DEPARTMENT OF CHEMICAL ENGINEERING, IIT (ISM) DHANBAD

ChemE Chronicles

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FROM HOD'S DESK

PROF. ADITYA KUMAR

It gives me great pleasure to present the March 2026 edition of *ChemE Chronicles*, the official newsletter of the Department of Chemical Engineering at IIT (ISM) Dhanbad. This issue reflects the vibrant academic environment, research excellence, and growing engagement of our students, faculty, and alumni.

The *Alumni ChEnect* section continues to strengthen our connection with former students, offering valuable insights into diverse career pathways. The experiences shared by our alumni serve as a source of motivation and guidance for our current students as they navigate their professional journeys.

I am particularly delighted to note the achievements featured in the *Students' Corner*. The excellent performance of our students in GATE 2026 and their selection for prestigious international research programs reflect their dedication, hard work, and academic rigour. Such accomplishments bring immense pride to the department and inspire others to strive for excellence. The *Feature Article* in this issue revisits the fundamental importance of Transport Phenomena, a subject that has shaped the very foundation of chemical engineering. It is encouraging to see how these core principles continue to evolve and find applications in modern interdisciplinary domains such as energy systems, biotechnology, and advanced materials. The *ChemE Trivia* section offers a fascinating look at Residence Time Distribution—an essential concept in reactor engineering. Understanding how fluids spend time within reactors is vital for optimising reaction efficiency, and this article brings clarity to a topic central to process control.

One of the highlights of this edition is the successful organisation of the Conference on Net Zero Emission Technologies (N0ET-2026). The conference served as a significant platform for bringing together experts from academia, industry, and policy domains to deliberate on sustainable solutions for achieving net-zero emissions. As we continue to foster innovation, I invite you all to engage, collaborate, and contribute to our collective journey. I extend my gratitude to the editorial team and our entire community for making this issue possible.

Let's continue to shape the future of chemical engineering—both in the lab and beyond.

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

What's Inside

Chemical Engineering News

Indian fertilizer, specialty chemical industries hit by US-Iran war

In the Indian chemical industry, fertilizer makers were the first affected. Now, even specialty chemical makers are beginning to feel the pain. The woes of both sectors are largely due to the scarce availability of a single molecule: ammonia, a pungent gas that is a lifeline for many chemical plants. India is one of the world's leading importers of ammonia, with most of its supplies coming from Oman, Saudi Arabia, and Qatar. Read more…

India's energy storage boom set to transform grid and renewables: IESA

India's stationary energy storage sector is charging ahead at record speed, with Battery Energy Storage Systems (BESS) projects in the pipeline now totaling 92 GWh-a stark leap from the currently installed capacity of less than 1 GWh. According to the India Energy Storage Alliance (IESA), this momentum is expected to accelerate significantly, with total installed capacity projected to reach around 346 GWh by 2033, supported by strong policy push and growing industry participation. Read more…

IESA India Energy Storage Alliance

Alumni ChEnect

Abhinav Kumar B.TECH

[2012-2016]

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

Thank you for this opportunity. After I completed my B.Tech in Chemical Engineering from IIT (ISM) Dhanbad, followed by an M.Tech in Chemical Engineering from IIT Bombay, I started my professional career as Technical Service Engineer at Ishedu AgroChem Pvt. Ltd. in Jagana, Palanpur (Gujarat). Later, I transitioned into the R&D domain when I joined Behr Process Paint (India) Pvt. Ltd. in Pune. Currently, I am working as a Senior R&D Chemist at Behr Process Paint. My role involves evaluating and formulating new raw materials, supporting the resolution of process challenges by replicating them at the laboratory scale, and working on formulation improvements for cost optimization.

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

I come from Triveniganj, a small town in Bihar, where I began my schooling. Later, I completed my matriculation from VVRS, Purnea, which is among the well-known schools in the region. After that, I moved to Kota to prepare for the JEE at Bansal Classes. Following a year of preparation there, I continued my coaching at Narayana in New Delhi, near IIT Delhi. With a combination of hard work and a lot of luck, I secured admission to the Mathematics and Computing Integrated course at IIT (ISM) Dhanbad. Through the internal branch change process, I later moved to Chemical Engineering. The four years at IIT (ISM) Dhanbad played a crucial role in shaping me as a Chemical Engineer and provided me with strong foundations in core subjects. I remain grateful to all the professors for their constant guidance and support.

After graduation, I spent about three years in Delhi preparing for the UPSC examinations. Eventually, I decided to return to my engineering roots and prepared for the GATE examination. After securing a good rank, I pursued my M.Tech in Chemical Engineering from IIT Bombay. This journey, with its different phases and experiences, has been instrumental in shaping both my academic and professional path.

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?

After clearing the JEE, I was allotted the Integrated Mathematics & Computing program at IIT (ISM) Dhanbad through the counselling process. During my first year, I opted for the internal branch change option mainly for two reasons. First, during my JEE preparation, I had developed a strong interest in Physics and Chemistry, and I felt that Chemical Engineering would allow me to build on that foundation. Second, at that stage I was not mature enough and did not yet have a complete understanding of the long-term industry trends and skill requirements. However, the transition to Chemical Engineering turned out to be a great decision and provided me with a strong platform to build my career.

4. How has IIT (ISM) Dhanbad helped you in 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 played a very important role in shaping both my academic and professional journey. The B.Tech programme provided me with a strong foundation in core Chemical Engineering subjects, which has been extremely helpful in my professional career. The rigorous curriculum, laboratory exposure, and problem-solving approach helped me develop analytical thinking and a practical understanding of engineering concepts. Another key aspect was the guidance and mentorship from professors, who were always supportive and encouraged us to think critically and explore beyond textbooks. Their insights helped me build confidence in my technical abilities. Apart from academics, campus life also contributed significantly to my personal growth. Interacting with peers from diverse backgrounds, participating in various activities, and managing academic responsibilities taught me teamwork, adaptability, and time management.

Overall, my time at IIT (ISM) Dhanbad helped shape my mindset as an engineer and prepared me well for the challenges of professional life.

5. What is your typical work-day like?

Currently, I am working as an R&D Chemist in a paint manufacturing company. My role involves evaluating and developing new formulations to ensure that our products maintain their competitive position in the market. I also collaborate closely with cross-functional teams to identify potential improvements in formulations and processes, with the goal of enhancing product performance while optimising costs and maximising overall company value.

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?

Based on my experience, I would like to share a few thoughts with young engineers. If someone wishes to continue in the core engineering field, preparing for the GATE examination can be a great pathway, especially for opportunities in PSUs and higher studies. If you feel passionate about a different field, do not hesitate to pursue it. However, it is important to stay consistent, be patient, and remain committed to your goals—hard work eventually pays off. Finally, this phase of life is the best time to explore new interests and opportunities. If there is something you truly want to try, it is worth giving it a chance. Exploration often leads to valuable experiences and personal growth

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

As a professional, one learns continuously through experience. In the workplace, we get the opportunity to apply the concepts we studied, often in situations that involve many practical variables. We also learn to collaborate with different departments, interact with people who have diverse perspectives, and adapt to new instruments and emerging technologies. Over time, these experiences help shape both technical and interpersonal skills. I believe that consistent growth in any profession requires dedication, discipline, and a willingness to keep learning.

Students' corner

GATE 2026

Himanshu Gupta (4th year), Soumyajit Ghosh (3rd year), Ankush Choure (4th year) and Narendra Kumar (4th year), Abhinav Kumar (3rd year), all UG Chemical Engineering at IIT (ISM) Dhanbad, secured All India Ranks of 101, 140, 293, 358, and 430 respectively, out of 14,077 candidates in GATE CH 2026, conducted by IIT Guwahati. Hearty congratulations and best wishes to the star performers!

The Graduate Aptitude Test in Engineering (GATE) continues to be the pioneer undergraduate-level exam for engineers in India, offering a path to prestigious careers in Public Sector Undertakings (PSUs) or postgraduate specialisations—such as M.Tech, MS, or PhD—at elite institutions like the IITs, IISc, or foreign universities, such as the Technical University of Munich in Germany or the National University of Singapore. Good ranks open numerous opportunities for major PSUs, including Engineers India Limited (EIL), Gas Authority of India Limited (GAIL), the Bhabha Atomic Research Centre (BARC), and the Nuclear Power Corporation of India Limited (NPCIL), which primarily operates nuclear power plants.

NUS National University of Singapore

Abhinav Kumar (3rd year UG Chemical Engineering) has been selected for the prestigious IRIS @ NUS programme at the National University of Singapore. As a third-year undergraduate student in the Department of Chemical Engineering, IIT (ISM) Dhanbad, this opportunity allows him to gain valuable international academic exposure.

As part of this programme, he will undertake a two-month research internship from 25 May to 24 July 2026. During this period, he will work under the guidance of Dr. Rahul Prasanna Misra in the Department of Chemical & Biomolecular Engineering at NUS College of Design & Engineering. This achievement reflects his academic dedication and interest in research. We all wish him good luck for this assignment!

Feature Article

Transport Phenomena – Subject that transformed Chemical Engineering

The development of Chemical Engineering as a major discipline started in the early 20th century, when the production of essential chemicals such sulfuric acid, nitric acid, soda-ash, ammonia, etc. moved from the laboratory scale to large industrial scale. Chemical Engineers were mostly dealing with unit operations, involving physical and chemical transformation of raw materials into finished products using electrical and mechanical equipment. The issues in chemical plants were generally solved based on prior experience or empirical correlations. However, post World War II, deeper understanding of the chemical processes in the industry became essential.

Before 1950s, chemical engineering students were taught separate subjects on fluid mechanics, heat transfer, and diffusion focusing on individual chemical processes. In the late 1950s, Prof. R. Byron Bird, Prof. Warren E. Stewart and Prof. Edwin N. Lightfoot introduced a course at the University of Wisconsin-Madison unifying fluid dynamics, heat transfer, and mass transfer. This led to the publication of the textbook on Transport Phenomena (1960).

Since its inception, the subject has transformed the perspective of Chemical Engineering. Transport Phenomena provides mathematical equations based on the fundamental laws of physics to predict the behaviour of chemical processes. There are hardly any processes where heat, mass, or momentum transfer takes place in isolation, making a holistic approach essential.

Over the years, Transport Phenomena has broadened the field of Chemical Engineering. The study is no longer limited to chemical reagents, petroleum refining, soaps or shampoos, but has extended to bio-process engineering, food processing, drug delivery, space technology, energy storage and utilization. Chemical Engineers cater to these sectors due to their expertise in Transport Phenomena, which provides a unifying knowledge base and analytical skill set.

Prof. Aritra Santra

ChemE Trivia

Residence Time

In chemical engineering, residence time is a fundamental concept defined as the average duration a fluid element—whether a molecule, particle, or parcel of gas or liquid—spends inside a specific control volume, such as a reactor, distillation column, or pipe. While it is most commonly expressed mathematically as the mean residence time, denoted by the Greek letter tau (τ), which is calculated by dividing the reactor volume (V) by the volumetric flow rate (Q) ($\tau = V/Q$), the reality of fluid flow is rarely ideal. This leads to the critical concept of the Residence Time Distribution (RTD), which describes the probability distribution of the time that different fluid elements spend within the equipment, recognising that in real-world systems like a Continuous Stirred-Tank Reactor (CSTR), some molecules may exit almost instantly while others remain for extended periods.

The control of residence time is central to chemical engineering because it directly dictates the trade-off between conversion and selectivity in chemical reactions; a longer residence time generally increases the conversion of reactants, but may also promote unwanted side reactions, creating an optimal window for maximising desired products. Consequently, it serves as the primary driver for reactor sizing, as the required volume is directly proportional to the desired residence time for a given throughput, creating a critical balance between capital expenditure (reactor size) and operational efficiency (yield).

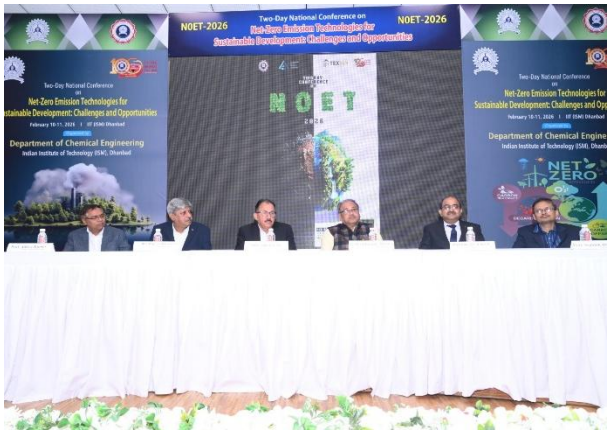
In multiphase reactors—such as those involving gas-liquid, liquid-solid, or gas-liquid-solid interactions—engineers must consider distinct residence times for each phase independently, as the gas holdup time may be significantly shorter than the liquid residence time, while solid catalysts may have residence times measured in months due to slow catalyst deactivation and periodic replacement. These disparities create complex dynamics, where mass transfer limitations between phases can effectively decouple the bulk residence time from the actual contact time at the reaction site, making the distinction between nominal residence time and true contact time essential for accurate modeling. Operationally, residence time analysis serves as a powerful diagnostic tool; deviations from expected residence time distribution often reveal underlying issues such as dead zones where the material stagnates and degrades, channeling where fluid bypasses the intended flow path, or excessive back-mixing that reduces conversion efficiency.

Conference on Net Zero Emission Technologies: Challenges and Opportunities for Sustainable Development (N0ET-2026)

The Conference on Net Zero Emission Technologies: Challenges and Opportunities for Sustainable Development (N0ET-2026), organised by the Department of Chemical Engineering, IIT (ISM) Dhanbad, was held during February 10th–11th, 2026. The conference brought together a distinguished assembly of eminent speakers from the Indian Institutes of Technology (IITs), along with experts from leading industries, policymakers, and a diverse group of internal and external participants. The event served as a dynamic platform for interdisciplinary dialogue, fostering collaboration between academia, industry, and government bodies to address the pressing challenges of climate change and sustainable development. The central theme of the conference revolved around achieving net-zero emissions, a concept defined as balancing anthropogenic greenhouse gas (GHG) emissions with their removal from the atmosphere. This objective is critical for mitigating global warming and ensuring long-term environmental sustainability. The conference highlighted that achieving net-zero emissions is not merely an environmental aspiration, but an urgent necessity, aligned with global commitments such as limiting the rise in average global temperature to 1.5 °C, as envisioned under the Paris Agreement.

Throughout the two-day event, experts shared valuable insights into cutting-edge research, innovative technologies, and evolving policy frameworks. Key areas of focus included carbon capture, utilization and storage (CCUS), direct air capture technologies, hydrogen and hydrogen-based fuels, bioenergy, renewable energy systems, and advanced energy storage solutions. These technologies represent essential pathways toward decarbonising conventional energy systems and industrial processes. However, speakers emphasised that each of these areas faces significant techno-economic and scalability challenges, that must be addressed through sustained research and collaborative efforts. A notable strength of the conference was the integration of academic perspectives with real-world industrial experiences. Industry representatives shared case studies and practical insights into the implementation of low-carbon technologies, highlighting both successes and existing barriers. This exchange ensured that discussions were grounded in reality, enabling participants to better understand the gap between laboratory-scale innovations and large-scale deployment.

The conference also underscored the importance of policy support and institutional frameworks in driving the transition to a low-carbon economy. Participants discussed the need for targeted research funding, supportive regulations, and incentives to accelerate the adoption of clean technologies. It was widely acknowledged that no single sector can achieve the net-zero goal independently; rather, it requires coordinated action among academia, industry, and the public sector. In addition to technical sessions, the conference provided opportunities for networking and collaboration, enabling young researchers, faculty members, and industry professionals to engage with leading experts. Such interactions are expected to foster future research partnerships and innovative solutions to complex sustainability challenges. Overall, N0ET-2026 successfully highlighted both the challenges and opportunities associated with achieving net-zero emissions. By bringing together diverse stakeholders and promoting knowledge exchange, the conference reinforced the collective commitment toward building a sustainable, resilient, and decarbonised future.



Editorial Board