiency of 70%, resulting in an energy loss of around 30%. Further energy loss occurs when this hydrogen is stored and converted back to electricity, primarily in the transport and power applications. Also CO_2 intensity of electrolytic hydrogen production is higher than that of the input fuel, electricity and so the input electricity must be very low emissions to achieve net emissions reductions. This clearly suggests that Hydrogen deployment should thus be prioritized in sectors where no alternatives exist, and its production must be based largely on zero-carbon electricity.

Currently India's dependence on oil import is 85%, natural gas – 50% and Coal is 30% which adds up to a significant expense, exposing India to the frequent price fluctuations of international energy markets. Domestic production of hydrogen from renewable electricity in the desired sectors will significantly reduce energy imports and contribute towards improving energy security. It is estimated that by 2050, annual energy imports could be reduced by around 120 Mtoe (around 20% of today's final consumption), reducing import costs by around Rs. 150,000 Cr ($20bn) each year. Thus scaling up domestically hydrogen production will significantly improve the energy security.



Prof. Sunil Khanna
Director, SOT, PDEU

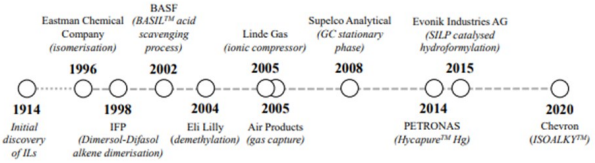
Faculty Article

IONIC LIQUIDS - Solvents for the Future

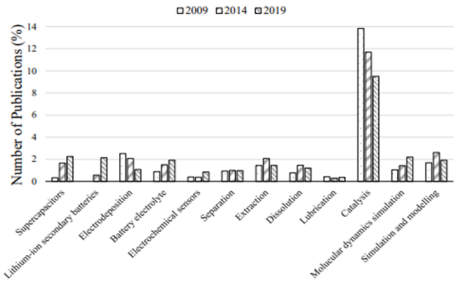
The study of ionic liquids (ILs) is exploding. The first industrial use of ILs was introduced in March 2003, and since then, the efficacy of ILs for novel chemical processes has emerged, generating booming interest in a variety of industries where ILs are the key attraction. ILs contain ions; for example, molten NaCl is an IL, but a NaCl solution in H2O is an ionic solution. The term "molten salts" has been replaced by "ILs," which are corrosive viscous media. ILs can be liquid at T (-96 C) in reality. Furthermore, ILs at room temperature are colourless and simple to handle. ILs are liquids that are full of ions and have a melting point of 100 °C. The projected benefit of replacing industrial solvents (VOCs) with non-volatile ILs is one of the major driving forces behind ILs development. VOC emissions would be prevented and pollution would be reduced if VOCs were replaced by ILs. Although ILs are commonly referred to as "green solvents," they are not inherently green; certain ILs are quite poisonous, but they can be engineered to be environmentally friendly, with significant potential for long-term growth.

Heterogeneous catalysis (solventless), water, supercritical fluids, and ILs are the four main techniques for avoiding traditional VOCs. The petrochemical industry, which is the least polluting, relies heavily on heterogeneous catalysis. Although the use of water is beneficial, certain organic chemicals are difficult to dissolve in water, and the disposal of contaminated water is costly. Supercritical fluids, which have both gaseous and liquid-like properties, are extremely useful solvents for mass-transfer, phase-transition, and nanostructured materials. The majority of chemical reactions used to be carried out in molecular solvents. The behaviour of molecular solvents has been used to understand chemistry. ILs are a new kind of solvent that has arisen in recent decades and has a number of intriguing qualities, including non-volatility, non-toxicity, a wide electrochemical window, excellent thermal stability, and application designability. They've gotten a lot of attention as green synthesis medium, and rightly so.Several authors, including Welton, Holbrey, and Seddon, have reviewed the field of ILs. The first RTIL, [EtNH3][NO3], was found in 1914, but binary ILs piqued people's interest.

In general, ILs are salts having one or both big ions and a low degree of symmetry in the cation. These factors contribute to lower the melting point of the crystalline form of the salt by lowering the lattice energy. The designability of ILs is one of the most important characteristics that makes them future energy efficient solvents. ILs can be customised to meet specific needs. Simple structural modifications in ions can control properties including melting temperature, viscosity, density, and hydrophobicity. The miscibility of water in these ILs is another important property that changes with structure. When performing solvent extractions or product separations, this behaviour can be quite useful because the relative solubilities of the ionic and extraction phases can be altered to make the separation as simple as feasible. The marketed ILs-based processes and regions where ILs are emerging are depicted in the diagrams below.



Development of commercialized ILs-based processes



The number of ionic liquid publications in 2009, 2014 and 2019, over a selection of topics found using the “Categorize” function in SciFinderTM

Dr. Swapnil Dharaskar
HoD, Chemical Engineering

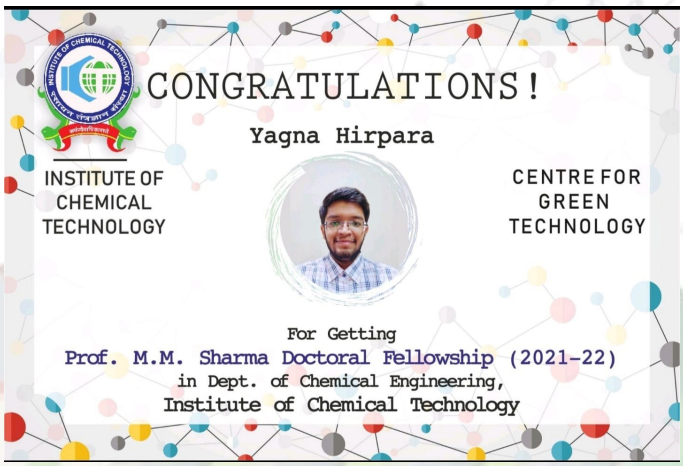
Student Board : Conference Papers

- **Mr. Nirav Prajapati and Mr. Suvik Oza,** attended conference at International Chemical Engineering Conference 100 Glorious Years of Chemical Engineering & Technology, September 17 to 19, 2021 (Online Mode) organized by Department of Chemical Engineering, Dr B R Ambedkar National Institute of Technology, Jalandhar, Punjab, India.

Student Board : Achievements

Winners of Let's Hack 4.0 by IIC, PDEU.

Ms. Shreya Singh received an award from Engineer's Association, Vapi.



Mr. Yagna Hirapara got Prof. M.M. Sharma Doctoral Fellowship in Dept. of Chemical Engineering, Institute of Chemical Technology.

Student Article

A Comprehensive Study on Complex Fuids

Complex fluids are non- Newtonian fluids that have different structure and rheology than simple fluids mainly found out due to the presence of a dispersed phase, whose length scale is large compared to molecular scales. Basically complex fluids are known to have mechanical properties between to that of solids and fluids. We have known solids that reside and fluids that take shape of the container and complex fluids having lying in the middle in terms of properties maintain their shape but eventually begin to flow.

Another distinction of properties of complex fluids to those from simple fluids would include the fact that simple fluids are purely isotropic where as complex fluids flow as fluids but are anisotropic in nature. Rheological properties include steady – state and transient shear viscosity, storage and loss moduli and different types of rheological response to external stimuli, extensional and mixed flow, the velocity gradient tensor, deformation gradient and finger tensors and the stress tensor. The classification of complex fluids are subdivided into mainly three categories:

1) Polymers, glassy liquids and polymer gels

2) Particulate suspensions, particulate gels, electro and magneto responsive suspensions, foams, emulsions and blends

3) Liquid crystals, liquid crystalline polymers, surfactant solutions and block co polymers.

Different experiments such as microscopy, neutron scattering, polarimetry, linear dichroism, Raman scattering etc. have been performed so as to study structure of these fluids objectively. Modern extensive study of structure includes use of computational methods like molecular dynamics simulation, Brownian dynamics simulation, Monte Carlo sampling, suspension simulation etc to yield a more accurate and precise result.

What are some basic on field applications of such fluids?

Applications include the hygienic movement and processing of food and pharmaceutical products, the transport of coal and ores, and the secure transportation of effluent and waste products. In such systems, these fluids are conveyed in horizontal or/and vertical pipes.

How do these fluids offer an industrial advantage?

(i) The apparent viscosity of a shear thinning fluid is a maximum at the centre of the pipe and this aids particle suspension (though some of this effect may be offset by the propensity of migration across streamlines and the enhanced settling velocities in sheared fluids)

(ii) The apparent viscosity is a minimum at the pipe wall, thus, the frictional pressure drop will be low and will increase only relatively slowly with increasing mixture velocity, hence leading to a lower power consumption

(iii) If the fluid exhibits a yield stress, it tends to assist the suspension of coarse particles in the central region of the pipe

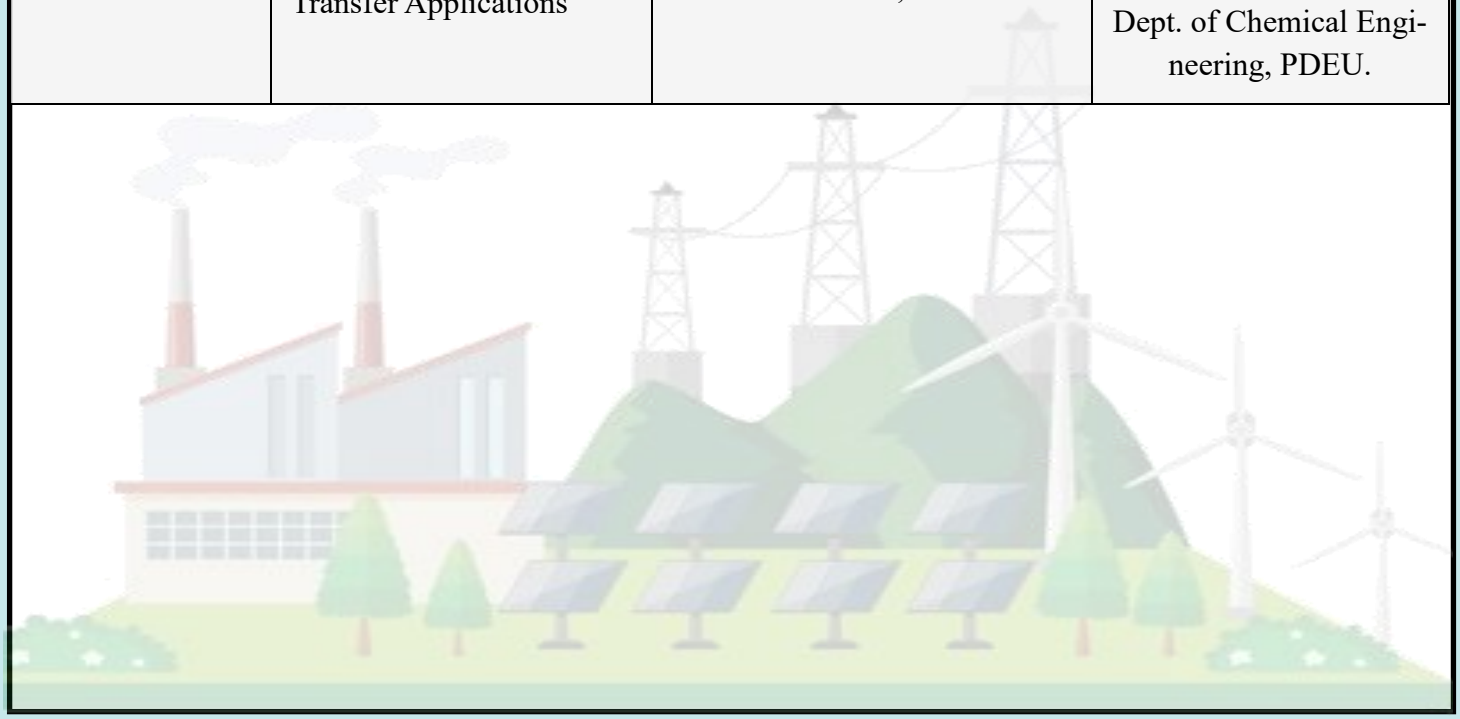
Some of our daily-use complex fluids include personal care products and our food. Our body also produces some essential “complex fluids” in form of bio fluids. Another industrial “complex fluid” is polymers, electronic and optical instruments. Thus complex fluids are now an indispensable part of our lifestyle.

Companies like Tata Consultancy Services, Bajaj Auto, Defense Research & Development Organization, Robert Bosch, Volvo Group, Cummins are at the top of the industries and are keen on CFD (computational fluid dynamics) engineers to further bring creative solutions and applications to put such fluids to use for increased output and yield an optimal efficacy.

Vanshika Jain
Chemical Engineering ,
PDEU. (20BCH032)

Departmental Events

Date	Title of Webinar	Speakers Name	Coordinators
24th August, 2021.	Carbon Dioxide to Liquid Fuel	**Dr. Mihir Kumar Purkait** Dean of Alumni and External Relations Professor, Department of Chemical Engineering Indian Institute of Technology Guwahati	**Dr. Manish Kumar Sinha** Associate Professor, Dept. of Chemical Engineering, PDEU.
9th September, 2021.	Safety in Laboratories– An Overview	**Dr. Anurag Gupta** Former Executive Director IOCL (R&D) Senior Mentor PDEU, Gandhinagar.	**Dr. Swapnil Dharaskar** HoD, Dept. of Chemical Engineering, PDEU.
21st September, 2021.	Role of CNT/Graphene Nano Particles in Heat Transfer Applications	**Dr. Sanjiv Dharwadkar,** Ex Professor, SRICT.	**Dr. Swapnil Dharaskar** HoD, Dept. of Chemical Engineering, PDEU.



Departmental Events (Glimpse)

EXPERT LECTURE

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

SOT SCHOOL OF TECHNOLOGY

AIChE The Global Home of Chemical Engineers

Carbon Dioxide to Liquid Fuel

EXPERT SPEAKER
Dr. Mihir Kumar Purkait
Dean of Alumni and External Relations
Professor, Department of Chemical Engineering
Indian Institute of Technology Guwahati

MODERATOR
Dr. Manish Kumar Sinha
Associate Professor
Dept. of Chemical Engineering
PDEU, Gandhinagar

Organized By:
Department of Chemical Engineering
School of Technology
& AICHE Student Chapter PDEU

24th August 2021, Tuesday
3:00 –4:00 pm
Platform : Microsoft Teams

SOT SCHOOL OF TECHNOLOGY

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

EXPERT LECTURE

SAFETY IN LABORATORIES - AN OVERVIEW

Dr. Anurag Gupta
Former Executive Director
IOCL (R&D)
Senior Mentor
PDEU, Gandhinagar

Organized by
IIChE Student Chapter,
Department of Chemical Engineering
School of Technology, PDEU

Platform

9th September, 2021 Thursday| 11:00 AM Onwards

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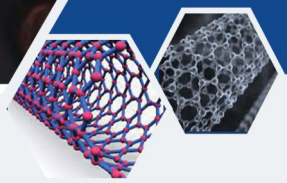
INTERNATIONAL WEBINAR

Role of CNT/GRAPHENE NANOPARTICLES in Heat Transfer Applications

Dr. Rashmi Walvekar
Associate Professor
Dept. of Chemical Engg.
Xiamen University, Malaysia.



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IIChE Student Chapter
Department of Chemical Engineering
School of Technology, PDEU

Platform

21st September, 2021 Tuesday| 11:00 AM Onwards