ChemE Chronicles

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FROM HOD's DESK

PROF. ADITYA KUMAR

It is with immense pleasure that I present the April 2026 edition of *ChemE Chronicles*, the official newsletter of the Department of Chemical Engineering at IIT (ISM) Dhanbad. Through every edition, the newsletter strives to strengthen communication and engagement among students, alumni, faculty, and all those associated with the department. I would like to sincerely thank all the contributors for their commitment and hard work in making this edition possible.

This edition highlights a wide range of academic, research, and student-centric activities carried out within the department. The *Alumni ChEnect* section includes an insightful interaction with one of our undergraduate alumni, shedding light on the diverse career prospects that can emerge from a solid background in chemical engineering. Such experiences serve as a source of guidance and motivation for students as they shape their academic journey and future careers.

The *ChemE Trivia* section discusses Water Expansion and the different techniques used for its production, highlighting the vital role played by chemical engineers in healthcare infrastructure and other essential sectors. The Feature Article in this edition focuses on the Navier–Stokes equations and their profound impact on chemical engineering applications. The article highlights the importance of fluid flow analysis in the design of pipelines, reactors, heat exchangers, and other process equipment, while also discussing the growing role of Computational Fluid Dynamics (CFD) in modern industrial and energy systems. It illustrates how fundamental principles of fluid mechanics continue to drive innovation, process optimization, and technological advancement in chemical engineering.

This edition also showcases recently published research articles, demonstrating the department's growing focus on innovation, industry-relevant research, and the development of intellectual property. Furthermore, we warmly welcome the newly enrolled undergraduate students and wish them a fulfilling and enriching experience throughout their academic journey in the department.

I encourage all readers to go through this issue and share their valuable opinions, feedback, and suggestions. Let us continue working together to promote excellence in education, research, and innovation in the field of chemical engineering.

What's Inside

Chemical Engineering News

Adani Total Gas caps FY26 with growth surge despite global headwinds

Adani Total Gas closed FY26 on a strong note, delivering steady growth across volumes, infrastructure, and earnings—even as global energy markets reeled under geopolitical shocks. The city gas distributor reported a 14% year-on-year jump in volumes to 1,133 MMSCM for FY26, alongside EBITDA rising 5% to Rs. 1,225 crore. In the fourth quarter alone, volumes climbed 13% to 297 MMSCM, while EBITDA rose to Rs. 310 crore. Read more

adani Gas

Specialty Chemicals' Power Shift: From manufacturing scale to orchestration & control

A new report from Redseer Strategy Consultants signals a structural shake-up in the global specialty chemicals industry—one where control is shifting away from manufacturing scale and toward orchestration, formulation ownership, and deep customer integration.
Read more

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

Alumni ChEnect

Gajesh Gaurav
B.TECH [2012-2016]

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

I am Gajesh Gaurav, graduated from IIT (ISM) Dhanbad with a Bachelor's degree in Chemical Engineering. I am currently working as a Process Design Engineer at Oil and Natural Gas Corporation (ONGC), where I am responsible for the design and optimisation of upstream oil and gas processing facilities. My role combines process design, simulation, and cross-disciplinary coordination within FEED and EPC project environments. A significant part of my work involves developing and reviewing Process Flow Diagrams (PFDs) and Piping and Instrumentation Diagrams (P&IDs), ensuring that process intent, control strategies, and safety systems are properly defined. I perform material and energy balances, process simulations using Aspen HYSYS, and equipment sizing for systems such as separators, gas dehydration units, and flare systems. I also prepare and review technical specifications and datasheets for process equipment and coordinate with vendors to ensure compliance with design requirements and applicable standards. In addition to design activities, I contribute to process safety and risk management through active participation in HAZOP and HAZID studies, where I help identify potential hazards and define mitigation measures. I am also involved in the design and analysis of relief and flare systems, ensuring safe operation under both normal and upset conditions. My role requires close collaboration with multidisciplinary teams, including mechanical, piping, electrical, and instrumentation engineers, to deliver integrated and constructible designs. I support project execution from concept through detailed engineering, and contribute to technical discussions, design reviews, and decision-making processes. Alongside design responsibilities, I support process optimisation and techno-economic evaluations, identifying opportunities to improve efficiency, reduce operational costs, and enhance overall system performance. This includes evaluating different process configurations and recommending improvements based on both technical and economic considerations.

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

My academic journey has been quite gradual and evolving rather than something that was always perfectly structured from the beginning. During my school days, I consistently performed well in science and mathematics, and I also had a good interest in subjects like geography and history. However, I was comparatively weaker in languages, especially English and Hindi, which reflected in my overall performance at that time. Alongside academics, I was quite actively involved in sports, particularly cricket and badminton, which I enjoyed a lot and spent a significant amount of time on. A turning point came around class 9, when I became more conscious of my academic direction. I started putting in more balanced effort across all subjects, including improving my language skills. At the same time, I consciously reduced the amount of time I spent on sports to focus more on studies. This shift helped me become more disciplined and consistent. In classes 11 and 12, my focus became much clearer. Like many engineering aspirants, I dedicated myself primarily to Physics, Chemistry, and Mathematics, with the goal of performing well in competitive entrance examinations. Those two years were quite intensive and structured, with a strong emphasis on problem-solving, concept clarity, and regular practice.
My efforts resulted in a good rank in the engineering entrance examinations, which gave me multiple options. I received admission offers from Indian Institute of Technology (Indian School of Mines) Dhanbad, Indian Institute of Technology Patna (which was relatively new at that time), and Birla Institute of Technology and Science, Pilani, across different engineering branches.

After considering these options, I chose to pursue a Bachelor of Technology in Chemical Engineering at Indian Institute of Technology (Indian School of Mines) Dhanbad. The institute's legacy, strong foundation in core engineering disciplines, and learning environment were key factors in my decision. Overall, my academic journey has been shaped by gradual improvement, increasing clarity of goals over time, and the ability to adapt and focus when it mattered most.

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

To be honest, at the time of finishing Class 12, my decision was more driven by circumstances than by a clear passion for a specific branch. Like many students in that phase, I was strongly influenced by what I saw around me. A lot of my friends, seniors, and relatives were aiming for Computer Science, and there was a lot of discussion about high salary packages and opportunities in multinational companies. Naturally, that created an initial inclination in me as well to pursue Computer Science, largely because it seemed like the most "rewarding" and talked-about option. However, at that stage, I would say my understanding of different engineering disciplines was quite limited and somewhat superficial. There wasn't enough structured guidance available to help us deeply understand what each branch actually involved in terms of subjects, career paths, or long-term growth. So, like many students, my decision-making was based more on available information, rank, and options at hand, rather than a well-informed passion. When I received admission offers, I had the opportunity to join institutions like Indian Institute of Technology (Indian School of Mines) Dhanbad, Indian Institute of Technology Patna, and Birla Institute of Technology and Science, Pilani across different branches. Eventually, I chose Chemical Engineering at IIT (ISM) Dhanbad, primarily influenced by the institute's legacy and my admission rank. So yes, at that point, the choice of Chemical Engineering was largely circumstantial. However, this perspective started to change quite quickly once I began my first semester. As I got exposed to subjects like thermodynamics, mass transfer, and fluid mechanics, I began to appreciate the depth and real-world applicability of the field. Over time, I realized that Chemical Engineering is not just limited to traditional industries but spans across energy, materials, pharmaceuticals, and emerging areas like clean technologies.

As the course progressed, my understanding became clearer—not just academically, but also in terms of career opportunities and industry relevance. Placement statistics, interactions with seniors, and exposure to different career paths helped me see the field in a much more practical and informed way.
So, if I reflect on it now, my journey with Chemical Engineering started as a circumstantial choice, but gradually evolved into a well-understood and appreciated career path. That transition—from uncertainty to clarity—was an important part of my overall development.

4 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?

My time at Indian Institute of Technology (Indian School of Mines) Dhanbad played a defining role in shaping both my career path and personal development. From an academic perspective, the Chemical Engineering programme provided a strong foundation in core subjects such as thermodynamics, fluid mechanics, heat and mass transfer, and reaction engineering. More importantly, it trained me to think analytically, approach problems in a structured way, and connect theory with real-world applications. This way of thinking has stayed with me throughout my professional career, especially in process design and problem-solving roles. The institute also exposed me to a competitive yet collaborative academic environment, where you are constantly surrounded by highly capable peers. This naturally pushes you to improve, while also teaching you how to learn from others and work in teams—something that is very important in engineering careers. Beyond academics, the campus life at IIT (ISM) Dhanbad is one of its biggest strengths. Since the programmes are fully residential, your batchmates gradually become like family. Seniors play the role of guides and mentors, helping you navigate academics, internships, and career decisions. At the same time, as you grow, juniors begin to look up to you, which builds a sense of responsibility and leadership. Professors are also very approachable and supportive, often acting as mentors beyond just academics.

5. What is your typical work-day like?

My typical workday as a Process Design Engineer at Oil and Natural Gas Corporation (ONGC) is quite dynamic, but it generally revolves around a mix of engineering design work, coordination, and problem-solving. I usually start my day by reviewing pending tasks, emails, and project priorities, especially for ongoing FEED or EPC assignments. Based on the project stage, a significant portion of my time goes into core process engineering activities—such as developing or reviewing Process Flow Diagrams (PFDs) and P&IDs, performing material and energy balances, and running process simulations in Aspen HYSYS. These tasks help in validating design assumptions and ensuring that the process is both technically sound and efficient. Another key part of my day involves equipment sizing and preparing or reviewing datasheets for various process equipment like separators, dehydration units, and pressure relief systems. This often requires coordination with vendors and other engineering disciplines to ensure that the design is aligned across mechanical, piping, instrumentation, and control requirements.
Meetings and discussions are also a regular part of the day. I interact with multidisciplinary teams to resolve design issues, participate in design reviews, and sometimes contribute to HAZOP or HAZID studies, where we assess safety and operability aspects of the system.

Depending on project needs, I may also work on process optimisation or troubleshooting studies, analysing data to identify improvements in efficiency, reliability, or cost. In some cases, this involves evaluating different design options and supporting techno-economic decision-making. Overall, my workday is a balance between technical analysis, design development, collaboration, and continuous learning, with each day bringing slightly different challenges depending on the project stage and priorities.

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

From my experience as a process engineer, I would say it is a very rewarding profession, but it also comes with its own set of challenges. I'll try to give a balanced and honest view.

Pros:
One of the biggest advantages is the nature of the work itself. Process engineering involves solving real-world problems—whether it is designing a new plant, improving efficiency, or ensuring safe operations. You can actually see the tangible impact of your work in large-scale industrial facilities.
Another strong positive is the diversity of opportunities. As a chemical engineer, you are not limited to one industry. You can work in sectors like oil & gas, pharmaceuticals, energy, chemicals, and emerging areas like clean technologies and hydrogen. This flexibility allows you to adapt your career over time based on interests and industry trends.
The profession also builds a strong analytical and problem-solving mindset. You are constantly required to think critically, work with data, and make decisions that balance safety, efficiency, and cost. Over time, this develops a very structured way of thinking that is valuable in many roles.

Cons:
At the same time, there are some challenges. One of them is that the work can be highly demanding and responsibility-driven, especially when dealing with safety-critical systems. Even small errors in design or operation can have significant consequences, so there is always a need for attention to detail and accountability. In some roles, especially in industries like oil & gas, the job may involve remote locations, offshore assignments, or site work, which can affect work-life balance at times. Another aspect is that career growth and compensation in core engineering fields may not always match the pace seen in some other domains like IT, especially in the early years. This can sometimes be a concern for fresh graduates. Also, depending on the role, there can be a significant amount of documentation, standards compliance, and repetitive checks, which, while necessary, may feel less exciting compared to pure technical problem-solving.

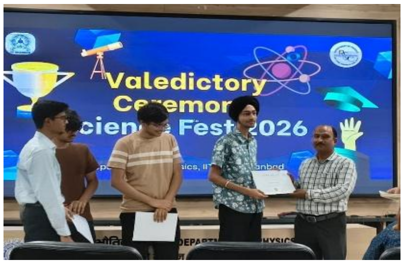
Overall Perspective:
Overall, I see process engineering as a long-term, stable, and intellectually fulfilling career, especially for those who enjoy working on complex systems and real-world challenges. While it may not always offer instant rewards, it provides deep technical expertise, diverse opportunities, and meaningful impact, which become more valuable over time.

7. What advice would you give to current Chemical Engineering students?

Based on my experience, I would suggest a few things:
1. Build strong fundamentals: Subjects like thermodynamics, fluid mechanics, and mass transfer are not just for exams—they form the foundation of your entire career.
2. Be open to starting anywhere: Your first job may not be exactly what you imagined, but every role teaches you something valuable.
3. Focus on practical understanding: Try to go beyond textbooks—understand how processes actually work in real plants.
4.Develop problem-solving and communication skills: Technical knowledge is important, but equally important is your ability to explain ideas, work in teams, and take decisions.

Closing thought
If I look back, my journey has not been perfectly planned, but it has been progressive and learning-driven. For students, the key is to stay curious, stay consistent, and keep building skills—the direction becomes clearer with time.

Students' corner



Adhiraj Singh, a 1st Year B.Tech student, recently participated in the Physis Techne Symposium organised by the Department of Physics and secured 1st position in the Electronics Division. The symposium focused on transforming mathematical concepts into computational and technological applications. His problem statement involved recovering a hidden message from a damaged spacecraft using a weak and distorted radio signal received on Earth. Working with a highly noisy 15 GB dataset, he processed the signal by isolating noise, correcting distortions, identifying the encoding method, and decoding the hidden message into meaningful information. Well done, Adhiraj!

Jharkhand IIT-ISM students develop eco-friendly fuel by enriching coal bed methane with hydrogen. (Photo | Special Arrangement)

Nation

Jharkhand IIT-ISM students develop eco-friendly fuel by enriching coal bed methane with hydrogen

Chemical engineering students at the Indian Institute of Technology (Indian School of Mines), Dhanbad, have developed a technique to convert harmful coal bed methane into environmentally friendly hydrogen fuel that can be directly used in CNG vehicles. The achievement was made by second-year students Kailash Krishna, Nitin Gaur, and Devashish Das under the guidance of Associate Professor Ejaz Ahmed. Coal bed methane, released during coal mining, is a greenhouse gas nearly 25 times more harmful than carbon dioxide. The team purified the gas to obtain methane, a portion of which was cracked to produce hydrogen and carbon nanotubes. The hydrogen generated can be directly used in vehicles without requiring any vehicle modifications while also improving fuel efficiency.

Feature Article

Navier-Stokes equations and their profound impact in Chemical Engineering

Navier-Stokes equations, developed by Claude-Louis Navier and George Gabriel Stokes, describing the motion of viscous fluid flows, play a pivotal role in chemical engineering. These equations help chemical engineers to analyse fluid flows in pipes, reactors, distillation columns, and so on, which in turn help design these integral devices. To understand their usefulness, let us focus on viscous fluid flows in pipes, which are widely encountered in chemical industries, from petroleum refining to fertilizer. Under steady, incompressible, laminar flow conditions, solving these equations with the help of conservation of mass yields a proportional dependency of the pressure drop across the pipe on the length of the pipe, velocity of the flow, and the viscosity of the fluid, and an inverse dependency of the same on the diameter of the pipe. Extending this analysis to most practical turbulent flow conditions, the pressure drop additionally becomes a function of the roughness of the pipe. This entire analysis helps engineers evaluate the pressure drop given the values of these variables, which in turn helps decide the right specifications of pumps for delivering the fluids effectively.

In addition, Navier–Stokes equations are widely applied in the design of reactors, heat exchangers, and mixing vessels to predict flow distribution, turbulence, and mixing efficiency. They also form the foundation of Computational Fluid Dynamics (CFD), enabling engineers to visualize complex flow behavior, heat transfer, and species transport within industrial equipment while reducing costly experimental trials. Beyond traditional process industries, these equations are increasingly important in environmental and energy applications, including pollutant transport, fuel cells, electrolyzers, hydrogen production, microfluidics, and biomedical systems. Thus, Navier–Stokes equations continue to serve as one of the most important mathematical tools driving innovation and process optimization in modern chemical engineering.

Prof. Sandip Mandal

ChemE Trivia

Water Expansion

Water expansion is a unique and important property of water in which its volume changes with temperature. Like most substances, water expands when heated and contracts when cooled. However, water behaves differently between 0°C and 4°C, a phenomenon known as the anomalous expansion of water. When water is cooled from room temperature to 4°C, it contracts normally, but upon further cooling from 4°C to 0°C, it begins to expand instead of continuing to contract. At 4°C, water attains its maximum density. This unusual behavior is mainly due to the presence of hydrogen bonding between water molecules. When water freezes into ice, the molecules arrange themselves in a hexagonal crystalline structure that occupies more space than liquid water. As a result, ice becomes less dense than water and floats on its surface. This property is extremely significant in nature because it prevents lakes and rivers from freezing completely during winter.

The expansion of water also has several practical and engineering implications. During freezing, water expands considerably, which can lead to bursting of water pipes, cracking of rocks, and damage to containers. Engineers must therefore consider water expansion while designing pipelines, boilers, cooling systems, and storage tanks to avoid pressure buildup and structural failure. Water expansion also contributes to natural processes such as weathering. Water enters small cracks in rocks and, upon freezing, expands and exerts pressure on the rock surfaces. Repeated freezing and thawing gradually break the rocks apart, shaping landscapes over time. Thus, the phenomenon of water expansion is not only scientifically fascinating but also environmentally and industrially important.

Overall, the anomalous expansion of water is one of the most remarkable properties found in nature. Its influence can be observed in environmental systems, daily life, and engineering operations, highlighting the critical importance of understanding the physical behavior of water in science and technology. In cold regions, water trapped inside concrete, roads, or building materials can freeze and expand, leading to cracks and structural deterioration, a phenomenon known as frost damage. In industrial operations, the thermal expansion of water and steam is widely utilized in power generation systems. In thermal power plants and steam boilers, water is heated to produce steam, which expands significantly and drives turbines to generate electricity.

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