



ChemE Chronicles

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DEPARTMENTAL NEWSLETTER*

FROM HOD's DESK

PROF. ADITYA KUMAR

Dear friends and well-wishers,



Welcome to the third issue of **"ChemE Chronicles"**! We are approaching the end of the year, and it is a common practice during this time to reflect on the year that passed. In terms of our newsletter, although we have just reached the third issue, the readership is going stronger and more supportive with each issue! Amongst the various sections, **"Chemical Engineering News"**, **"ChemE Trivia"** and **"Feature Article"** have been highly applauded by our readers, for the unique perspective each of these sections offers. The **"Alumni ChEnect"** section, which has been a recent introduction (introduced since the previous issue), has also been immensely praised by our community of readers. We aim to continue working hard, so that our newsletter is eagerly awaited every month!

Chemical engineering has always been interdisciplinary in nature, possibly more than most branches of engineering. One of the primary reasons behind chemical engineering professionals securing employment

across a myriad of industries is the interdisciplinary nature of the chemical engineering curriculum.

To better expose the budding chemical engineers to this interdisciplinary flavour of chemical engineering, our department had successfully organised two events recently - a National Conference on Net-Zero Emissions: Challenges and Opportunities (NOET-2024), and a National Workshop on Concepts of Interfacial Phenomena in Microscale Flows: Theory and application (IPMF-2024). The details regarding these events are also present in the current newsletter.

Our placement season has started – it is that time of the year, when our graduating students (both at the bachelors and masters level) secure recruitment offers from reputed national and multinational corporations across the globe. We hope that like previous years, we would continue to receive support and patronage from the industries in this regard - please feel free to contact me in case of any queries. Wishing you all a Happy New Year 2025 in advance – hope the New Year brings in an array of opportunities for all of our stakeholders!

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Chemical Engineering News

Eco-friendly alternative to greenhouse gases in cooling

Researchers have developed a material which has the potential to replace greenhouse gas-emitting chemicals used in refrigeration and air-conditioning. The research, recently published in *Science*, discusses the development of "plastic crystals" that can work as refrigerants without global warming impact. [Read more](#)



BPCL to build India's last greenfield refinery-cum-petrochemical complex in AP

Bharat Petroleum Corporation Limited (BPCL) has decided to build a new greenfield refinery-cum-petrochemical complex in Andhra Pradesh, at an estimated cost of Rs 6,100 crores. BPCL board has approved the commencement of pre-project activities for the same. [Read more](#)



HPCL approves modernisation of Mumbai Refinery

The Board of Hindustan Petroleum Corporation Limited (HPCL) has recently approved the "Lube Modernisation and Bottoms Upgradation Project" at their Mumbai Refinery, at an estimated cost of Rs 4,679 crores. [Read more](#)



*Please send your suggestions to: che@iitism.ac.in

Alumni ChEnect

DR. VANDANA KUMARI JHA
(PhD, 2021)



Q. Welcome to the “Alumni ChEnect” interview series! Please tell us in detail about your current job.

I am deeply grateful for this opportunity to share my experiences with the *ChemE Chronicles* community. I am currently working as a Postdoctoral Fellow in the Department of Chemical Engineering at KTH Royal Institute of Technology, Stockholm, Sweden. My role involves developing a simulation framework for the crystallization of metal salts using COMSOL software, which will help to quantify the formation and growth of crystals. This project is crucial for the recycling of Li-ion batteries, making them a suitable and sustainable solution for industries. Additionally, it will also be helpful in identifying the issues that might occur during the early stages of scale-up.

Q. Please describe your academic journey, starting from school days.

My academic journey was somewhat diverse during my childhood, as I attended several schools due to my father's transferable job. This helped me to develop adaptability, along with a good foundation in science and mathematics. I was deeply inspired by my father, who was also an engineer, and aspired to follow his footsteps. Later, I pursued my undergraduate and postgraduate studies in Chemical Engineering from BIT Sindri, Dhanbad, where I developed a keen interest in subjects like heat transfer, mass transfer, fluid dynamics, thermodynamics, etc.

At BIT Sindri, I got several opportunities to participate in numerous scientific activities, like research projects, internships, and technical events, all of which helped me shape my career objectives. During my masters, I realized the beauty of research and decided to continue in this field. Overall, the academic journey has been instrumental in shaping my career and personal growth.

Q. Why did you choose chemical engineering? Was it out of passion, or driven by circumstances? Please walk us through your thoughts as a Class 12 pass-out.

As a Class 12 pass-out, I was always fascinated by the idea of becoming an electrical engineer like my father. However, while my interest in engineering was clear, I was unable to secure a seat in that branch during counselling. As a result, I chose chemical engineering as my second option because of its versatility and importance in various industries. Therefore, I can say that choosing chemical engineering was a blend of both passion and circumstances.

Q. How has IIT (ISM) Dhanbad helped you in this journey? How did the BTech/MTech/PhD programme here help shape your career path? How did the academic environment and campus life contribute to your personal growth?

IIT (ISM) Dhanbad has played a crucial role in shaping my academic and professional journey. The PhD programme at IIT (ISM) provided me with a strong technical foundation in chemical engineering, where I not only gained an in-depth knowledge of the core subjects, but also developed problem-solving and analytical skills. The exposure to cutting-edge research and software tools further enriched my learning experience. My supervisor, Prof. Soubhik Kumar Bhaumik, helped me to broaden my knowledge, and taught me how to conduct meaningful research and live with it. I learnt a lot under his guidance. I also received tremendous support from him, for which I am very grateful. The constructive feedback from other faculty members, who attended and evaluated my progress

in research presentations, also helped me to expand my knowledge and gain a deeper understanding of the practical applications of my studies. In addition to academics, campus life at IIT (ISM) Dhanbad also played a big role in my personal growth. I found a supportive and friendly environment both from my seniors and juniors. I also had the opportunity to perform teaching assistantship duties for UG/PG courses, that gave me additional confidence, thereby improving my communication and interpersonal skills. Overall, IIT (ISM) Dhanbad provided me not only with the technical skills, but also helped me grow personally, which was essential to succeed in career.

Q. What is your typical work-day like?

Typically, I start the day by setting short-term goals and making plans to organize and complete those. Since my job is mostly computational, I focus on modifying the model by analysing the solutions I obtain and going through the relevant literature. This helps me track the steps that I take towards developing the final model for the ongoing project. As collaboration is an essential part of my current job, I often have project meetings with supervisors and colleagues during the day, to discuss the progress, challenges faced, and their potential solutions. Towards the end of the day, I review my progress and revise my plan for the next day.

Q. What are the pros and cons of the profession in your honest opinion?

In my honest opinion, research profession offers both advantages and challenges, just like any other field. If we talk about pros, it provides diverse career opportunities across a wide range of industries, academia, and dedicated research-oriented institutes. I personally find research as a very beautiful field, regardless of the background, as it keeps the work interesting and dynamic, while allowing you to teach and learn at the same time. Essentially, research involves a continuous learning process, with ample freedom to set one's own objectives and execute those by defining the path in a flexible manner.

Such kind of freedom is often hard to find in non-research oriented profession. As for the disadvantages, the workload can be demanding, and high-pressure situations may arise at times, especially when facing deadlines. Sometimes, fieldwork is also required, which can be physically demanding. Additionally, there can be occasions when you may meet individuals whose thought processes do not align with yours, which can be challenging to navigate. However, despite these apparent challenges, the rewards of the profession are far more fulfilling, making it an ideal career choice for those who have an inquisitive mind and are passionate towards finding something new.

Q. How has your career evolved since you graduated, and what advice would you give to the current batch of chemical engineering students aspiring to follow a similar path?

Since graduating, I think my career has evolved in a way similar to how the chemical engineering field evolves. This is because I now find myself more involved in interdisciplinary research and collaborations, working with experts from different fields towards tackling real-world problems. This interdisciplinary exposure has greatly enhanced my understanding, and has also opened up new opportunities in both research and teaching. Based on my experience with chemical engineering over the last few years, I would advise the current chemical engineering students to respect this field and genuinely be a part of the continuous learning process. For aspiring researchers, the key to success is the ability to think critically, and maintain a positive approach towards the problems encountered. Most importantly, seeking guidance from professionals in the field is essential for sustained learning and growth in your career.

ChemE Trivia

- The Haber process, also known as the Haber-Bosch process, is the dominant industrial process for the production of ammonia, using nitrogen (from air) as the feed material. The process was developed by the industrial chemist Fritz Haber, and scaled up by the chemical engineer Carl Bosch.
- Fritz Haber, along with his assistant Rober Le Rossigno, developed the catalyst and the high-pressure devices for the production of ammonia at a laboratory scale. They demonstrated the process in 1909, and it was purchased by the German chemical company BASF.
- Carl Bosch, a chemical engineer working at BASF, was subsequently assigned with the task of scaling up Haber's table-top apparatus to an industrial scale. While Haber was able to produce only about 125 mL of ammonia per hour using his laboratory set-up, Bosch successfully developed the scale-up technology in 1910.
- Both Haber and Bosch were awarded the Nobel Prize in Chemistry, in 1918 and 1931 respectively, for their pioneering work towards overcoming the chemical and engineering problems of large-scale, continuous-flow, high-pressure technology.
- The Haber-Bosch process is possibly one of the greatest technological developments in the history of human civilisation, as the commercial production of synthetic fertilisers could be achieved via this process. It ensured that we can produce enough food for the ever-increasing population on our planet.
- Without the existence of Haber-Bosch process, we would have been able to produce only two-thirds of the amount of food that we produce today.
- However, Haber-Bosch process also had its potential share of destructive usage. Ammonia is not only useful in the fertiliser industry, but is also a key raw material for the production of explosives. During World War I, the availability of synthetic ammonia (via the process) ensured the supply line for explosives production, even when natural ammonia got exhausted. It is widely believed that without the Haber-Bosch process, World War I would have ended much earlier. Thus, as scientists and engineers, it is our moral duty to always remain vigilant, so that the scientific inventions do not get used for our own destruction.

Feature Article

Soft Matter and Chemical Engineering

- Have you ever wondered what could be the similarity in molten lava, slime of hagfish, printer ink, shampoo, toothpaste, artificial bio implants, foams, gels, or oobleck? Well, they all belong to a class of materials known as soft matter. The term "soft matter", coined by Pierre-Gilles de Gennes (won the Nobel Prize in Physics in 1991), typically refers to materials that could be physically deformed at ambient temperature with or without the application of an external force.
- Various branches of science and technology including physics, mathematics, chemistry, engineering, and bioscience are always interested to better understand the dynamics and flow behaviour of soft matter to discover novel materials and exploit their properties to develop new products for daily uses and for advanced applications. Over the past several decades, numerous theoretical, computational, and experimental research have been carried out in this field to explain some long standing mysteries such as, why does medieval glass windows flow? What makes an object to sink in quicksand? How can we make an apparent liquid polymer solution to climb up a rotating rod? Or, what is the mechanism of gene expression in biological species?
- While researchers in basic science are involved in understanding the fundamentals behind the exquisite properties of soft matter, chemical engineers are translating these knowledge to develop various products and applications including consumer goods, personalized medical treatment procedure, construction materials, defense equipment, and so on. Playing such an important role at the interface between fundamental science and technology in the field of soft matter and other allied areas, chemical engineering is among the most thriving disciplines worldwide.



PROF. ARITRA SANTRA

N0ET-2024

The third edition of the National Conference on "Net-Zero Emission Technologies for Sustainable Development: Challenges and Opportunities" (N0ET-2024) was organised by the Department of Chemical Engineering, IIT (ISM) Dhanbad, during 6-7 December 2024.

The major themes of the conference were • Energy Storage Systems • Clean Energy Innovation • Carbon Capture, Utilization & Storage (CCUS) • Green Hydrogen • Renewable Energy • Materials Science & Nanotechnology • Electro, Chemical, Bio & Photo-catalysis • Circular Economy • Other Relevant Areas

Some of the prominent speakers at the event included: Prof. Vivek Kumar [IIT Delhi], Prof. Siddhartha Panda [IIT Kanpur], Prof. B C Meikap [IIT Kharagpur], Prof. Sudipto Chakraborty [IIT Kharagpur], Prof. Pankaj Tiwari [IIT Guwahati], Prof. VVSS Srikanth [University of Hyderabad], Prof. Ashish Kumar Singh [Guru Ghasidas University, Bilaspur], Prof. Yagnaseni Roy [IISc Bengaluru], Prof. Vikram Singh [CSIR-CIMFR Dhanbad], Prof. Omvir Singh [RGIP], Dr. Shabi Thankaraj Salammal [CSIR-AMPRI Bhopal], Dr. Kunamalla Alekhya [CSIR-IIT Hyderabad], Dr. Piyush Kumar Sonkar [BHU], Dr. Jagadeeshwar Kodavaty [UPES].

In addition, a large number of bachelors, masters, doctoral and postdoctoral scholars, faculty members and scientists across IITs, NITs, CSIR laboratories, central and state universities across India took part in oral and poster presentations.

Prof. Aditya Kumar was the Convenor, while Prof. Ejaz Ahmad and Prof. Suresh Kumar Yatirajula were the Co-convenors for N0ET-2024.



IPMF-2024

A three-day Anusandhan National Research Foundation (ANRF)-sponsored workshop on "Concepts of Interfacial Phenomena in Microscale Flows: Theory and application" (IPMF-2024) was organised by the Department of Chemical Engineering, IIT (ISM) Dhanbad, during 10-12 December 2024. This workshop was being held as part of the Centenary Celebrations of IIT (ISM) Dhanbad [the Institute is going to complete 100 years in 2026].

The workshop encompassed the following themes: • Wettability and spreading • Capillary flows • Interface instability • Electrokinetic flow • Micromixing effects in complex geometries • Flow over patterned surfaces • Rheology in microscale flow

The following renowned experts and young researchers gave invited talks in the Workshop: Prof. Sunando DasGupta [IIT Kharagpur], Prof. Suman Chakraborty [IIT Kharagpur], Prof. V Shankar [IIT Kanpur], Prof. Sanjeev Kumar Gupta [IISc], Prof. Rabibrata Mukherjee [IIT Kharagpur], Prof. Dipankar Bandyopadhyay [IIT Guwahati], Prof. Rochis Thaokar [IIT Bombay], Prof. Jayanta Chakraborty [IIT Kharagpur], Prof. Prosenjit Sen [IISc Bengaluru], Prof. Aditya Kumar [IIT (ISM) Dhanbad], Prof. Soubhik Kumar Bhaumik [IIT (ISM) Dhanbad], Prof. Pawan Singh [IIT (ISM) Dhanbad], Prof. Chandi Sasmal [IIT Ropar], Prof. Bidhan Chandra [IIT (ISM) Dhanbad], Prof. Aritra Santra [IIT (ISM) Dhanbad]. A large number of bachelors, masters, doctoral and postdoctoral scholars from IITs, NITs, IISc, central and state universities across India were registered participants in the workshop.

Prof. Soubhik Kumar Bhaumik was the Convenor, while Prof. Aritra Santra and Prof. Bidhan Chandra were the Co-convenors for IPMF-2024.



Patents

1. An adsorbent/catalyst support material from the byproduct of hydrolysis of aluminium waste or scrap and a process for the preparation thereof. Date of publication: 29/11/2024 Name of the Inventors: A. Samanta, B. Prasad, S K Das and S Sen Gupta.

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