DEPARTMENT OF CHEMICAL ENGINEERING, IIT (ISM) DHANBAD

# ChemE Chronicles

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## FROM HOD'S DESK

**PROF. ADITYA KUMAR**

It gives me immense pleasure to present the May 2026 edition of *ChemE Chronicles*, the official newsletter of the Department of Chemical Engineering, IIT (ISM) Dhanbad. This newsletter continues to serve as a vibrant platform for showcasing the academic achievements, research activities, student accomplishments, and technological developments associated with our department. I sincerely appreciate the efforts of all contributors, editors, students, and faculty members whose dedication has made this edition possible.

This issue reflects the evolving and interdisciplinary nature of modern chemical engineering. The *Alumni ChEnect* section features an insightful interaction with one of our young alumni currently working in the field of photonics, simulations, and Generative AI applications. His journey highlights how a strong foundation in chemical engineering can open pathways into emerging interdisciplinary domains involving materials science, electronics, artificial intelligence, and advanced technologies.

The *Feature Article* of this edition discusses *Process Intensification*, one of the most transformative concepts in contemporary chemical engineering. The article highlights how compact, energy-efficient, and sustainable process designs are reshaping industrial practices and contributing toward greener manufacturing technologies. In addition, the *ChemE Trivia* section introduces readers to the fascinating world of *Supercritical Fluids* and their growing importance in extraction processes, pharmaceuticals, sustainable technologies, and environmentally friendly industrial operations.

This edition also highlights several encouraging student achievements and departmental activities. We are proud to share the accomplishments of our students who have secured prestigious research fellowships and leadership positions, reflecting the department's growing emphasis on research, innovation, and holistic student development. The farewell ceremony organized for the graduating students beautifully celebrated the strong bond shared within the department and marked an important milestone in their academic journey.

I encourage all readers to go through this issue and share their valuable feedback and suggestions. Let us continue working together to strengthen the culture of academic excellence, innovation, and collaboration within the department.

## What's Inside



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

## Chemical Engineering News

### Oil India Strikes Fresh Gas in Rajasthan's Dandewala Field

Oil India Limited (OIL) has announced a new natural gas discovery in Rajasthan's Dandewala field, recording an average gas inflow of nearly 25,000 standard cubic metres per day from a depth of around 950 metres.

The discovery marks the first confirmed gas presence in the shallower Sanu Formation of the field and is expected to strengthen future exploration and production activities, supporting India's domestic energy security efforts.

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### Ketjen and Imubit Partner to Introduce AI-Driven Catalyst Intelligence for Refineries

Ketjen and Imubit have partnered to develop real-time AI-powered solutions for refinery operations. This collaboration aims to enhance catalyst performance and operational efficiency through advanced machine learning and process analytics.The technology will enable refineries to monitor catalyst behavior in real time, optimizing reaction conditions and improving the reliability of fluid catalytic cracking (FCC) units.

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# Alumni ChEnect

## Hemanth Ajithkumar
## B.TECH [2020-2024]

**1 Welcome to the "Alumni ChEnect" interview series! Please tell us in detail about your current job.**

I am currently working as a Research Associate at a research lab in Nanyang Technological University. I am primarily working on spectrometry and spectral reconstruction simulations as well as on the application of Generative AI modelling for Photonic applications.

**2. Please tell us about your academic journey, starting from your school days**

I did all my schooling in my hometown of Trivandrum, Kerala. From a young age onwards, I was always enamored by technology. I particularly remember getting my first PC at the age of 7 and being in awe about the machine and being able to manipulate the operating system and play video games. As time went on, my fascination with Science grew throughout my schooling, which motivated me to prepare for JEE Mains and Advanced to obtain admission to the best engineering colleges in the country.

After successfully clearing JEE Advanced, I decided to take Chemical Engineering at IIT(ISM), Dhanbad, where I learned about Chemical engineering and all its major concepts in detail. During my undergrad, I also gained interest in Material science and Electronics through the interdisciplinary field of Photonics. Through this interest, I ended up doing a remote internship at MIT on Optical Neural Network simulations and an in-person internship at EPFL, Switzerland through the E3@EPFL internship program.

After completing my Bachelors, I decided to pursue my Masters in Materials Science and Engineering at the National University of Singapore. This decision was persuaded by my passion of Photonics and since my degree in Chemical engineering created a relatively strong base for a Materials Science masters. In this Masters, I primarily learned about Semiconductor fabrication technologies, Photonic devices and their fabrication and about sustainable technologies. I believe that both my Bachelors and Masters degrees together have molded me to become a competent engineer in the workplace.

**3. 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**

I got a rank of around 8500 for my JEE Advanced. I was initially planning to do an engineering degree on Electronics or Material science, since I already was familiar with electronics and I was already aware of my interest in working on electronic hardware and devices. However, I realized that my rank wasn't enough to get into the premier electronics engineering courses in the country. In addition, most of the Materials science courses in the IITs focused on metallurgy and material properties, with limited exposure to device characterization and fabrication, which made those curriculums uninteresting to me.

Chemical engineering on the other hand is a more fundamental field of engineering with tried-and-true curriculum and a lot of potential job prospectives. In addition, the concepts of fluid and mass transfer seemed elegant and complex, which sort of drew me into the subject which eventually persuaded me to take the Chemical engineering course at IIT(ISM), Dhanbad.

**4. What is your typical workday like?**

My typical workday is a 9-5, although my timings are usually quite flexible depending on meetings and schedule of simulations and experiments. My usual workday involves simulation and coding work, troubleshooting instruments and being part of device characterization experiments.

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

As a researcher, I am able to solve pertinent research problems and attempt to solve complex simulation paradigms and perform experiments which can be quite fulfilling and rewarding. Additionally, I get the opportunity to mentor students, which is also quite engaging. However, research is quite taxing in general and at times, the problems you solve can get slightly abstract. Moreover, depending on the projects you get, you may end up working on more theoretical concepts, which may not be appealing for some.

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

Since I have just joined a couple of months ago, I am excited to see where my own career goes and flourishes. For aspiring Chemical engineers, an important fact to consider is that the research world in general is going more interdisciplinary. More research topics pop up which combine various traditional disciplines such as Materials science (which combine elements of Mechanical engineering and Electronics, as well as a bit of Chemical engineering).

For aspiring Chemical engineers, I urge you all to broaden your horizon and get an idea about various sister engineering disciplines and the major trends going on there, since this would give a unique perspective about the engineering world in general and give you inspiration for future projects and endeavours.

## Students' Farewell

The Department of Chemical Engineering bid a warm and heartfelt farewell to the graduating students of the B.Tech. and M.Tech. batches in a memorable farewell ceremony organized by the students and faculty members of the department. The event celebrated the academic journey, achievements, and cherished memories shared by the graduating batch during their time at IIT (ISM) Dhanbad.

The program included cultural performances, interactive sessions, and speeches by faculty members and students, creating an atmosphere filled with nostalgia, gratitude, and excitement for the future. Faculty members conveyed their best wishes to the graduating students and encouraged them to uphold the values of dedication, integrity, and continuous learning in their professional careers.

The graduating students also shared their experiences, expressing sincere gratitude to the department, faculty, staff, and friends for their constant support and guidance throughout their academic journey. The occasion served as a reflection on the strong bond shared within the department and marked the beginning of a new chapter in the students' lives.

The department wishes all graduating students' great success and fulfillment in their future endeavors.

## Feature Article

### Process Intensification: Redefining the Future of Chemical Engineering

Chemical engineering has traditionally focused on developing large-scale industrial processes capable of producing chemicals efficiently and economically. However, with increasing concerns regarding energy consumption, sustainability, and environmental impact, the field has witnessed a significant shift toward *process intensification* — an approach aimed at making chemical processes smaller, safer, cleaner, and more energy efficient.

Process intensification involves redesigning conventional processes to achieve higher efficiency within compact equipment. Instead of relying on large reactors and extensive separation units, intensified systems combine multiple operations into a single unit, thereby reducing energy requirements and operational costs. Technologies such as microreactors, rotating packed beds, membrane reactors, and reactive distillation are prominent examples of this approach.

One of the major advantages of process intensification is enhanced heat and mass transfer. Since intensified systems often operate at smaller scales with larger surface-area-to-volume ratios, they allow rapid mixing and improved transport phenomena. This leads to higher reaction rates, better selectivity, and reduced by-product formation. Such improvements are particularly valuable in pharmaceutical manufacturing, petrochemical industries, and sustainable fuel production.

Process intensification also plays a crucial role in green engineering. Compact systems consume less raw material and energy while generating lower emissions and waste. In many cases, intensified processes reduce the number of processing steps, simplifying plant design and improving safety by minimizing hazardous inventories. As industries move toward sustainable and energy-efficient manufacturing, process intensification is emerging as one of the most transformative concepts in modern chemical engineering. It demonstrates how innovation in process design can simultaneously improve productivity, safety, and environmental performance, shaping the future of chemical process industries.

Prof. Khantesh Agrawal

## ChemE Trivia

### Supercritical Fluids

A supercritical fluid is a unique state of matter formed when a substance is subjected to temperatures and pressures above its critical point, where the distinction between liquid and gas disappears. In this state, the fluid exhibits properties of both liquids and gases simultaneously. It possesses liquid-like density, which provides good solvent power, while also maintaining gas-like diffusivity and low viscosity, enabling rapid mass transfer. These unusual characteristics make supercritical fluids highly valuable in modern chemical and industrial processes.

Among all supercritical fluids, supercritical carbon dioxide (SC-$CO_2$) is the most widely used because it is non-toxic, non-flammable, inexpensive, and environmentally friendly. Carbon dioxide becomes supercritical above a critical temperature of 31.1°C and a critical pressure of 73.8 bar, conditions that are relatively easy to achieve industrially. In the supercritical state, carbon dioxide can penetrate porous solids like a gas while dissolving substances like a liquid, making it an excellent extraction medium.

One of the most common industrial applications of supercritical $CO_2$ is the decaffeination of coffee and tea. Traditional solvent extraction methods often use organic solvents that may leave harmful residues. Supercritical $CO_2$, however, selectively dissolves caffeine without significantly affecting flavor compounds, resulting in a cleaner and safer process. Supercritical fluid extraction is also extensively used in pharmaceutical, food, cosmetic, and fragrance industries for extracting essential oils, bioactive compounds, and natural products.

In chemical engineering, supercritical fluids are important because they enhance heat and mass transfer rates while reducing solvent waste and environmental impact. The tunable density of supercritical fluids allows engineers to precisely control solubility and separation processes simply by adjusting temperature and pressure. This provides remarkable flexibility in process design and optimization.

Despite their advantages, handling supercritical systems requires careful engineering design due to the high operating pressures involved. Specialized equipment, pressure-resistant reactors, and accurate process control systems are essential for safe operation. Nevertheless, supercritical fluid technology continues to gain attention as industries move toward greener and more sustainable chemical processes, demonstrating how thermodynamics and transport phenomena can be applied to develop innovative industrial solutions.

# Students' Corner

The Department of Chemical Engineering is pleased to share that two undergraduate students, Kailas Krishna A and Nithin Gowda K V, have been selected as CEIP Research Fellows at the Indian Institute of Science (IISc), Bangalore. This achievement reflects the strong academic and research culture fostered within the department and highlights the students' dedication toward advanced research in the field of modelling and simulation. Kailas Krishna A is offered to work under the guidance of Prof. Debashis Roy, while Nithin Gowda K V has been selected to work with Prof. Sanjeev K. Gupta. Their selection for this prestigious research fellowship is a matter of pride for the department and serves as an inspiration for fellow students to actively pursue research and innovation in emerging areas of chemical engineering.

The department congratulates both students on their achievement and wishes them success in their future academic and research endeavors.

The Department of Chemical Engineering is pleased to share that one of its students has been elected as a Senate Member representing the first-year batch at the Students' Gymkhana, IIT (ISM) Dhanbad. The position was secured through a democratic electoral process and reflects the trust and confidence placed in the student by fellow batchmates. As a Senate Member, the student will represent the interests and concerns of nearly 1,200 first-year students and act as a vital link between the student community and the institute administration. The role involves contributing to discussions related to student welfare, campus development, and academic and extracurricular initiatives within the institute. This achievement highlights the student's leadership qualities, sense of responsibility, and commitment towards serving the student community. The department congratulates the student on this accomplishment and wishes continued success in contributing positively to the institute and the department.

# Editorial Board