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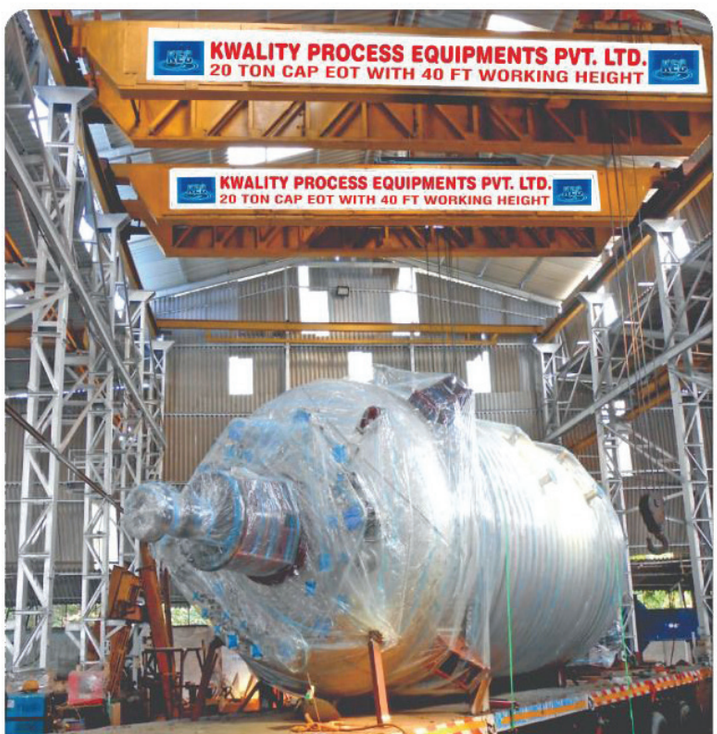

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Single Copy Price: ₹ 150/-
Annual Subscription: ₹ 1620/-, Foreign: USD 180

Registered Office: 26, Maker Chambers VI, 2nd Floor, Nariman Point, Mumbai 400 021, INDIA.
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E-mail: sales@jasubhai.com

PLACE OF PUBLICATION
JASUBHAI MEDIA PVT. LTD.

210, Taj Building, 3rd Floor, Dr. D. N. Road, Fort, Mumbai 400 001, Tel: +91-22-4037 3636

Published by Mr Hemant K. Shetty
Address: 406-D, The Karachi Citizens Co-Op Hosg Soc Ltd., Juhu Varsova Link Road, Andheri West, Mumbai - 400053.

Printer: Harilal Gangaji Patel

Printing Press (Name & Address): The Great Art Printers
25, Unique House, S A Brelvi Road, Fort, Mumbai 400 001.

Published from Jasubhai Media Pvt .Ltd. 3rd Floor, Taj Building, 210, Dr. D N Road, Fort, Mumbai 400 001.

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Printed as on: 11-05-2026

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FEATURE

Kirloskar Brothers Limited's Q4 consolidated revenue rises 11% YoY

Pune: Kirloskar Brothers Limited (KBL), a leading pump manufacturing company with expertise in the engineering and manufacturing of fluid management systems, announced its audited financial results for the quarter and financial year ended March 31, 2026.

For the quarter ended March 31, 2026, the company reported consolidated revenue from operations of ₹1,415 crore, compared to ₹1,281 crore in the corresponding quarter last year, registering a year-on-year (Y-0-Y) growth of approximately 11%. Consolidated Profit Before Tax (PBT) for Q4 FY26 stood at ₹147 crore as against ₹127 crore in Q4 FY25. Consolidated Profit After Tax (PAT) for the quarter stood at ₹104 crore compared to ₹112 crore in the corresponding quarter last year.

For the full year FY26, consolidated revenue from operations stood at ₹4,538 crore as against ₹4,492 crore in FY25. Consolidated PAT for FY26 stood at ₹361 crore compared to ₹403 crore in FY25.

During Q4 FY26, the company recognised an exceptional item of ₹25.8 crore on a consolidated basis towards the impact of the new labour codes notified by the Government of India. For FY26, the cumulative impact stood at ₹41.7 crore. The company classified the impact as a non-recurring exceptional item related to post-employment defined benefits. KBL's international business continued to contribute significantly to consolidated revenues. Revenue from international operations stood at ₹1,720 crore in FY26 compared to ₹1,603 crore in FY25.

Epigral reports record Q4FY26 revenue of ₹736 crore, up 17%

Gujarat: Epigral Limited, India's leading integrated chemical manufacturer, has announced its financial results for the quarter ended March 31, 2026. The company reported its highest-ever quarterly revenue of ₹736 crore, registering a growth of 17 per cent from ₹631 crore in Q4FY25. Profit After Tax (PAT) stood at ₹82 crore for the quarter, compared to ₹87 crore in the corresponding period last year.

On a sequential basis, Epigral witnessed strong recovery and growth momentum, driven by improved volumes and realizations. Revenue grew by 22 per cent in Q4FY26 to ₹736 crore as against ₹603 crore in Q3FY26, supported by higher plant utilization and normalized inventory costs. EBITDA margin improved to 23 per cent from 17 per cent in Q3FY26, reflecting operational efficiencies. PAT jumped by 109 per cent in Q4FY26 to ₹82 crore as against ₹39 crore in Q3FY26.

Commenting on the performance, Maulik Patel, Chairman and Managing Director, Epigral said, "Our diversified product portfolio continues to provide resilience amid geopolitical uncertainties, including developments in West Asia. At the same time, our ongoing capex projects for Epichlorohydrin and Chlorinated Polyvinyl Chloride (CPVC) expansion are progressing as planned and within budget."

Henkel delivers good organic sales growth in Q12026

Düsseldorf: In the first quarter of 2026, Henkel generated Group sales of around 5.0 billion euros and achieved good organic growth of 1.7 per cent. The increase was driven by both business units - Adhesive Technologies and Consumer Brands, each with positive volume and price developments.

The good organic sales growth in the Adhesive Technologies business unit in the first quarter was driven primarily by very strong growth in the Mobility & Electronics business area. The good organic sales development in the Consumer Brands business unit was mainly due to a very strong increase in the Hair business area.

Group sales in the first quarter of 2026 totaled 4,952 million euros, a nominal decrease of -5.5 per cent compared to the prior-year quarter (5,242 million euros). Organically (i.e. adjusted for foreign exchange and acquisitions/divestments), sales increased by 1.7 per cent. Both price and volume showed a positive development. Acquisitions/divestments reduced sales by -2.1 per cent. Foreign exchange effects also had a negative impact on sales performance of -5.2 per cent.

Organic sales development in the Europe region amounted to -3.4 per cent in the first quarter. In the IMEA region, sales increased organically by 12.8 per cent. Organic sales performance was positive in North America at 0.9 per cent. In Latin America, organic sales were -3.1 per cent below the prior-year quarter. The Asia-Pacific region achieved organic sales growth of 10.3 per cent. ■

Technip Energies India commissions first captive jetty at Dahej, dispatches first module to Europe

New Delhi: Technip Energies India has commissioned its first captive jetty at its Modular Manufacturing Yard (MMY) in Dahej, Gujarat, with the dispatch of its first large-scale process module consignment to the Netherlands for a global energy major. The jetty enables the direct movement of oversized modules - each weighing up to 4,000 metric tonnes - that were previously constrained by road transport limitations. The modules have begun their journey and are currently enroute to North Europe via the Red Sea and the Suez Canal.

This infrastructure has reduced transit time from an estimated 15 days via road to just 48-72 hours. It also delivers approximately 60–70 per cent fuel savings, resulting in lower logistics costs and a meaningful reduction in carbon emissions. Completed in an accelerated timeline of approximately seven months, the jetty stands as a testament to strong execution capabilities and engineering excellence.

Davendra Kumar, Managing Director, Technip Energies India & APAC, said, "We see India emerging as a strategic hub for Technip Energies, playing a pivotal role in our global project delivery network. It is a proud step forward in advancing the spirit of 'Make in India' on the global stage."

Cabinet approves two semiconductor manufacturing units under ISM

New Delhi: The Union Cabinet chaired by the Prime Minister Shri Narendra Modi has approved two more semiconductor projects under India Semiconductor Mission (ISM), which includes country's first commercial Mini/Micro-LED display facility based on GaN (Gallium Nitride) Technology and a semiconductor packaging facility.

The two approved proposals will set up semiconductor manufacturing facilities in Gujarat with a cumulative investment of around ₹3,936 crore and are expected to generate cumulative employment for 2,230 skilled professionals.

Crystal Matrix Limited (CML) will establish an integrated facility for compound semiconductor fabrication and ATMP in Dholera, Gujarat for manufacturing Mini/ Micro-LED display modules. The integrated facility will also provide GaN foundry services, including epitaxy on 6" wafers.

The annual proposed production capacity for Mini/ Micro-LED Display Panels is 72,000 sq. meters, and for Mini-Micro-LED GaN Epitaxy Wafers is 24,000 sets of RGB wafers. The proposed products will have applications in large displays for TVs and signages/ commercial displays, Medium-sized displays for tablets, smartphones, and in-car displays, and Micro-displays for Extended Reality (XR) glasses and smart watches.

Suchi Semicon Private Limited (SSPL) will be setting up an Outsourced Semiconductor Assembly and Test (OSAT) facility in Surat, Gujarat for manufacturing discrete semiconductors. The proposed production capacity of the Suchi Semicon is 1033.20 million chips per annum. The target applications include power electronics, analog ICs, and industrial systems, serving end markets such as automotive, industrial automation, and consumer electronics.

With these two approvals, semiconductor ecosystem in the country would get a significant boost as the total number of approved projects under India Semi-conductor Mission (ISM) reaches 12, with cumulative investments of around ₹1.64 lakh crore.

Recyclekaro signs technology licensing agreement with IIT Bombay

Recyclekaro joins hands with IIT Bombay to strengthen critical mineral extraction and urban mining

Mumbai: Evergreen Lithium Recycling, a group company of Evergreen Recyclekaro India Limited, has entered into a technology licensing agreement with the Indian Institute of Technology (IIT), Bombay, to advance the extraction of battery precursor-related critical minerals and enhance efficiency in battery recycling operations.

The licensed technology is expected to deliver up to 30-40 per cent processing cost optimization while improving overall process efficiency, strengthening Recyclekaro's capabilities in urban mining and resource recovery. Commenting on the development, Rajesh Gupta, Founder & MD, Recyclekaro, said, "Building a robust critical minerals ecosystem in India requires strong collaboration between industry and academia. Our partnership with IIT Bombay is a strategic step towards enhancing process efficiency while also investing in indigenous innovation, talent, and infrastructure. We believe such R&D specific collaborations will play a pivotal role in shaping India's position in the global resource recovery and recycling landscape."

The partnership reflects Recyclekaro's broader vision of fostering deeper industry-academia engagement to accelerate growth in the critical minerals and circular economy sectors.

Chemetall sets up new application laboratory in Vietnam

Vietnam: Chemetall, the surface treatment global business unit of BASF Coatings, has opened its first application laboratory in the southern province of Tây Ninh (formerly Long An), near Ho Chi Minh City, Vietnam. The facility provides product testing and technical support to surface treatment customers across diverse market segments such as automotive OEM and components, general industry, and plastics recycling.

The new laboratory is equipped to conduct liquid sample analytics, panel and workpiece analytics, and application testing for surface treatment technical trials. Its capabilities streamline the testing and performance validation processes, ensuring that surface treatments applied to materials meet rigorous customer specifications and perform effectively in real-world applications.

The launch of the new application laboratory in Vietnam further extends Chemetall's regional footprint, bringing the total number of application laboratories in Asia Pacific to eight, including operations in Australia, China, India, Singapore and Thailand. ■

Lanxess inaugurates new lubricant additives manufacturing plant in India

Neelanjan Banerjee (L), Senior Vice President and Global Head of Business Unit Lubricant Additives, Lanxess and Bankim Patra, Country Head (Lubes), IOCL, signing a strategic MoU to bring cutting-edge technologies to the Indian market.

Mumbai: Lanxess has inaugurated a new blending plant at its chemical manufacturing site in Jhagadia, Gujarat. As part of the first phase of development, the facility will manufacture specialty lubricant additives.

The new plant is designed to serve both domestic and international markets. It will primarily cater to customers across India, the Middle East, and other key global markets. The facility has been developed with a strong focus on safety, energy efficiency, and responsible environmental practices.

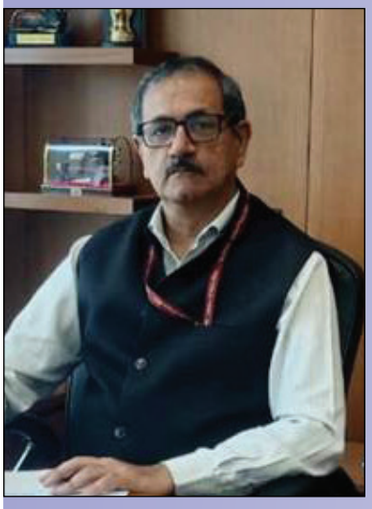
The company also signed an MoU with Indian Oil Corporation Limited (IOCL), bringing its cutting-edge technologies to the Indian market. In addition, Lanxess has also started third party manufacturing activities for the business unit Lubricant Additives in India.

Neelanjan Banerjee (L), Senior Vice President and Global Head of the Business Unit Lubricant Additives, Lanxess, and Srinivas Ch, ED - Lubes, HPCL, during the signing of MoU.

Speaking at the inauguration, Neelanjan Banerjee, Senior Vice President and Global Head of the Business Unit Lubricant Additives, Lanxess, said, "India is the third largest lubricants market in the world and a key growth region for us. To participate in this key market, we set up our Application Technology Center in 2025. The commissioning of this new production site in India is a next milestone for us and a strong testament to the 'Make in India' initiative."

In another major development, Lanxess and Hindustan Petroleum Corporation Limited (HPCL), have entered into a Memorandum of Understanding (MoU) to jointly advance availability of aviation and industrial lubricants in India and SAARC countries. Under this partnership Lanxess and HPCL will explore short, medium and long-term marketing and business development opportunities for lubricants. Lanxess Lubricant Additives business offers a variety of premium range of synthetic basestocks, additives and finished fluids for Aviation, Automotive and Industrial Applications under the brand names Royco®, Anderol®, Reolube®, Additin®, Naugalube®, Synton®, Hatcol®, Hybase®, Lobase®.

APPOINTMENT NEWS



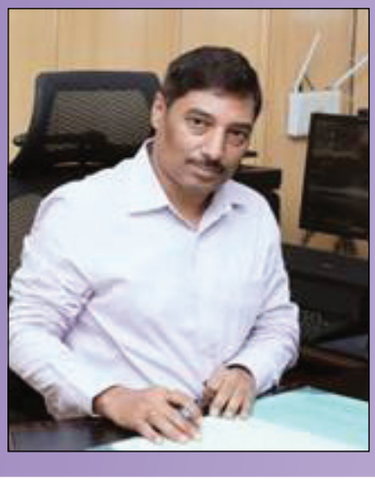
Bharat Khera assumes charge as Secretary, Ministry of MSME

A 1995-batch Indian Administrative Service (IAS) officer of the Himachal Pradesh cadre, Shri Bharat Khera brings with him more than three decades of administrative experience across key assignments in both the Central and State Governments. Prior to assuming his present role, he served as Additional Secretary in the Department of Consumer Affairs.

During his distinguished tenure in the Government of India, Shri Khera served for over five years as Joint Secretary in the Ministry of Defence from November 2014 to February 2020. While serving in the Department of Defence Production, Shri Khera was a member of the Board of Directors of Mazagon Dock Shipbuilders Limited, Garden Reach Shipbuilders & Engineers Limited, Goa Shipyard Limited and Hindustan Shipyard Limited. ■

Mahanagar Gas Limited appoints P.K. Srivastava as Managing Director

Mahanagar Gas Limited has appointed Mr. Praveer Kumar Srivastava, as Managing Director of the company for a period of five consecutive years with effect from April 30, 2026 to April 29, 2031. Mr. Praveer Kumar Srivastava is a Chemical Engineer from IIT Kharagpur and a certified Energy Auditor by the National Productivity Council, has a distinguished professional career spanning over three decades in GAIL (India) Limited. Throughout his tenure, he has been deeply involved in operations and maintenance of gas processing units and pipeline networks, as well as project execution across multiple strategic GAIL installations. ■



Shri Dilip Kumar takes charge as CVO, SAIL

Shri Dilip Kumar, a senior officer of Indian Railway Service of Mechanical Engineers (IRSME), has assumed the charge of Chief Vigilance Officer (CVO) in Steel Authority of India Limited (SAIL). Shri Kumar brings with him over two decades of experience in train operations, rolling stock maintenance and human resource management. He has held several key positions in Indian Railways, including Additional Divisional Railway Manager, East Central Railway (ECR) and Chief Workshop Manager, Harnaut, Nalanda, Bihar. He is credited with a number of innovations such as the first ISO 9001 certified train in ECR, pioneering in situ wheel replacement techniques for wagons, and the nationally acclaimed Madhubani railway station beautification project. ■

Atul launches three innovative crop protection products for Indian farmers

Mumbai: Atul Ltd (Atul) has introduced three proprietary crop protection products – Mylonis, Salix Gold and Tikadis – to enhance crop productivity and advance sustainable farming practices in India. The newly launched product portfolio comprises a seed treatment solution for oilseeds and soybean, an advanced fungicide formulation for rice and a premium technical-grade herbicide for rice cultivation. These innovations address critical gaps in disease management, pest control and weed management for major crops – factors that directly influence agricultural yields and farmer profitability.

Mylonis: Comprehensive disease management for rice Mylonis, a patented fungicide combining Azoxystrobin, Isoprothiolane and Mancozeb, is to tackle the most challenging diseases in rice – sheath blight, blast (including multiple strains), and grain discolouration. Beyond disease suppression, Mylonis strengthens plant health, enhances grain quality and supports resistance management strategies, making it an invaluable choice for rice farmers throughout India.

Salix Gold: Precision weed control for rice cultivation Salix Gold reflects the advanced manufacturing capability of Atul in high-purity technical grade production. This 2,4-D sodium salt–based water-dispersible granules formulation provides post-emergence weed control, effectively targeting broadleaf weeds and sedges in rice production systems across India.

Tikadis: Early-stage protection for legume and oilseed crops, Tikadis, a patented seed treatment formulation, combines Azoxystrobin, Carbendazim and Thiamethoxam to deliver day-one defence against soil-borne pests and pathogens in groundnut and soybean. Field trials demonstrate that Tikadis promotes robust seed germination, strengthens root nodule development for improved plant vigour and ensures uniform pod development.

Coromandel International Limited posts FY26 results, sustains growth momentum

New Delhi: Coromandel International Limited has announced its financial results for the quarter and full year ended March 31, 2026. During the year, the nutrient business operated its plants at full capacity and managed raw material sourcing efficiently, thereby ensuring timely availability of fertilisers.

Commenting on the results, Mr. S. Sankarasubramanian, MD & CEO, Coromandel International mentioned, "During the year, the company strengthened its position in the phosphatic fertiliser segment, registering 7 per cent growth and achieving sales of 4.3 million tons. Company's crop protection business recorded strong momentum during the year, delivering healthy 16 per cent revenue growth with 55 per cent rise in profitability."

The company's subsidiary NACL Industries Limited reported a 28 per cent increase in revenue and returned to profitability. The company's agri retail business continued to scale up its network to 1,200 centers, adding over 300 new stores across existing and new geographies in FY26, added Mr. S. Sankarasubramanian.

The company successfully commissioned a 2,000 Ton Per Day (TPD) sulphuric acid plant and a 650 TPD phosphoric acid plant at Kakinada in Q4, strengthening its backward integration capabilities. With an outlay of ~₹1,100 crore, these projects are expected to strengthen supply security and support India's *Atmanirbhar Bharat* vision in fertilisers.

The company's rock phosphate project in Senegal also ramped up output during the year, securing raw material supplies for the new phosphoric acid plant. Further, the fertiliser granulation capacity expansion project at Kakinada is progressing as per plan and is scheduled for completion by Q4 FY26-27.

The company's crop protection business continued to perform well in both domestic and international markets. Projects for key technical molecules are under implementation. ■

Health Safety & Environment World Expo 2026: Defined by Change, Adaptation and Growth

Health Safety &Environment World Expo 2026

Chemtech organised Health Safety & Environment (HSE) World Expo & Conference 2026 on 3rd February 2026 in Mumbai.

The one-day conference, was held during Chemtech 2026 – the world meet of the Chemicals, Petrochemicals, Biopharma & Process Industry in India, held during 3rd – 6th February 2026 at Bombay Exhibition Centre, Goregaon, Mumbai.

The conference, based on the theme - ***'Delivering HSE Excellence with a Unified Approach',*** *was held under the leadership of Dr. Alok Sharma, Director (R&D), IndianOil Corporation Limited. Dr. Lalit R. Gabhane, DG, NSC, was the Core Committee Member of the Technical Advisory Group of the conference.*

The conference was supported by the following associations:

1. Safety Engineers Association
2. National Safety Council and
3. World Safety Association

Chemical Engineering World **presents a few glimpses from the one-day conference.**

Inaugural session and launch of ChemTECH 2026 Exhibitors Directory

(L-R) : Mr. R. K. Srivastava, Former Director Exploration, ONGC & Core Advisory Committee Member, ChemTECH; Dr. Alok Sharma, Director R&D, IOCL & Chairman, Central Advisory Board, Health, Safety & Environment (HSE) Conference 2026; Mr. U. K. Bhattacharya, MD, Steag Energy Services Pvt Ltd, Former Director Projects, NTPC & Core Advisory Committee Member, ChemTECH; Mr. Luc Herwin, Group Head - EHS, Larsen & Toubro and Mr. Rajeev Mathur, Director, HCG Group & Core Advisory Committee Member, ChemTECH, during the inaugural session of HSE conference and the launch of the Exhibitors' Directory 2026.

Special Address

The inaugural session was followed by a special address by **Mr. Robert McGonagle** (L), Director of Sales and Service, Scully Signal Company, followed by **Mr. Shahzed Lehry** (R), Officer (HQ), O/o – Additional Controller of Civil Defence, Government of Maharashtra, Department of Home, on safety.

Session 1 – Health

The health session included 2 presentations – one by **Dr. Neena Sawant,** Professor and Head, Department of Psychiatry, Topiwala National Medical College & B Y L Nair Charitable Hospital, Mumbai, who spoke on the topic - 'Mental Wellbeing: The Need for Industrial Workers.'

The second presentation was made by **Dr. G. Jayaraj,** Managing Partner, Occupational Health Services, Chennai, who spoke on the topic - 'Occupational Health Promotion - Industry's Roles & Responsibilities.'

Session 2 – Safety

The safety session saw two presentations, followed by a panel discussion. The first presentation was made by **Mr. Vaibhav. V. Mehta,** Sr. Assistant Director, National Safety Council, India, who spoke on the topic – 'NSRS (NSCI Safety Rating System): A Tool to Carry Out Qualitative and Quantitative Assessment of OSHMS.'

Mr. Ajoy K. Tiwari, DGM (H,S&E), RHQ, IndianOil Corporation Limited, made a presentation on the topic – 'Addressing Process Safety Vulnerabilities Through Digital & Knowledge-Driven Interventions.'

A panel discussion was held on theme – 'Delivering HSE Excellence with a Unified Approach.' (L-R) : Mr. Mukesh Mohan, ED-HSE, IndianOil Corporation Limited & Moderator of the session; Ms. Rekha Sharma, Global Operations Director, GRIP Global Singapore; Mr. Vivek Gupta, HSE Director, Fluor India; Mr. Vaibhav Mehta, Sr. Assistant Director, National Safety Council, India; Mr. Hemant Sethi, Managing Director, British Safety Council and Mr. S. Sundaresan, VP (Technical), Janyutech Pvt Ltd, participated in the panel discussion.

Session 3 – Green Environment

Mr. Arvind Kumar Sharma, DGM (Environment), NHPC, Delhi, presented a case study on 'FLOF study Monitoring of Behaviour of Glacial lakes upstream of 26 Power Stations of NHPC in Himalayan ranges and planning of early warning system.'

Dr. Murali Janakaraj, Founder-cum-Executive Director, Innovotek Pvt Ltd (ITPL), Chennai, presented a case study on 'Mangrove Restoration on a landfill site - The Adyar Eco-Park, Chennai.'

The third presentation in this session was made by **Dr. Suraj Tandon,** Head – ESG, EverEnviro, Gurugram, Haryana, who presented a case study on 'Trash to Treasure - EverEnviro Way.'

Session 4 - Legal Issues in HSE

The last session of the one-day conference was on the topic of legal issues in HSE. **Mr. H. Vishvanathan,** HSE Consultant, Meenakshi Safety Consultancy Services, presented on the topic of 'Salient features of the Occupational Safety and Health and Working Conditions Code 2020.'

The second presentation was by **Mr. Alexey Artemiev,** Deputy Director of the Chemical Industry, Department of the Ministry of Industry and Trade of Russia, who spoke on the topic - 'BRICS Chemical regulation practices and BRICS PARTNER Working Group on Chemical Industry as a platform to exchange knowledge'.

Audience Glimpse

Testimonials

"ChemTECH has long been a catalyst for meaningful business engagement and strategic alliances for the chemical and energy value chain. It is gratifying to see successful inaugural HSE Conference at ChemTECH 2026 in Mumbai, themed "Delivering HSE excellence with a unified approach." The conference effectively underscored the need to break silos and align leadership intent, technological innovation, and frontline execution for sustainable growth. Well done and keep it up."

- Dr Alok Sharma,
Director (R&D), Indian Oil Corporation Ltd
Chairman, Technical Advisory Group,
Health Safety & Environment Conference 2026

Testimonials

"It is indeed a great moment for the National Safety Council of India to collaborate with Chemtech for their maiden Health, Safety & Environment Conference 2026. Our vision has always been to serve as a national leader in providing guidance and services that make workplaces safer, healthier, and environmentally sustainable. This vision is perfectly aligned with the theme of the conference — 'Delivering HSE Excellence with a Unified Approach'. On behalf of the National Safety Council of India, I extend my heartfelt congratulations to the Chemtech team for the successful organization of this important conference. We wish the team continued success in all future endeavors and look forward to strengthening our shared commitment to advancing health, safety, and environmental excellence across industries."

- Dr Lalit R. Gabhane,
Director General, National Safety Council of India

"It was an honour to deliver one of the keynote addresses at the recent HSE conference during the ChemTECH and Health, Safety & Environment World Expo 2026 in Mumbai. Participating in this prestigious platform and engaging with industry leaders, experts, and stakeholders was truly enriching. I sincerely appreciate the organisers and the ChemTECH team for the invitation and for curating such an impactful event that fosters dialogue, innovation, and collaboration across the HSE community. The insightful discussions and the collective commitment to advancing safety excellence made the experience deeply meaningful. My heartfelt thanks to everyone involved for the warm hospitality and the opportunity to contribute."

- Mr. Luc Herwin,
Group Head - EHS, Larsen & Toubro

"It was an honour to be a part of Chemtech 2026 held during 3-6 February 2026. I was associated with both Health Safety & Environment and WaterEx conferences, and it was wonderful to moderate panel discussions with experts during the event. Chemtech is a great platform and has played an instrumental role in bringing the experts and leaders from the industry to discuss and deliberate on the challenges, advancements and the future of the industry. The message is loud and clear – we need to gear ourselves to move towards the goal of achieving HSE excellence and focus on innovation, collaboration and sustainability to secure India's water future. I extend my heartfelt congratulations to the Chemtech team for organizing another successful edition of Chemtech 2026. My best wishes for your future events."

- Mr. Mukesh Mohan,
ED-HSE, IndianOil Corporation Limited

GUEST COLUMN

R. S. Jalan
Managing Director
GHCL Limited

Ending Import Dependency: Scaling Domestic Soda Ash Capacity by 2030

India is riding high on its development journey, and sustainable growth is closely linked to greater self-reliance to mitigate vulnerabilities, including cross-border risks. A recent example is the recent US–Israel–Iran conflict, which has triggered a fuel crisis across the globe. Such disruptions can significantly dent economic growth, including industrial expansion, prompting the need to reduce import dependency. ***R. S. Jalan, Managing Director, GHCL Limited,*** *throws light on ending import dependency with respect to the domestic soda ash industry.*

The soda ash industry, powers several Indian homegrown industries, including glass, ceramics, baking powder, detergents, solar panels, and lithium-ion batteries that underpin economic growth. Given its wide-ranging applications across these sectors, the focus on the demand side must be on integration and forward planning. The glass industry, which consumes nearly 30 per cent of soda ash, is expanding rapidly across infrastructure, automotive, and packaging segments. Linking soda ash capacity expansion to upcoming glass manufacturing clusters can create localised demand ecosystems, reduce transportation costs, and strengthen supply chain reliability.

The renewable energy push adds another layer of urgency. Solar manufacturing depends heavily on high quality glass, and India's aggressive expansion in solar capacity will steadily increase soda ash demand. The solution lies in anticipatory scaling, building capacity ahead of demand rather than reacting to shortages. This proactive approach distinguishes leaders from followers.

The detergent sector, which accounts for around 34 per cent of demand, presents a different opportunity. It is stable, predictable, and deeply linked to domestic consumption. Strengthening long term supply agreements between soda ash producers and FMCG manufacturers can ensure clear visibility of demand, supporting capacity planning and pricing stability. Certainty in this context directly drives confidence.

Similarly, the chemical industry, accounting for approximately 10 per cent of demand, benefits from stronger backward integration. Expanding domestic soda ash production strengthens the value chain for downstream products such as sodium bicarbonate and sodium silicate, creating a clear multiplier effect.

Import Dependency

India currently imports around 1 million tonnes of soda ash. Over the next four to five years, demand from key end-use sectors such as glass, detergents, chemicals and other strategic industries is expected to expand further adding another approximately 1 million tonnes to the country's requirement base.

Bridging this gap requires more than incremental thinking. It calls for decisive, multi-layered solutions spanning production, policy, technology, and market alignment. The path is clear; execution is now the imperative.

Capacity Expansion

To achieve this, the first and most immediate step is accelerated domestic capacity expansion. Existing players have already begun moving in this direction. However, expansion alone is insufficient. It must be strategically located and cost optimised. Gujarat offers a compelling template, proximity to salt reserves, access to ports, and established industrial ecosystems.

Replicating such integrated clusters can significantly reduce logistics costs and improve operational efficiency. In a cost sensitive industry, these advantages are decisive. The second priority is addressing the cost disadvantage of synthetic soda ash production. India's reliance on the Solvay process makes production energy intensive, particularly when compared with natural soda ash derived from trona deposits, as seen

in countries such as the United States and Turkey. While this gap cannot be eliminated overnight, it can be narrowed through investments in energy efficiency, waste heat recovery, and process optimisation.

The goal is not to match global players step for step, but to enhance domestic competitiveness with precision. Energy remains central to this equation. Soda ash production is fuel intensive, and fluctuations in energy prices directly affect margins. A focused shift towards cleaner, more stable energy sources, including the integration of renewables, can provide long term cost stability. This is both an economic and environmental imperative, a rare alignment of efficiency and sustainability.

Policy Alignment

Policy support, while alre-ady visible, must evolve into a consistent and predictable framework. Long term success depends on regular monitoring and continuity. Investment scales when policy visibility is clear. Stability therefore becomes a solution in itself. Equally important is aligning policy with industry expansion timelines. Capacity additions in the chemicals sector are capital intensive and time consuming. A synchronised approach, where infrastructure development, approvals, and industrial planning progress in tandem, can accelerate execution. Without such alignment, even well-intentioned policies risk losing effectiveness.

Another critical area is the efficiency of logistics and infrastructure. Even where production capacity exists, inefficiencies in transport and distribution can inflate costs. Developing dedicated bulk handling facilities, improving port connectivity, and optimising rail logistics can significantly enhance competitiveness. In a margin sensitive industry, logistics can determine profitability.

At the macro level, reducing import dependence directly affects foreign exchange outflows. The current structure results in a steady value leakage. Bridging the supply gap can reverse this dynamic. Over time, as capacity strengthens, India can transition towards a more balanced and resilient position, including opportunities in neighbouring markets such as Bangladesh, Nepal, and Sri Lanka.

Environmental Regulations

Sustainability must also be embedded within this framework. Environmental regulations are becoming more stringent, and rightly so. Future expansion must incorporate cleaner production technologies, efficient water usage, and reduced emissions. This is not a constraint but an opportunity to build a modern, globally competitive industry. Sustainable growth is no longer optional; it is the baseline.

Conclusion

What emerges is a clear roadmap: expand capacity with intent, improve cost structures through innovation, align policy with execution, integrate demand with supply, strengthen infrastructure, and embed sustainability. Each element reinforces the other, creating a resilient and self-sustaining ecosystem.

The momentum is already visible. Demand is rising steadily, driven by infrastructure development, consumption growth, and renewable energy expansion. Industry players are investing with confidence, and policy signals remain supportive. The pieces are not just in place; they are beginning to move.

If these measures are implemented with discipline and scale, India can realistically eliminate its nearly 1 million tonne supply gap by 2030. The impact will be immediate and far reaching, stabilised input costs, stronger supply chains, reduced exposure to global volatility, and enhanced competitiveness for downstream industries.

By scaling domestic capacity in line with demand, India can build a more confident, self-reliant industrial base. The objective is not merely to close a gap, but to create enduring strength from within.

Because when the fundamentals are strong, growth is not just possible, it is inevitable. ■

GUEST COLUMN

Tailor-made Ion Exchange Resins: A Systematic Approach to Tackling PFAS Contamination in Water

Dr. Dirk Steinhilber
Application Technology Manager, Business Development, Applications & Innovation
LANXESS Deutschland GmbH
Cologne, Germany

Contamination of water with per- and polyfluoroalkyl substances (PFAS) is widespread globally and is on the rise, posing a growing challenge to producers and users of these substances as well as to waste disposal firms, rehabilitation companies, and legislators. This is resulting in restrictions to the production and use of these substances. In addition, efficient yet cost-effective processes are required in order to remove PFAS from groundwater, surface water, and wastewater flows. The use of special ion exchange resins enables this kind of decontamination in technologically sophisticated processes that can be applied on a large scale. PFAS can be removed almost down to the limit of detection in the ppt range, explains ***Dr. Dirk Steinhilber, Application Technology Manager, Business Development, Applications & Innovation, Lanxess Deutschland GmbH****, in this article.*

Per- and Polyfluoroalkyl Substances (PFAS): This is a group of over 10,000 substances that have been produced on a large scale and used in various applications since the 1950s – in fire-extinguishing foams, as an impregnation agent for textiles and paper, and in lubricants, to name just a few examples. They all contain bonds between carbon and fluorine atoms, which are among the most stable in organic chemistry. This means that PFAS are 'persistent chemicals' that practically do not decompose in the environment and therefore accumulate over time – both in nature and in living organisms. To counter this, very low limits are now in place in many countries, particularly for groundwater and drinking water.

Powerful cleaning technologies are required in order to comply with these limits. They chiefly include adsorption processes such as the use of granular activated carbon (GAC) or ion exchange (IEX) resins. One complicating factor is that different PFAS differ significantly in terms

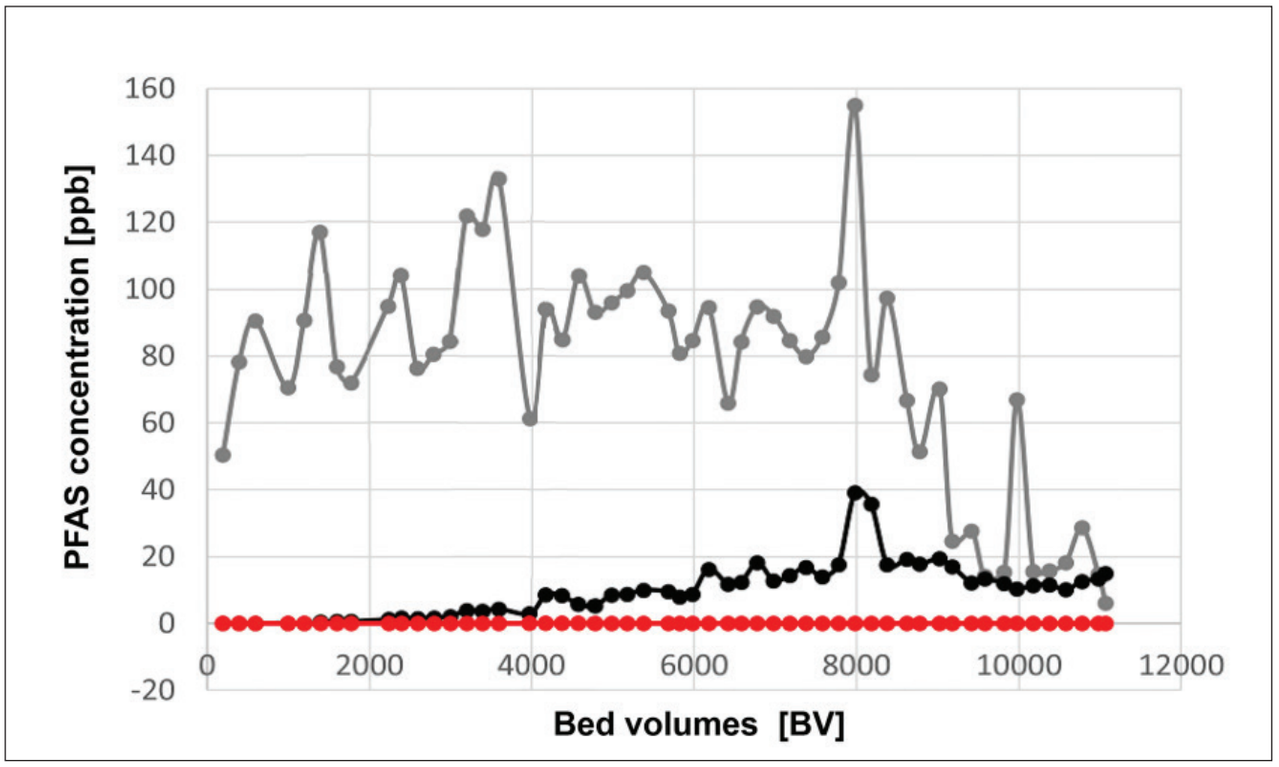


Figure 1: Overall efficiency of PFAS removal during groundwater treatment in Victoria, Australia: gray – inflow for pre-purification; black – effluent from pre-purification; red – effluent from final purification.

of properties – for instance, molecular weight, chain length, or polarity. Consequently, extensive PFAS removal in one or a few treatment steps is a demanding task that requires specially tailored absorber materials. A combination of adsorption and membrane processes, such as reverse osmosis, is another efficient option for PFAS removal.

Ultimately, PFAS can be destroyed under energetic conditions – for instance, as a result of plasma discharges or chemical and electrochemical oxidation. Many of these processes are still at the development or testing stage. Under pressure and at high temperatures, the likes of sodium hydroxide also destroy many PFAS (hydrothermal alkaline treatment, HALT). Purely thermal decomposition is currently the most frequently used destructive process, but requires temperatures above 1000°C.

Ion Exchange: A Highly Configurable Solution

All over the world, IEX resins have already shown that they can be used cost effectively on a large scale in order to meet the required limits and bind all manner of PFAS right down to the limit of detection, even in the presence of other ions, and therefore to remove them from water.

For instance, IEX resins have been used successfully at an aerodrome in the Australian state of Victoria to rid the groundwater of high PFAS concentrations of up to 200 ppb that originated from firefighting exercises on a former fire service training ground. The IEX configuration of the mobile unit encompassed the regenerable, weak base anion exchange resin Lewatit® MP 62 WS, followed by the highly selective, single-use anion exchange resin Lewatit® TP 108 in a lead/lag configuration.

The first filter adsorbed most of the PFAS. The remaining slip (mostly perfluorobutanoic acid, PFBA) was effectively reduced to non-detectable levels by means of the highly selective resin (Figure 1). As the resin has fast kinetics, a high level of PFAS retention can be attained, even with short dwell times (empty bed contact time, EBCT). Consequently, up to 500 cubic meters of water per day – more than 54 million liters in total – was purified. Thanks to their high effective absorption capacity of up to 100 g/l – even in the presence of chlorides and sulfates – this is far superior to conventional filtration using activated carbon. Notably,

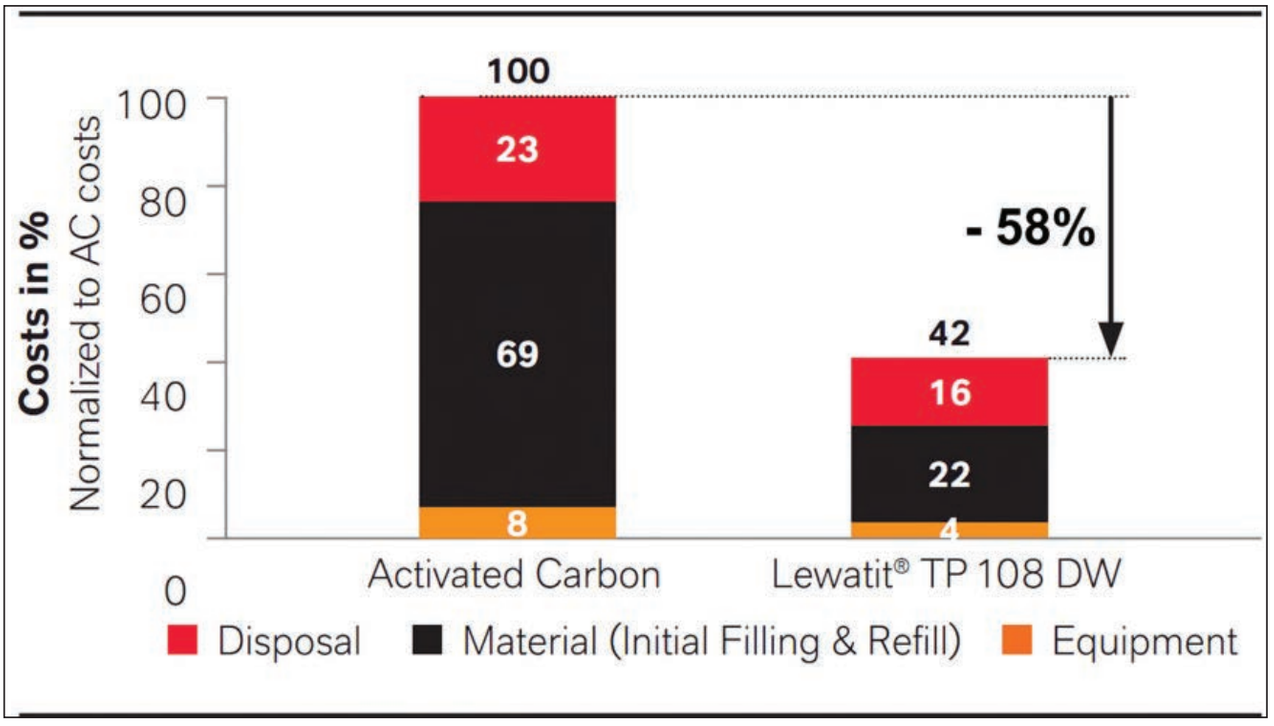


Figure 2: Comparison of total costs (orange – equipment investment; black – filter material over five years; red – disposal) for the use of activated carbon and IEX (Lewatit® TP 108 DW) for removal of perfluoroheptanoic acid (PFHpA) from extinguishing water; mobile unit for approximately 275 m³/d.

therefore, a high throughput of 10,000 bed volumes (BV) was attained in this final stage, resulting in relatively low quantities of loaded resin and commensurately low disposal costs.

In a comparative study, the cost assessment of GAC and IEX use over an operational period of five years was compared. Even when the resin was used only once without regeneration, a cost advantage of almost 60 per cent compared with activated carbon filtration is apparent (Figure 2). Even taking into account the initially lower material costs of GAC, the approximately five times longer service life of the IEX resin is the decisive factor here.

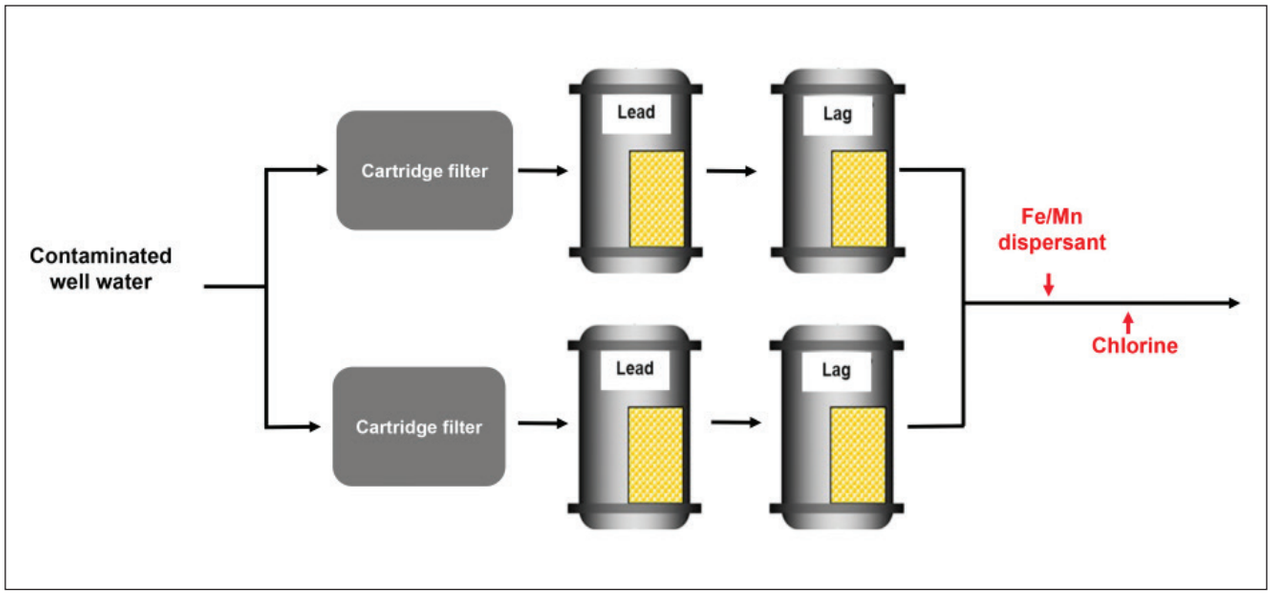


Figure 3: Lead/lag configuration for well water treatment in New Jersey, USA.

Resin in chloride form	
PFOS	61 ppt
PFOA	44 ppt
Resin volume	75 l
pH level	7
Specific flow	15 BV/h
Temperature	20 °C
Breakthrough threshold	> 1 ppt

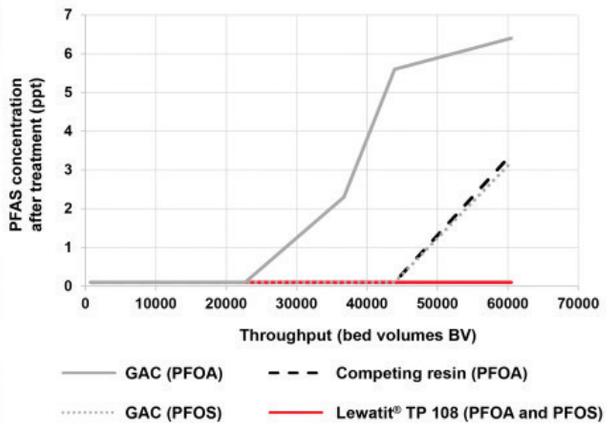


Figure 4: Operating conditions and results of a comparative test of PFOA and PFOS removal in an Italian pilot plant; red: Lewatit® TP 108 DW; black: competing resin; gray: GAC.

Further economic advantages of IEX resins could arise if these resins are regenerated and PFAS in the regenerate can subsequently be efficiently destroyed. Regeneration of this kind seems beneficial – especially with higher PFAS concentrations in water – not least because it allows the resin to be used sustainably.

At present, regeneration is not recommended for Lewatit® TP 108 DW, as the service life is long, the PFAS load is high, and PFAS is tightly bonded. By contrast, with only slightly lower PFAS selectivity, the monodisperse Lewatit® MonoPlus TP 109 can be regenerated efficiently with a mixture of 70 per cent aqueous methanol with the addition of 1 per cent sodium chloride.

In addition, the use of sodium hydroxide enables the weak base anion exchange resin Lewatit® MP 62 WS to be regenerated after loading with PFAS. On account of its high usable and total capacity, the resin is particularly suitable for pre-purification of water with a high PFAS content.

Clean Drinking Water from Contaminated Crude Water

Its ANSI/NSF 61 certification means that Lewatit® TP 108 DW can also be used for drinking water treatment. There is no need for rinsing (usually ≥20 BV) before commissioning here. For instance, groundwater is treated with this resin for the production of drinking water in Pennsylvania, USA.

Due to its proximity to a former military site, the water is heavily loaded with various PFAS there (e.g. 429 ppt perfluorooctanesulfonic acid [PFOS], 174 ppt perfluorooctanoic acid [PFOA], 210 ppt perfluorohexanesulfonic acid [PFHxS]), whereas the maximum contaminant level (MCL) for the first two of these compounds is just 4 ppt. With the selective resin, these limits can be complied with over several tens of thousands BV, as demonstrated in rapid small-scale column tests (RSSCT).

The selective resin also showed remarkably long service lives when used in a municipal water treatment plant in New Jersey, USA. In two parallel lines, each with two containers filled with 5.7 m³ of the resin, the concentration of a PFAS mixture (predominantly perfluorononanoic acid, PFNA) in water was reduced to well below the strict limits required there, even at high flow rates of up to 70 m³/h. After almost 200,000 BV and a service life of three years, the resin in the lead container in the lead/lag configuration (Figure 3) still met the strict requirements of the drinking water authorities in New Jersey, and even those of the national Environmental Protection Agency (EPA, $MCL_{PFOA,\ PFOS}$ = 4 ppt, MCL_{PFNA} = 10 ppt).

The upstream 5 µm filter is mainly used to separate suspended matter that would otherwise contaminate the resin. Traces of iron and manganese were subsequently removed, and the water was then disinfected with chlorine.

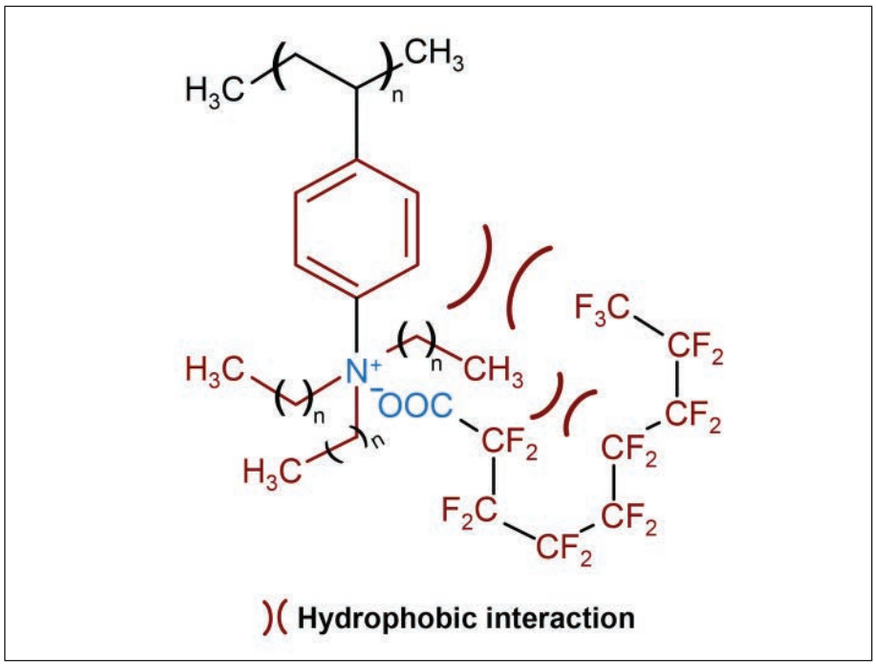


Figure 5: Cooperative bonding of a long-chain PFAS molecule (PFNA) on a polystyrene-based highly alkaline ion exchanger.

Short-chain (4–7 C atoms) and ultra short-chain (≤ 3 C atoms) PFAS have been gaining in prominence recently. The latter group includes trifluoroacetate (TFA), trifluoromethanesulfonate (TFMS), perfluoropropionic acid (PFPrA), and tris (pentafluoroethyl) trifluorophosphate (FAP). Although the environmental and health impacts of contamination with these substances have not yet been investigated extensively, they should also be removed from drinking water, surface water, and groundwater due to their longevity. Their growing role as industrial substitutes for long chain PFAS makes this all the more important.

Efficient Wastewater Treatment

The superior performance of Lewatit® TP 108 DW was demonstrated in a comparative test in Arzignano in the north Italian region of Veneto. The wastewater from a tannery there contained 61 ppt PFOS and 44 ppt PFOA, which was removed to the limit of detection during treatment (Figure 4). This was also running smoothly after 60,000 BV, while breakthrough with use of GAC and an also PFAS-specific competing resin occurred after just 23,000 BV (GAC, PFOA) and 45,000 BV (GAC, PFOS) as well as 45,000 BV (competing resin, PFOA).

Specific Binding Modes for PFAS of Different Chain Lengths

Particularly when removing PFAS with longer chain lengths (more than eight C atoms), the IEX resins become even more efficient because, in addition to the ionic interaction with the hydrophilic carboxylic acid or sulfonic acid 'head' of the PFAS molecule, weak, hydrophobic interactions of the aromatic polymer backbone can occur with the non-polar, fluoridated PFAS 'tail' – i.e. the bonding relationship is formed cooperatively (Figure 5).

In particular, short-chain PFAS are inadequately adsorbed to GAC and are easily displaced again. There are many promising advances here in the use of membrane processes, such as reverse osmosis and nanofiltration, as well as adsorption to IEX resins. In the latter case, it is possible to use both strongly and weakly alkaline anionic exchange resins that can also be regenerable, provided that the PFAS concentrated in the regenerates can be destroyed efficiently. One of these regenerable, weak base anion exchange resins is Lewatit® MP 62 WS, which additionally boasts high loading capacities, e.g. 10.3 g/l for perfluoropropionic acid (PFPrA) and up to 145 g/l for perfluorobutanoic acid (PFBA). Longer dwell times are usually required than is the case with adsorption of long-chain PFAS. Therefore, the latter should be separated in an upstream process step, as they are bonded more quickly and more tightly. If competing ions, such as chloride or sulfate, are present or very low residual concentrations of PFAS are desired, it is advisable to use a highly alkaline IEX resin such as Lewatit® TP 108 DW. ■

Filtration, Separation, Cooling and Flushing: How to Protect Vacuum Pump Efficiency

Filtration, separation and flushing are proven methods to safeguard equipment, extend lifetime and maintain consistent vacuum pump efficiency. When properly designed and applied, these protective measures can reduce running costs, cut unplanned downtime and improve overall process reliability. ***Meike Strasheim, Head of Market Management Content Strategy, Pfeiffer Vacuum+Fab Solutions,*** *in this article, further emphasizes on how to protect vacuum pump efficiency through filtration, separation, cooling and flushing.*

In industrial environments, vacuum systems are often exposed to contaminants. Dust, powders, vapors and condensates inevitably find their way into vacuum pumps and connected pipework, where they gradually erode the efficiency and performance. Energy use increases, maintenance becomes more frequent, and in severe cases, vacuum pumps fail long before the end of their expected service life. Fortunately, it is possible to protect against this.

Vertical separator vessel with inlet and outlet connections for removing liquids or particulates from the gas stream, supporting stable operating conditions. Image source: Busch Group.

Why Contamination Control is Essential

A vacuum pump is at its most efficient when the gas stream is clean and unobstructed. Contamination undermines this in three ways:

- **Particles:** Such as dust, powders or residues can abrade vacuum pump components and clog passageways.
- **Liquids:** Including water or solvents carried over from the process, can corrode metal surfaces and contaminate lubricants.
- **Condensates:** Can settle inside the vacuum pump, increase the risk of corrosion and disrupt stable operation.

The danger is that these effects develop gradually. Operators may only notice them once energy consumption has crept up, performance has fallen, or an unexpected breakdown has occurred. That is why preventive measures are so valuable. By capturing solids and liquids before they reach critical components, and by flushing away residues when necessary, vacuum pump efficiency can be preserved and costly breakdowns avoided.

Filters: The First Line of Defense

Filters protect the vacuum pump by intercepting unwanted solids at the inlet. In dusty processes such as packaging powders, woodworking or handling fine particulates, filtration is indispensable. Even in environments with less dust, filters are often used as a safeguard against foreign objects that could cause damage entering the vacuum pump.

Different media suit different environments. Paper cartridges provide high efficiency in dry conditions but must be replaced once full. Polyester elements are

more resistant to moisture and can be washed and reused, reducing both waste and cost.

Sizing matters as much as material. A filter with too little surface area may quickly clog, creating pressure drop and reducing efficiency. By matching the filter design to process conditions, operators can protect their equipment without adding unnecessary airflow resistance.

Separators: Stopping Liquids before they enter Vacuum Pump

While filters capture solids, separators are designed to remove liquids and vapors from the process gas stream. This is vital for vacuum pumps that are exposed to humid processes, condensation during cooling, or accidental liquid carryover.

Two-stage liquid separators offer reliable protection. In the first chamber, a sudden change in direction in the gas flow causes heavier droplets to lose momentum, fall out of the gas stream and drain to the bottom. In the second, a demister element traps finer droplets and residual contaminants before the gas exits. This staged approach ensures a high degree of separation efficiency.

Cross-sectional view of a separator showing gas flow through internal filtration elements and liquid collection at the bottom, enabling cleaner gas flow to the vacuum pump. Image source: Busch Group.

For applications with high liquid or particulate loads, cyclone separators provide additional performance. By spinning the gas into a rapid vortex, centrifugal force drives heavier contaminants to the chamber wall, where they settle out. The cleaned gas exits at the top, ready to enter the vacuum pump. Cyclone separation is particularly effective where contamination levels are unpredictable or extreme.

Cyclonic separator design with tangential inlet, illustrating rotational flow and separation of condensate from the gas stream, reducing contamination reaching downstream equipment. Image source: Busch Group.

Condensers & Heat Exchangers: Managing Vapors before they reach Vacuum Pump

While separators remove liquids already present in the gas stream, in vacuum processes, liquids often evaporate as pressure decreases. Water, solvents, or process media can therefore enter the system in the gas phase and pass through separators without being removed.

To address this, condensers or heat exchangers are installed upstream of the vacuum pump. By cooling the gas stream, vapors are brought below their condensation temperature at a controlled location to be removed before entering the pump.

This is particularly important because condensation can otherwise occur inside the vacuum pump. As the gas progresses towards the exhaust, temperature conditions within the pump can promote condensation. This can lead to contamination, deposits, or unstable operation.

Temperature control is an additional factor. Gas compression and process conditions can increase gas temperature. Each vacuum pump has a defined maximum inlet temperature, and exceeding this limit can affect clearances, lubricants, or internal components. Cooling the gas ensures that it enters the pump within the specified operating range.

Flushing: Cleaning from Inside

Even with the best external protection, some contaminants will still reach internal vacuum pump components. In some cases, these residues can harden into deposits over time. This can restrict flow, cause corrosion and accelerate wear.

Regular flushing prevents this. Using compatible fluid, operators can wash away residues and condensates, keeping the vacuum pump interior clean and protecting seals and lubricants. The frequency of flushing depends on process conditions. Vacuum pumps exposed to humid or heavily contaminating gases require more frequent attention.

Best practice is to always follow manufacturer guidance and use approved flushing agents. This ensures the procedure is effective without damaging internal components such as seals.

Balancing Protection & Efficiency

While filters and separators play a critical role in extending equipment life, they must not compromise vacuum pump efficiency. Undersized or clogged elements can create resistance, forcing the vacuum pump to consume more energy.

It is therefore essential to select filters and separators with sufficient surface area for the expected flow and contaminant load. Monitoring their condition regularly and replacing or cleaning them before they become restrictive makes protection and efficiency work together rather than against one another.

Long-term Benefits

Filtration, separation and flushing can be core to the performance and longevity of a vacuum system. When properly applied, they deliver:

- Consistent process performance, with stable vacuum levels and predictable performance.
- Reduced unplanned downtime, thanks to fewer blockages or contamination-related failures.
- Lower maintenance costs, as vacuum pumps require fewer repairs and replacements.
- Extended equipment life, protecting your investment over the long term.

Most importantly, they help maintain vacuum pump efficiency, ensuring that energy use remains low and operating costs stay under control.

Summary

Protecting a vacuum system from contamination is one of the simplest and most effective ways to improve performance. Filters prevent harmful solids from entering the vacuum pump. Separators remove liquids and vapors before they cause damage. Flushing clears residues that build up over time.

Together, these measures preserve efficiency, extend equipment lifetime and reduce operating costs. When carefully selected and maintained, they repay their investment many times over — not only by keeping your system running smoothly today, but by safeguarding reliability for the future. ■

Author

Meike Strasheim
Head of Market Management Content Strategy
Pfeiffer Vacuum+Fab Solutions

The Manufacturing Advantage No One Talks About: Filtration and Separation

Manufacturing today is undergoing one of its most significant transformations in decades. Across industries, factories are becoming smarter, faster, and more automated. Technologies such as artificial intelligence, robotics, industrial automation, and predictive analytics are redefining how production environments operate. While these innovations continue to dominate conversations around the future of manufacturing, one critical enabler often remains underappreciated despite playing a foundational role in industrial success - filtration and separation technologies. ***Hariprasad Padaki, Head of Vision Care Operations, Zeiss India,*** *throws more light on the role of these technologies.*

For decades, filtration systems were viewed largely as backend operational components designed to remove impurities and maintain process stability. However, as industries increasingly move toward precision manufacturing and global quality benchmarks, filtration and separation have evolved into strategic business imperatives. Today, these technologies directly influence product quality, operational efficiency, sustainability outcomes, equipment reliability, and regulatory compliance.

Whether it is pharmaceutical manufacturing, semiconductor fabrication, food processing, chemical production, or advanced electronics, manufacturers are operating in environments where even microscopic contamination can result in production losses, compromised product quality, or operational downtime. In this context, filtration is no longer simply a maintenance function. It has become central to ensuring manufacturing excellence and long-term competitiveness.

Precision Manufacturing Demands Cleaner Processes

Modern industrial ecosystems are far more sensitive and quality-driven than ever before. As products become more sophisticated and manufacturing processes more complex, the demand for ultra-clean production environments continues to rise. In sectors such as semiconductors and electronics, even the smallest airborne particles can affect yield, damage components, or disrupt production cycles. Similarly, in pharmaceutical and biotechnology manufacturing, maintaining sterile environments is essential not only for operational consistency but also for patient safety and global regulatory adherence.

For factory leaders, this presents a growing challenge. Scaling production while maintaining consistent quality standards requires highly reliable contamination control mechanisms throughout the manufacturing process. This is where advanced filtration and separation systems become indispensable.

Air filtration systems help maintain cleanroom integrity in highly sensitive manufacturing environments, while liquid filtration technologies ensure process purity across industrial operations. Separation technologies are also increasingly being used to optimize resource recovery, improve material handling, and support higher process efficiencies.

In industries such as food and beverage manufacturing, filtration technologies play a critical role in ensuring hygiene, product consistency, and shelf-life stability. In chemical processing facilities, advanced separation systems improve operational efficiency while reducing waste and contamination risks. Across sectors, the ability to maintain process purity directly impacts productivity, customer trust, and brand reputation.

As manufacturing standards continue to evolve globally, factories that invest in advanced contamination control and filtration infrastructure will be better positioned to compete in increasingly demanding markets.

Sustainability is Driving Industrial Transformation

Alongside precision manufacturing, sustainability has emerged as one of the defining priorities shaping industrial operations worldwide. Governments, regulators, investors, and consumers are placing growing pressure on industries to reduce their environmental footprint while improving resource efficiency.

Factories today are expected to reduce water consumption, minimize emissions, improve energy utilization, and adopt circular economy practices. This shift has significantly increased the relevance of advanced filtration and separation technologies, particularly in resource-intensive industries.

Water management is one of the most pressing concerns facing manufacturing ecosystems globally. Industrial facilities consume large volumes of water across production, cooling, and cleaning processes. In water-stressed regions, efficient water utilization is becoming critical to ensuring long-term operational sustainability.

Advanced filtration systems are now enabling manufacturers to recycle and reuse wastewater within production cycles, significantly reducing freshwater dependency. Membrane filtration technologies, reverse osmosis systems, and industrial water treatment solutions are helping industries improve water recovery while ensuring process safety and compliance.

Similarly, air filtration systems are helping factories improve workplace safety and reduce airborne emissions. Dust collection technologies, gas separation systems, and industrial air purification solutions are increasingly supporting cleaner and safer production environments.

This transformation is particularly important in India, where rapid industrial growth must be balanced with environmental responsibility and sustainable resource management. As the country accelerates investments in manufacturing, infrastructure, and industrial expansion, the adoption of energy-efficient and sustainable filtration technologies will become essential to supporting long-term growth.

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Rise of Intelligent Filtration Systems

Another major shift shaping the future of filtration and separation is the integration of digital technologies into industrial operations. The rise of Industry 4.0 and smart manufacturing is changing how factories monitor, manage, and optimize production environments.

Traditionally, filtration systems relied heavily on scheduled maintenance and reactive interventions. However, manufacturers today are increasingly adopting intelligent filtration systems equipped with sensors, predictive analytics, and real-time monitoring capabilities.

These systems allow factory operators to continuously assess filtration performance, monitor contamination levels, track equipment efficiency, and predict maintenance requirements before failures occur. AI-driven analytics can identify performance anomalies early, helping reduce unplanned downtime and improve overall process reliability.

For factory heads, this represents a significant operational advantage. Predictive maintenance not only reduces disruptions but also extends equipment lifespan and lowers maintenance costs. Real-time visibility into operational conditions enables better

decision-making, improved energy optimization, and enhanced process control.

Digital integration is also enabling greater automation across industrial filtration infrastructure. Smart filtration systems can automatically adjust operational parameters based on changing production requirements, ensuring consistent performance while improving efficiency.

As manufacturing becomes increasingly data-driven, intelligent filtration technologies will play a key role in building more resilient, agile, and future-ready factories.

Supporting India's Manufacturing Ambitions

India's ambition to emerge as a global manufacturing powerhouse further reinforces the importance of advanced industrial infrastructure and precision-driven operations. The country is witnessing significant investments across sectors such as semiconductors, electronics, electric mobility, renewable energy, healthcare manufacturing, and advanced materials.

However, global competitiveness requires far more than production scale alone. It requires manufacturing ecosystems capable of consistently delivering quality, reliability, process precision, and operational sustainability at international standards.

Filtration and separation technologies will therefore play a foundational role in enabling this industrial transformation. Semiconductor fabrication facilities require ultra-clean environments with highly controlled contamination levels. Battery manufacturing and electric mobility ecosystems demand precision handling and advanced material separation processes. Pharmaceutical production facilities depend heavily on sterile processing and high-purity manufacturing environments.

As industries continue to expand, factory leaders will increasingly need to focus on building operational ecosystems that prioritize both efficiency and sustainability. Investments in advanced filtration infrastructure will not only support compliance and operational performance but also enhance global competitiveness.

Building the Factories of the Future

Looking ahead, the future of manufacturing will not be defined solely by how much industries produce, but by how intelligently, sustainably, and precisely they operate. Filtration and separation technologies may often remain behind the scenes, but their contribution is visible across every stage of modern industrial operations.

From enabling contamination-free production and improving operational efficiency to supporting sustainability goals and resource optimization, these technologies are becoming central to the next generation of manufacturing excellence.

For factory leaders, investing in advanced filtration and separation systems is no longer simply about operational maintenance or compliance. It is about future-proofing manufacturing ecosystems in an increasingly competitive and environmentally conscious industrial landscape. The factories that prioritize precision, purity, efficiency, and sustainability today will ultimately become the industry leaders of tomorrow. ■

Author

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GUEST COLUMN

India's Wastewater Challenge Is No Longer Just About Treatment Capacity

Satish Ingavale
Director
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India has made real progress in building wastewater treatment capacity. The next challenge is ensuring that this infrastructure performs consistently under real operating conditions. Reliability across the system, particularly in how critical equipment operates, will determine how effectively we can scale reuse, emphasizes ***Satish Ingavale, Director – India, John Crane.***

India produces 112 billion litres of wastewater every day, making it the third-largest producer globally. It reads like a distant statistic until it begins to surface in ways that are difficult to miss. A river that once ran clear starts slowing down. A lake shrinks at the edges before slipping out of daily use.

According to the Economic Survey 2025–26, only 28 per cent of this volume is treated, and just 8 per cent is reused. A large share still returns to the environment with limited control. For years, this remained in the background, absorbed into how cities functioned. That ease is starting to fade.

Water stress is becoming more visible, and this has brought treating wastewater, particularly for non-potable purposes, into the mainstream conversation. The focus is now moving beyond treatment volumes to how wastewater actually moves through collection systems before it reaches a plant, and where losses and inefficiencies begin to build.

Much Wastewater Never Reaches Treatment Plants

Indian cities have expanded quickly, often without fully considering what happens after water is used. In many areas, sewer networks are still incomplete or already under pressure. Pipes stop midway. Flow does not always move as intended. It gets redirected, held back, or lost along the way. In many cities, a considerable share of wastewater never reaches a treatment facility at all.

Sealing solutions play a key role in maintaining process integrity, ensuring that different stages remain contained and do not interfere with each other. Improvements in pump design are also helping to deliver more stable flow while managing energy use more effectively. There is a clear shift away from relying on excess flush water, towards more controlled and efficient system operation.

Local authorities operate within tight budgetary constraints that are not always reflected in formal plans. Water infrastructure often competes with transport projects, housing demands, and essential civic services. Land becomes a challenge much later, once most suitable space has already been used. Even where plants are in place, keeping them running effectively depends on people who understand how these systems behave, and that expertise is not always available. There is also some hesitation around using treated wastewater, shaped more by perception than actual performance.

Plants Exist but Operate Below Capacity

Even existing wastewater treatment plants often fail to operate at full capacity. The issue frequently lies within the system itself. The chemical composition of wastewater gradually degrades equipment, sometimes so slowly that it is difficult to detect until performance begins to decline.

When critical equipment such as pumps and seal faces, start to wear due to prolonged stress, it impacts how different stages of the plant work together. In plants that operate continuously, even minor inefficiencies can lead to higher energy consumption and inconsistent output.

This is where the role of reliable flow control technologies becomes increasingly important. Supporting the performance of pumps, sealing systems, and filtration processes helps maintain stable operating conditions across the treatment chain. At John Crane, this focus is on enabling customers to keep critical equipment running consistently, even in challenging and variable wastewater environments.

Another challenge arises when upgrades or modifications are needed. Most plants cannot afford to stop, so even routine improvements are difficult to plan. Work typically happens in phases around ongoing operations, which slows progress. Costs compound this challenge, particularly where ageing systems require more than minor intervention.

Industrial wastewater adds further complexity. Its composition can change without much warning, requiring systems to respond quickly. Some plants adapt effectively, others struggle to maintain performance over time.

Engineering Systems that can keep up with Real Conditions

What is changing now is how critical components are being designed and applied to address these challenges. There is greater emphasis on durability, reduced maintenance, and consistent performance under continuous load.

Sealing solutions play a key role in maintaining process integrity, ensuring that different stages remain contained and do not interfere with each other. Improvements in pump design are also helping to deliver more stable flow while managing energy use more effectively. There is a clear shift away from relying on excess flush water, towards more controlled and efficient system operation.

Alongside this, monitoring technologies are becoming more widely adopted. With IoT-enabled condition monitoring, operators are able to track how equipment is performing in real time, rather than reacting to failure. This allows early signs of wear to be identified, enabling maintenance to be planned before issues escalate.

Across John Crane, this combination of engineered reliability and condition monitoring is helping operators extend equipment life, reduce unplanned downtime, and maintain more consistent plant performance.

However, improving reliability and efficiency is only part of the challenge. Building confidence in treated wastewater, and ensuring consistent output quality, remains equally important.

Industry focus is shifting towards tighter process control and better coordination across treatment stages so that output quality remains consistent enough for reuse. This relies on improved instrumentation, more stable equipment performance, and closer monitoring of key operating parameters to reduce variation across the treatment chain.

Building Confidence in Treated Wastewater Use

Industry focus is shifting towards tighter process control and better coordination across treatment stages so that output quality remains consistent enough for reuse. This relies on improved instrumentation, more stable equipment performance, and closer monitoring of key operating parameters to reduce variation across the treatment chain.

For applications such as industrial processes, cooling systems, and utility operations, consistency is critical. These systems depend on predictable quality thresholds, and variability can limit adoption.

By improving the reliability of core process equipment and reducing performance variability, it becomes easier to maintain the stable conditions required for reuse. This is where robust sealing, efficient pumping systems, and effective filtration all contribute to overall system confidence.

In many existing plants, the challenge lies in integrating these improvements into infrastructure that was not originally designed with reuse in mind.

The next step is aligning treatment performance more closely with end-use requirements, so that reuse can be planned as part of standard water management rather than treated as an additional layer.

Conclusion

The future of wastewater treatment will be defined by how effectively engineered systems can translate treatment capacity into dependable, usable output under real operating conditions.

As plants become more technically refined, the focus will remain on maintaining consistent performance despite continuous demand and variable wastewater inputs, rather than treating efficiency as a one-time outcome.

For John Crane, this means continuing to support customers with technologies and expertise that help improve the reliability of critical equipment, stabilise operations, and enable more predictable outcomes across the treatment process.

Across regions, progress will vary depending on infrastructure maturity and readiness to adopt upgraded systems, but the direction is clear.

What will ultimately shape the sector is not expansion alone, but the ability of systems to deliver the same expected result every day, without deviation from defined operating conditions. ■

Chemical Process Safety Assessment using Thermal Screening Unit and Reaction Calorimeter

Most incidents in the chemical process industry are due to improper handling of hazardous chemicals and processes, or to the improper design of process equipment without sufficient safety data. Multiple incidents have been reported from solvent recovery and distillation plants due to exothermic reactions and violent decomposition, which occurred mainly because their operating temperatures were unsafe and the thermal stability of the feed and residue was not assessed. All such incidents can simply be avoided if proper process safety data is generated and a safety culture is built in the chemical industry. In this article, ***Rajendra Kumar, Sr. Scientist, Chemical Engineering and Process Development, Sr. Scientist, Chemical Engineering and Process Development, CSIR - National Chemical Laboratory****, explains the importance of Thermal Screening Unit and Reaction Calorimeter data for a safe and sustainable chemical industry through several real case studies.*

To ensure the safe operation of the chemical industry, process safety assessment must be considered an integral part of process development at both lab and commercial scales. Process safety data, safety culture, and safety equipment components must be connected like a triangle; this is called the process safety triangle concept (Figure 1). It ensures safe handling of hazardous substances and processes to prevent fires, explosions, or toxic releases in the chemical industry. Hence process safety triangle must be established. The process safety triangle also protects lives, preserves the environment, and supports business continuity.

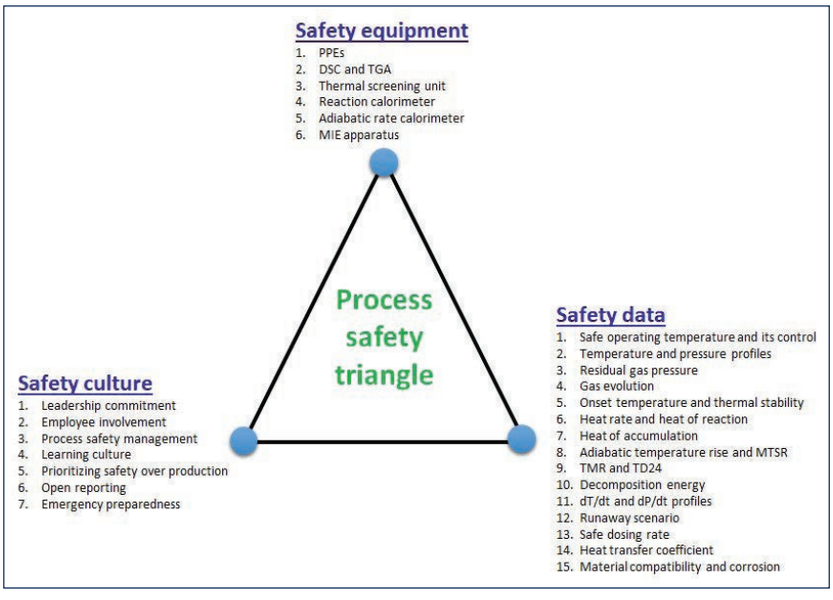

Figure 1: Process safety triangle, which ensures safe and incident-free chemical industry.

Among all the process safety equipment, the CSIR-NCL Pune lab has its own operational thermal screening unit and reaction calorimeter. Data such as safe and un-safe region to operate, onset temperature, explosion severity in terms of rate of temperature and pressure rise, heat rate, heat of reaction, adiabatic temperature rise, MTSR, safe dosing rate, etc., can be generated using these two equipment. A simple temperature and pressure profile generated by the thermal screening unit has capability to prevent an explosive incident in a plant.

Thermal Screening Unit (TSU)

TSU is one of the advanced thermal screening tools for analyzing a chemical sample in solid, liquid, slurry, or gaseous phase (Figures 2a, 2b). TSU testing can be conducted at 2 to 3 ml sample size of a pure chemical or a reaction mass under

air, nitrogen, hydrogen or vacuum environment. TSU uses a hastelloy test cell of 5 ml volume with the design pressure from vacuum to 150 bar and design temperature from ambient to 400°C (Figure 2c). TSU consists of a thermocouple to measure the sample temperature and a pressure transducer to measure the sample pressure. An external oven is provided to heat the sample in ramp or isothermal mode as per the user requirement.

TSU is also given a vent line to release any excess or generated residual pressure during the test. TSU provides temperature and pressure profiles, maximum temperature and pressure rise due to decomposition (Tmax and Pmax), dT/dt, dP/dt, residual gas pressure (Pres), and onset temperature (Tonset) data. TSU also predicts the safe and un-safe region to operate in terms of the selection of safe process temperature. TSU data also indicate the situations that need to be avoided while handling chemicals. TSU data of organic peroxide and H_2O_2 samples are presented as case studies.

TSU Study of Explosive Organic Peroxide Sample

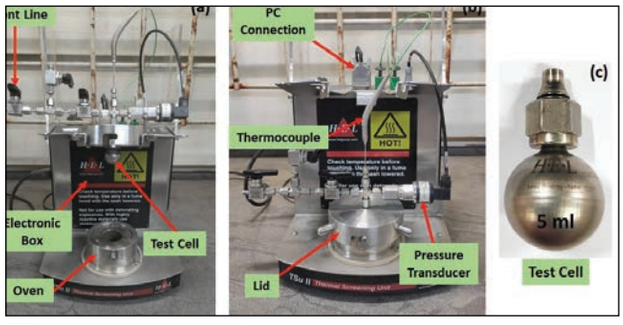

Figure 2: Thermal screening unit installed at CSIR-NCL Pune. (a) TSU with open lid. (b) TSU with closed lid. (c) TSU test cell.

A TSU data of an explosive organic peroxide sample is presented. While heating this sample, temperature and pressure vs time profiles are recorded. It is found that this peroxide sample undergoes exothermic decomposition as expected, releasing exothermic energy as a sudden rise in temperature and pressure. Tmax and Pmax are found to be 221.29°C and 62.46 Bar. As during decomposition of this peroxide, gases such as CH_4, CO_2, and CO might have been generated, which will not get condensed after cooling this sample, hence there is a final sample pressure in the test cell, which is called residual pressure. It is found to be 27.96 Bar (Figure 3a). Temperature and pressure data is further analyzed to obtain dT/dt, dP/dt and d_2T/dt_2 vs temperature profiles to obtain the decomposition

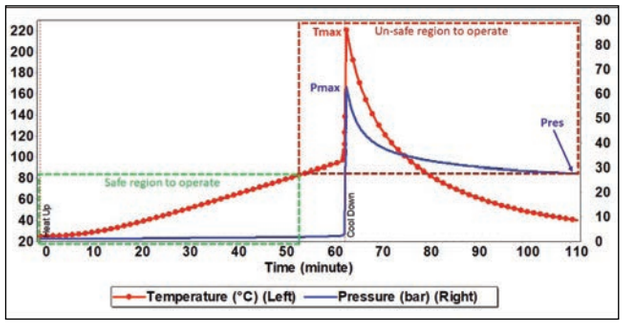

Figure 3a: Temperature and pressure vs time profiles of an organic peroxide sample from TSU testing.

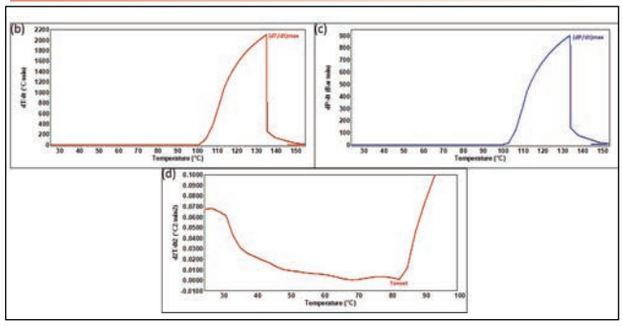

Figure 3: (b) dT/dt vs temperature profile. (c) dP/dt vs temperature profile. (d) d^2T/dt^2 vs temperature profile for the onset temperature determination.

severity in terms of rate of temperature and pressure rise due to decomposition and onset temperature of the decomposition. For this peroxide, (dT/dt) max and (dP/dt)max is found to be 2096.65°C/min and 901.48 Bar/min (Figures 3b, 3c). Onset temperature of the decomposition is found to be 82.86°C (Figure 3d).

TSU Study of H_2O_2 Sample

The temperature and pressure profile of an H_2O_2 sample is presented, which shows there is a decomposition event during its heating. Tmax and Pmax due to the decomposition are found to be 218.10°C and 70.97 Bar. As during decomposition of H_2O_2, O_2 gas would be generated, which has shown residual pressure of 40.14 Bar (Figure 4a). (dT/dt)max and (dP/dt)max is found to be 775.27°C/min and 445.49 Bar/min (Figures 4b, 5c). Onset temperature of the decomposition is found to be 55.58°C (Figure 4d).

For the safe handling of such organic or inorganic peroxides and any other explosive sample, and reaction mass, operating temperature must always be below to its onset temperature to avoid any decomposition and runaway. Operating temperature must be selected within the safe region to operate only. TSU data provides preliminary information of possible thermal hazards.

Reaction Calorimeter (RC)

RC is widely used isothermal reaction calorimeter to

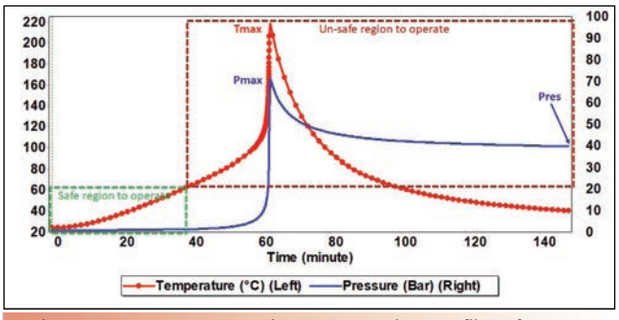

Figure 4a: Temperature and pressure vs time profiles of H_2O_2 sample from TSU testing.

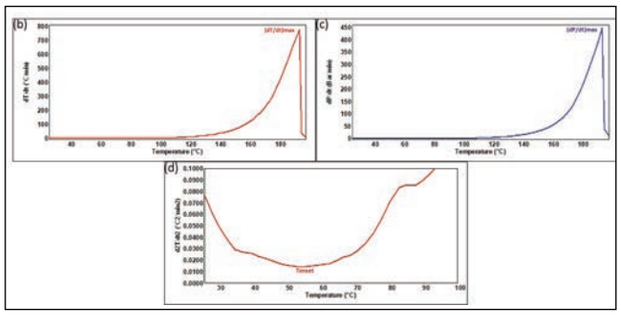

Figure 4: (b) dT/dt vs temperature profile. (c) dP/dt vs temperature profile. (d) d^2T/dt^2 vs temperature profile for the onset temperature determination.

determine the heat rate, heat of reaction and adiabatic temperature rise data of a chemical process. Data such as heat of accumulation, Maximum Temperature of Synthesis Reaction (MTSR), temperature and pressure rise in case of cooling failure, safe dosing rate and reaction end point can also be determined using this equipment. RC is mainly used for process safety data generation of exothermic processes such as hydrogenation, nitration, sufonation, Grignard, esterification, gas absorption, etc.

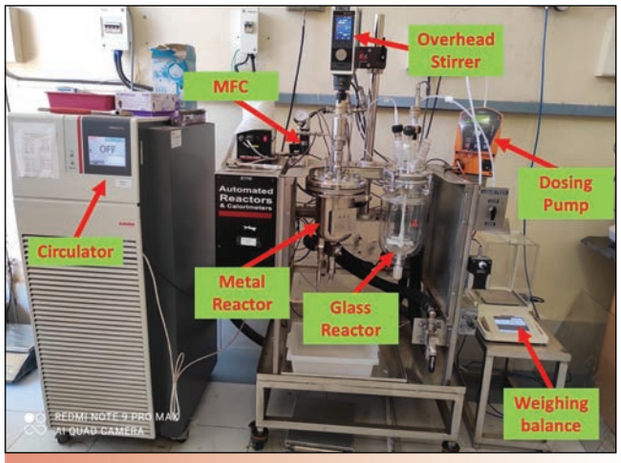

Figure 5: Reaction calorimeter installed at CSIR-NCL Pune.

RC at CSIR-NCL Pune has the capability to generate this data using both heat flow and power compensation methodologies. Due to its dual reactor provision, which consists of a SS316 and a glass reactor, this is a unique facility. It can conduct both high-pressure reactions, such as hydrogenation, and ambient-pressure reactions, such as nitration (Figure 5). Both reactors have a volume of 1000 ml, and RC testing can be conducted at a reaction mass volume of 400 ml. Temperature ranges from -10°C to 180°C, and pressure ranges from ambient to 50 bar can be handled. All industrial exothermic chemical reactions can be tested using this RC.

For RC, two case studies are presented, first is exothermic hydrogenation reaction and second is exothermic nitration reaction.

RC Study of Hydrogenation Reaction

An aromatic hydrogenation reaction is conducted at 60°C temperature and 7 bar pressure. Heat rate and energy profile is obtained from the RC experiment (Figure 6a). As hydrogen feed into the reactor is done using a mass flow controller (MFC), hydrogen consumption data is also obtained (Figure 6b). Reaction end point based on the heat rate profile, energy profile and hydrogen consumption profile can also be determined.

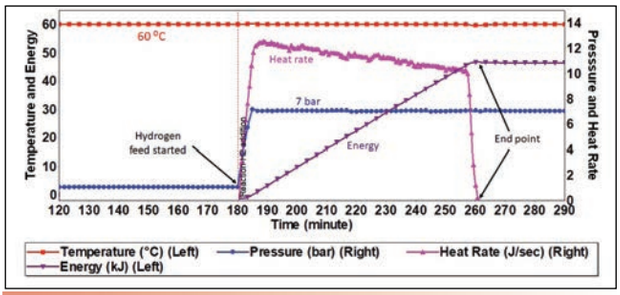

Figure 6a: Heat rate and energy profile of an exothermic hydrogenation reaction from RC experiment.

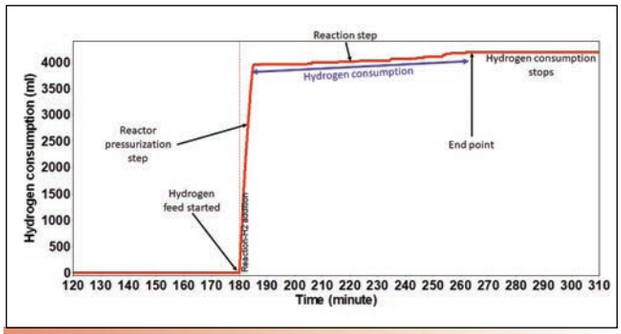

Figure 6b: Hydrogen consumption profile of an exothermic hydrogenation reaction from the MFC of RC.

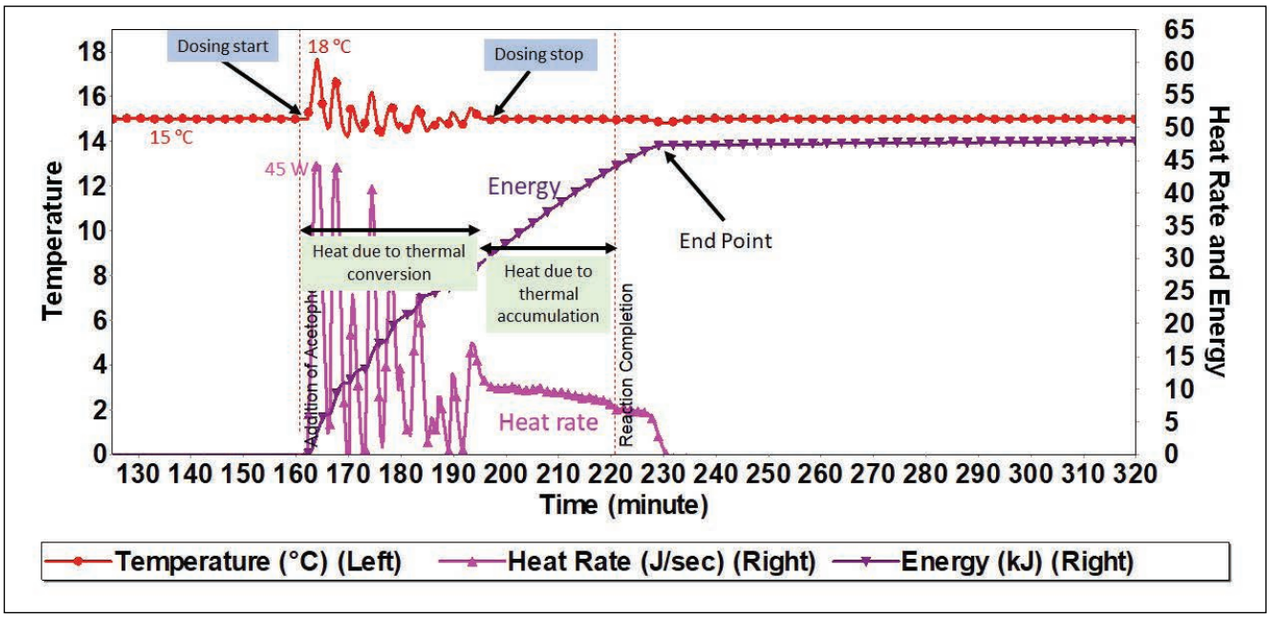

Figure 7: Heat rate and energy profile of an exothermic nitration reaction at 15 °C temperature and ambient pressure.

RC Study of Nitration Reaction

An aromatic nitration reaction at 15°C temperature and ambient pressure was conducted. Heat rate and energy data is obtained from the RC experiment (Figure 7). Heat released due to thermal conversion and due to thermal accumulation is also being obtained.

Heat rate and energy data can help to determine a safe dosing rate to avoid significant temperature shoot-up or runaway. Temperature and pressure rise during cooling failure can also be predicted from RC data to assess the possibility of decomposition and auto-ignition of the reaction mass. RC data can also help a user to choose the appropriate chilling capability to handle the energy released during the exothermic process.

Summary

Data, such as safe operating temperature, heat rate, and heat of reaction, obtained from TSU and RC are key pieces of information required for the safe scale-up and commercialization of a chemical process. TSU and RC data predict the possible temperature and pressure rise due to decomposition and cooling failure, which helps to choose appropriate temperature and pressure ratings of the process equipment.

TSU and RC capability are being presented with the help of 4 case studies for awareness purposes. Almost 70-80 per cent data mentioned in Maharashtra Factories (1st Amendment) Rule 2025: 73-ZC, which talks about the safety precautions and data required for conducting exothermic chemical reactions, can be generated using TSU and RC equipment available at CSIR-NCL Pune.

In the past, CSIR-NCL Pune has provided process safety data generated by the TSU and the RC to many chemical companies for the safe handling of their chemical processes. ■

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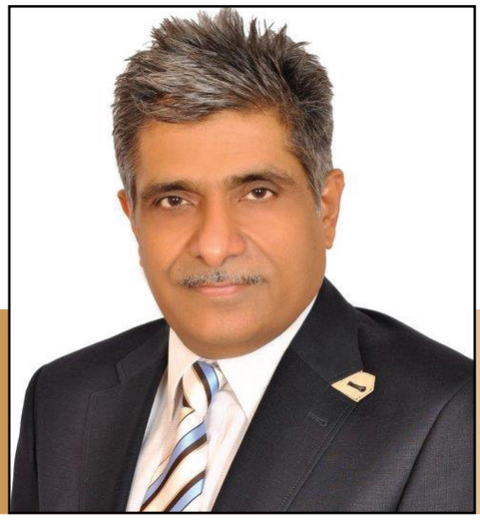
Smart Systems, Safer Workplaces: Integrating Technology into Risk Management



Mahesh P. Babani
Chairman & Managing Director
Privi Speciality Chemicals

With the chemical industry scaling to meet global demand, safety has become a strategic imperative. As operational complexities increase, there is an expectation for better regulations and heightened stakeholder scrutiny. Manufacturers are now rethinking how safety can be integrated across the value chain. However, the shift is seen moving from reactive protocols to proactive and technology-enabled risk management systems. This is the imperative key to avoiding any hazards. ***Mahesh P. Babani, Chairman & Managing Director, Privi Speciality Chemicals,*** *though this article, explains that the shift is both extremely necessary and urgent.*

Millions of workers across the globe face daily exposure to harmful substances, often resulting in long-term health impacts. The scale of operations keeps growing, increasing the probability and impact of incidents if the system is not made robust. Chemical manufacturing has accounted for a substantial share of industrial incidents involving hazardous substances, highlighting the need for a stronger preventive framework.

Shift from Compliance to Predictive Safety

Safety in the chemical sector has largely been driven by compliance. Procedures, audits, and certifications such as ISO 45001 have helped establish a structured approach to managing risk. Many manufacturers now operate with integrated management systems that link safety with operations, quality, and environment. This creates consistency, in identifying risks and putting up appropriate controls but it does not eliminate risk. Most incidents occur despite systems being in place, often due to gaps in execution or behavioural issues. Small lapses such as missed checks or process deviations can build into larger failures.

To address this, companies are applying these

frameworks more rigorously. Tools such as HAZOP studies, job safety analysis, change control, and pre-startup safety reviews, Behaviour Based Safety are being used to identify risks early and maintain control during operations. The focus is shifting from meeting standards to ensuring they are followed consistently on the ground.

Building a strong safety culture is increasingly driven by proactive workforce engagement. Daily safety toolbox talks (TBT) and behaviour-based safety (BBS) platforms encourage workers to identify hazards, discuss near misses, and take shared ownership of risk. Such engagement moves safety from a top-down mandate to a collective responsibility.

The Period of Continuous Monitoring

In modern-day chemical plants, there is an increasing trend of adopting continuous visibility, which involves monitoring critical process parameters continuously for operational stability and safety. Chemical processes like hydrogenation, peroxides, chlorination, and high vacuum distillation use many instruments for measuring pressure, temperature, flow, tank level, gases, etc., for keeping the process variables within the normal range. These instruments include pressure transmitters, temperature probes, flow meters, level instruments, gas detection systems, and analytical instruments.

These instruments feed their data into the DCS/PLC system in order to provide monitoring capabilities from control room consoles. Important safety loops are then provided additional safety through SIS (Safety Instrumented System). This system is capable of initiating emergency actions or shutdowns as a result of any detected dangerous state. The redundant configuration of instruments, coupled with the provision of uninterrupted power sources, helps in ensuring reliable operation.

Recent innovations in the sphere of digitalization have considerably improved the effectiveness of monitoring systems used in chemical processes. Self-calibrating smart sensors are capable of recognizing any signs of calibration drift, malfunctioning, and improper operation of equipment prior to the appearance of negative effects on the process being monitored. Moreover, IoT software solutions allow integrating and analysing data collected by instruments on an enterprise level in real-time manner.

The next step will be the introduction of AI-powered devices, which means analysing historical and operational data with the help of machine learning algorithms to recognize unsafe tendencies that could lead to alarms. In particular, smart devices powered by artificial intelligence will be able to recognize abnormal pressure changes, vibration patterns associated with rotating equipment, or deviations in the reactor's temperatures, thus indicating equipment fouling, deterioration, or problems in the process itself.

Rather than dealing with the consequences of potential emergencies and responding to alarms, chemical manufacturers can now use digitalized instruments to predict potential risks related to abnormal conditions and prevent them.

Smart Fire Detection and Response Systems

Fire risk remains one of the most serious threats in chemical manufacturing. Globally, fires and explosions account for a significant share of major chemical incidents, often with severe consequences.

Facilities are responding by strengthening detection and response systems. Plants are now equipped with multi-layered detection mechanisms, including hydrogen, LPG, and oxygen gas detectors, along with smoke, heat, and flame sensors placed near critical zones.

These systems are linked with response mechanisms such as nitrogen or steam-based suppression, which help contain incidents before they escalate. Regular testing and third-party inspections ensure that these systems remain effective over time.

At the same time, structured hazard assessments and periodic audits are helping identify high-risk areas within plants.

This allows for focused preventive measures instead of a uniform approach.

Additionally, some of the most critical risks in chemical plants are not visible. Electrostatic discharge is one such example, especially in environments handling flammable materials. Managing this requires structured

Safety has become an imperative. In India, authorities such as the Directorate of Industrial Safety and Health (DISH) and evolving frameworks under the Factories Act and recently notified Occupational Safety Health Working Condition (OSHW) Code 2020 are pushing for stricter compliance, regular audits, and greater accountability from plant operators. There is also a growing emphasis on process safety, not just workplace safety, especially for units classified under Major Accident Hazard (MAH) categories.

processes. Dedicated audits, grounding systems, and multidisciplinary reviews help identify and control such risks. When supported by digital tracking, these audits become more consistent and easier to monitor over time. This level of discipline ensures that less obvious hazards are not overlooked.

Workforce Preparedness for Building Safety Culture

People remain central to safety, but the way workforce systems are managed is becoming more structured and accountable. Worker participation is also becoming more formalised. Safety committees with representation from both management and workers review incidents, share learnings, and drive improvements. Recognition programs and regular engagement help reinforce safe practices across teams.

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Preparedness is treated with equal importance. Regular mock drills, clearly marked evacuation routes, emergency siren systems, and trained response teams ensure readiness during critical situations. At the same time, continuous improvement is built into the system. Accident trend analysis, corrective and preventive action frameworks, and periodic safety audits led by senior teams help identify gaps and strengthen controls over time.

Building a strong safety culture is increasingly driven by proactive workforce engagement. Daily safety toolbox talks (TBT) and behaviour-based safety (BBS) platforms encourage workers to identify hazards, discuss near misses, and take shared ownership of risk. Such engagement moves safety from a top-down mandate to a collective responsibility. International frameworks and advanced process safety management guidelines consistently highlight that a positive safety culture plays a critical role in reducing workplace incidents, strengthening hazard awareness, and creating an organisation that responds early and effectively to emerging risks.

Path Ahead to Smarter Safety for a Safer Industry

Safety has become an imperative. In India, authorities such as the Directorate of Industrial Safety and Health (DISH) and evolving frameworks under the Factories Act and recently notified Occupational Safety Health Working Condition (OSHW) Code 2020 are pushing for stricter compliance, regular audits, and greater accountability from plant operators. There is also a growing emphasis on process safety, not just workplace safety, especially for units classified under Major Accident Hazard (MAH) categories.

Tighter norms, if implemented consistently, can help standardise safety practices across the industry. They push companies to invest in better systems, improve documentation, and maintain higher levels of preparedness. More importantly, they create a level playing field where safety is not compromised for cost or speed. As the industry expands, the ability to combine regulatory discipline with strong on-ground practices will determine which organizations are able to operate reliably and sustain long-term growth. ■

Suraj Limited: Dedicated towards Technical Excellence & Quality Products

Suraj Limited, is an ISO-9001:2015, 14001:2015, OHS AS 45001:2018 certified company, PED approved and Government Recognized Export House and one of the world's leading producers and exporters of stainless steel, alloy steel, carbon steel seamless pipes, tubes, fittings and flanges. With over three decades of expertise, we serve critical industries including Oil & Gas, Petrochemicals, Power, Nuclear, Defense, Fertilizers, and Water Treatment across 60+ countries.

Manufacturing Infrastructure

Suraj Limited operates from two state-of-the-art plants in Gujarat, India:

- **Thol Plant:** Dedicated to seamless pipes, tubes, and fittings with hot extrusion, cold pilgering, and finishing facilities.
- **Chandarda Plant:** Specialized in carbon and alloy steel forged fittings and flanges with advanced forging, heat treatment, and machining lines.

Our total installed capacity exceeds 24,000 MT per annum.

Quality Assurance

We have our own in-house testing laboratory with modern testing equipment to carry out all mandatory as well as optional tests on the products. Complex tests for which we do not have in-house facilities will be conducted at an external third party approved test house. Products will also be supplied under third party inspection where customer demands.

Certifications & Approvals

- Our manufacturing is PED 2014/68/EU approved, and we hold product approvals from IBR, EIL, ONGC, BHEL, NTPC, and major global EPCs.
- We are also approved by international inspection agencies like Bureau Veritas, DNV, TUV, Lloyd's, and SGS.

Commitment

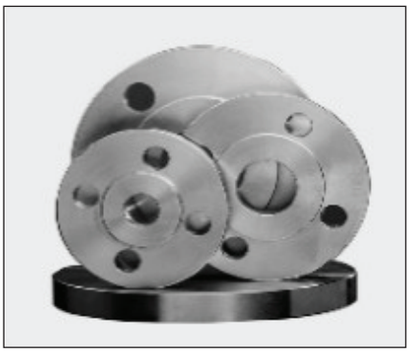
At Suraj Limited, we believe every customer has unique needs. Our technical and commercial teams work closely with clients to offer customized solutions, reliable delivery, and dedicated after-sales support.

Key Highlights

- **Gujarat-based Suraj Limited is one of the world's leading producers and exporters of stainless steel, alloy steel, carbon steel seamless pipes, tubes, fittings and flanges.**
- **SO-9001:2015, 14001:2015, OHS AS 45001:2018 certified company.**
- **PED approved and Government Recognized Export House.**
- **Operates from two state-of-the-art plants in Gujarat.**
- **Company's total installed capacity exceeds 24,000 MT per annum.**


Seamless Hot Finish Mother Pipe


Stainless Steel Seamless Heat Exchanger U-Tubes


Stainless Steel Flanges


Stainless Steel Seamless Buttweld Fittings


Stainless Steel Seamless Heat Exchanger Tubes


Stainless Steel Forged Rings


Stainless Steel Seamless Pipes

Product Range

- **Stainless Steel Seamless Pipes:** 1/8 NPS to 6 NPS
- **Stainless Steel Seamless Butt-weld Pipe Fittings:** ½ NPS to 12 NPS
- **Stainless Steel Seamless Stubends (Type A):** ½ NPS to 12 NPS
- **Stainless Steel Flanges:** ½ NPS to 40 NPS
- **Stainless Steel Forged Rings:** Max. 1200 mm OD
- **Heat Exchanger Tubes:** 6.00 mm to 101.60 mm OD
- **Heat Exchanger 'U' Tubes:** 12.70 mm to 50.80 mm OD
- **Hydraulic & Fuel Injection Tube:** 6.00 mm to 114.00 mm OD

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Filtration: An Important Unit Operation

Excellence Consultants

Filtration is an important 'unit operation', where solid cake is separated from the 'mass'. ***K G Tijare, Proprietor, Excellence Consultants****, in this article, explains in detail about the major filtration systems, generally used in chemical industry and their selection criteria.*

Following major mfiltration systems are generally used in chemical industry.

Filter Presses: Assembly of filter plates and filter cloth. Filter presses have been old 'work horse' in the chemical industry, with disadvantages of large footprint area, manual messy jobs, filtration performance not very satisfactory and high time-cycles.

Solid Bowl Decanters: These are used for slimy slurries, does not use filter media, utilizes high bowl RPM for separation. These are mainly utilized for ETP sludges, as an alternative to filter presses.

Nutsche Filters: These filters use filter cloth for separation and agitator for mixing and washing. Filtration by pressurization, batch equipment, long time cycles. These are used in pharma industry.

Rotating Vacuum Drum Filters (RVDF): RVDF uses vacuum for filtration, a continuous equipment, but the operation is messy and separation is not very clear. Not recommended for acidic streams as the vapors lead to corrosion of vacuum system.

Basket Centrifuges: These are commonly used equipment in chemical industry. Filter cloth is used for separation. Centrifugal force by rotation of basket leads to separation. The centrifuge basket comes in different MOCs/lining for filtration duty of acidic streams.

Peeler Centrifuges: Improvised basket centrifuge with semi continuous operation, cycle is feeding, washing cake discharge. These come with options for MOC for acidic slurries.

Pusher Centrifuges: These are used for separation of slurries of particle size above 50 - 100 microns. They utilize slotted screen for separation. These have multiple basket rotating at the same RPM with reciprocating motion of inner basket for cake discharge.

Tower Pressure Filters: These are commonly used in mining industry, initially with large volumes to handle. With their sizes and automation, they have become an excellent alternative in chemical and pharma industry. Options of various material of constructions like SS / PP / Teflon / SS 904 etc, no rotating baskets like centrifuges, replaceable filter cloths and modular construction for increase in capacity, cake washing, automated cake delivery, makes this equipment technically superior to available filtration system.

Filtration Systems: Selection Criteria

To sum up, the criteria for selecting the right filtration system, would be based on the following:

- Nature of slurry to be processed
- Capacities to be handled
- MOC required as per process parameters
- Operating cost and manpower requirement
- Commercial viability of the equipment for the required duty ■

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R.N.I. No. 11403/1966 Date of Publication: 29th of every month. Postal Registration No: MCS/095/2023-25
Posted at Patrika Channel Sorting Office, Mumbai 400001, on 30th of every month. Total Pages No.: 50

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