

CHEMICAL TODAY

Connecting World Chemically

IT in Chemicals
Cosmetics

International Focus
Paint & Coating
Sustainable Aviation Fuel

Equipment Interview
Lubricants, Oil & Gas

Women in Chemistry
Dr. Petra Severit, ALTANA AG

CHEMICAL TODAY
MARCH 2025

VOLUME IX ISSUE X

RNI NO : KARENG/2016/771454

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**MICROBE DEFENDERS:
ROLE OF BIOCIDES ACROSS INDUSTRIES**



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Shri Mohan Charan Majhi
Chief Minister, Odisha

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DECIPHERING KEY VARIABLES IN CHEMICAL MARKET



The chemical industry stands at a crucial juncture as economic policies continue to shape its trajectory. With the national spotlight on the Union Budget 2025-2026, industry leaders analyzed how key reforms can drive transformation and growth. In this edition, we bring you exclusive insights from industrialists on the anticipated impact of these policy changes on the sector.

For this edition's Sector Focus, we have covered the applications and key aspects of biocides. Biocides are among the most widely used chemical agents across industries, serving as preservatives to maintain product integrity and extend shelf life. Given their growing significance, this month's edition explores crucial aspects such as market trends, types, key players, and regulatory compliances governing biocides.

Going ahead we have covered an interview with the leader in Specialty Chemicals, Dr. Severit, CTO at Altana AG shared key points on transformational variables affecting the market. Additionally, Dr. Severit also shared her aspirations and contributions as a "Women in Chemistry".

Additionally, this edition features an insightful discussion with Mr. Alexander Kueper, VP, Renewable Aviation Business at Neste, on the role of Sustainable Aviation Fuel in decarbonizing aviation and transforming global reliance on fossil fuels.

Building on our Feb Edition theme, Chemical Today interviewed Mr. Skilbred, Global Sustainability Manager to share Jotun's vision, and trends and discuss how the market is evolving in the Paint & Coating Sector in terms of sustainability, digitalization, and compliance.

We extend our heartfelt gratitude to all the guest authors who shared their knowledge and expertise in ion exchange resin, Fire Safety, the Graphite market, and novel innovations like Polycotton recycling.

Stay ahead in the chemical industry—explore this edition's exclusive insights and subscribe today to never miss an update!

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CHEMICAL TODAY

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Printed by Jaison M Jose, Published by Bejoy Koroth on Behalf of Kimberlite Softwares Pvt. Ltd. and Printed at Josco Printers, #14, 12th Cross, Little Flower Hospital Road, R.M.Nagar, Bangalore 560016 and Published Kimberlite Softwares Pvt Ltd., #46, Near ST. James Church, Dasarahalli, Bangalore 560024. Editor: Shradha Verma.

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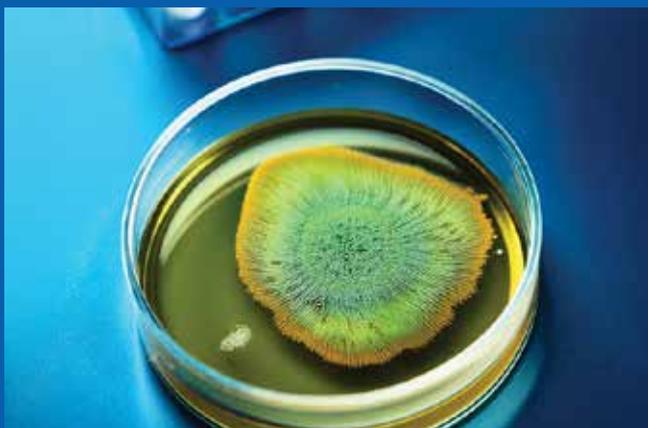
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CHEMICAL TODAY

Connecting World Chemically

SECTOR FOCUS

BIOCIDES 40



INTERNATIONAL FOCUS

WOMEN IN CHEMISTRY



Mr. Anders Skilbred 28
Global Sustainability Manager,
Jotun.



Mr. Alexander Kueper 30
Vice President,
Renewable Aviation Business,
Nestle.



Dr. Petra Severit 32
Chief Technology Officer,
ALTANA AG.

EQUIPMENT INTERVIEW

LOGISTICS



Mr. Dean Segal 60
VP of Sales & Marketing,
Pope Scientific, Inc.



Mr. Sadegh Jalali 66
Managing Director,
Fulcrum Shipping and Logistics.

Chemical Today

is a monthly magazine focused
on chemistry & the chemical industry.

CONTENTS

NEWS

MOVERS & SHAKERS	13
MERGERS & ACQUISITION	15

MAKE A DIFFERENCE

19

IN-HOUSE ARTICLE

21

ARTICLE

AGRICULTURE	24
PLASTIC RECYCLING	26

GREEN CHEMISTRY

34

REPORT

BIOPLASTIC	41
ACETONE	43
GRAPHITE	44
COAL	46

IT IN CHEMICALS

48

ACADEMIC R & D

50

PRODUCT ARTICLE

ION EXCHANGE RESIN	55
--------------------	----

PRODUCTS

57

EQUIPMENT ARTICLE

62

EQUIPMENT

64

SAFETY

68

Published for March 2025.



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GALA

DINNER

“My thrust is to bring investment into India and to help standardize our product offering to be amongst the best in the world. We are progressing in this direction by engaging all the global associations and industry work groups. This is helping us to see how they have been doing these activities and to learn from them. We also wish to engage with them to help forge partnerships and collaborations at the industry level.”

- Harneet Kochar, Chairman, IPUA (Indian Polyurethane Association).



“SAF demand has increased globally but there is an urgent need for accelerating the usage and production. SAF holds immense promise for the Indian aviation industry, which could achieve a more sustainable aviation sector while ensuring its continued growth and development. The Indian Ministry of Petroleum & Natural Gas announced SAF targets of 1% by 2027 and 2% by 2028 for all international flights which showcases the positive action taken by the Indian Government. Additionally, the Government of India introduced an excise duty reduction for blended aviation turbine fuel used for flights under the Regional Connectivity Scheme (RCS). These are encouraging steps by the government of India which recognizes the role that SAF can play in decarbonizing India’s aviation sector.”

- Alexander Kueper, Vice President of Renewable Aviation Business at Neste on SAF scope in India.

“Recycling Technologies are on the rise given the crucial role of minimizing environmental impact by developing eco-friendly, biodegradable lubricants and adopting processes that minimize environmental impact. Biobased methods for processing fuels and lubricants will showcase growth at a faster rate than petrochemicals-based methods, especially for South America, Africa, Asia, and Oceania regions.”

- Dean Segal, VP of Sales & Marketing, Pope Scientific, Inc. on the importance of efficient equipment for advanced processing.



“India’s chemical market is transforming due to rapid industrialization, a growing upper middle class with disposable income, and an increasing emphasis on sustainability. This presents significant growth opportunities, especially in sectors like paints and coatings, agriculture, and home and personal care. A major trend is the shift towards sustainability. The focus on eco-friendly products and practices is reshaping the industry. Nouryon is at the forefront of this transition, developing sustainable solutions that meet customer needs. Additionally, in 2024, we received an A- score for global climate leadership from CDP and an EcoVadis Gold rating, placing us in the top 5 percent of companies rated by EcoVadis.”

- Sobers Sethi, Senior Vice President, Emerging Markets and China, Nouryon on specialty chemicals market outlook.

10-12 April 2025

India Paint and Coating Expo

Location : BIEC, Bangalore, India
 Organized by : Media Day Marketing
 Website : <https://paintandcoatingexpo.com/>

Connect with industry leaders, policymakers, and potential customers

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09-12 May 2025

Plastasia 2025

Location : BIEC, Bangalore, India
 Organized by : Plastasia
 Website : www.plastasia.in

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24-26 June 2025

CPHI & PMEC China 2025

Location : Shanghai New International Expo Centre (SNIEC), Shanghai, China
 Organized by : Informa Markets
 Website : <http://www.cphi.com/china>

CPHI & PMEC China is Asia's premier pharmaceutical event for sourcing, networking, learning and innovation with over 20 years' experience of bringing together Chinese and global pharma professionals.

10-11 July 2025

23rd ARC Industry Leadership Forum Bangalore

Location : Bangalore, Karnataka, India
 Organized by : ARC Advisory Group
 Website : <https://www.arcweb.com/events/arc-industry-leadership-forum-asia-bangalore>

"Winning in the Industrial AI Era" increase business performance through AI, digitalization, and sustainability.

Booth - Chamber 02
Hall Name : Chancery

17-19 July 2025

CII Surface & Coating Expo 2025

Location : Chennai Trade Centre, Chennai, India
 Organized by : Confederation of Indian Industry
 Website : <http://www.ciisce.in/>

CII is organizing the 5th edition of "Surface & Coating Expo" (SCE2025) scheduled from 17 - 19 July 2025, The 3rd Edition of "Adhesives & Sealants Expo" will be organised concurrently with SCE2025.

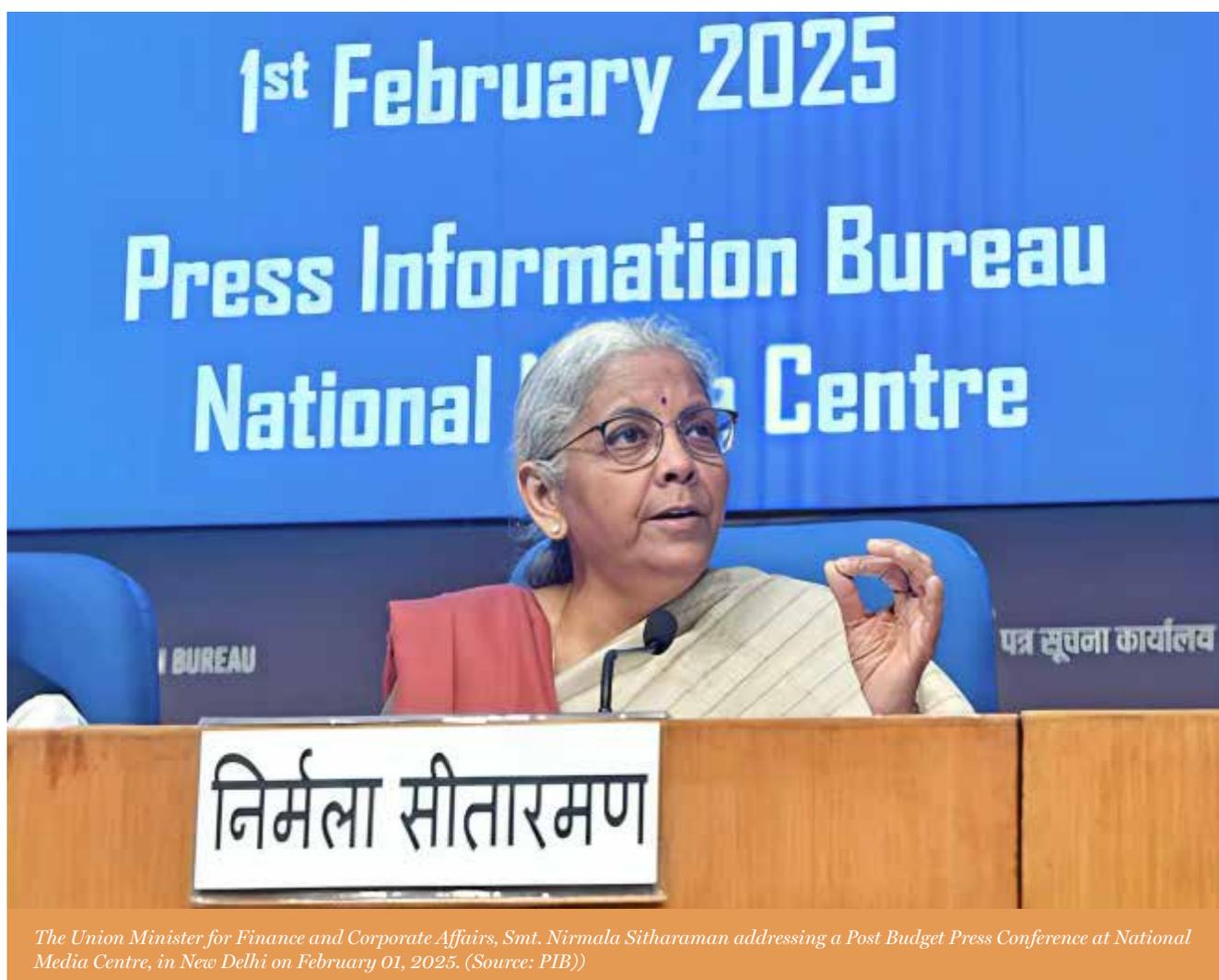
01-02 August 2025

Cosmetics Ingredients Expo

Location : Chennai, Tamil Nadu
 Organized by : Future Market Events (FME Media Private Limited)
 Website : <https://cosmetics-ingredientsexpo.com/>

South India's only event for sourcing ingredients, raw materials, formulations, extracts, and oils, for the cosmetics, personal care, and home care industries.

UNION BUDGET 2025-26 HIGHLIGHTS FOR THE CHEMICAL INDUSTRY



The Union Minister for Finance and Corporate Affairs, Smt. Nirmla Sitharaman addressing a Post Budget Press Conference at National Media Centre, in New Delhi on February 01, 2025. (Source: PIB)

Union Minister for Finance and Corporate Affairs, Smt. Nirmla Sitharaman, presented the Union Budget 2025-26, which marked a historic step for India in terms of economic growth. Some of the major announcements that directly influences the chemical industry were:

The new policies in all these sectors are productivity-enhancing, sustainable, and farmer and small-enterprise-friendly. Under agrochemicals and fertilizers, Prime Minister Dhan-Dhaanya Krishi Yojana is aimed at increasing agricultural productivity through better irrigation and credit availability. The Kisan Credit Card loan limit has been increased for the benefit of farmers and agrochemical companies.

In the electric vehicle sector, customs duty exemptions for capital goods will spur battery production and support a clean energy transition, while the nuclear energy mission allocates INR. 20,000 crore for Small Modular Reactors.

The pharmaceutical industry enjoys 36 lifesaving drugs exempted from customs duty, incentives for domestic production, and healthcare coverage for gig workers under PM Jan Arogya Yojana. Textile initiatives include a five-year Cotton Productivity Mission and support for MSMEs. The Urban Challenge Fund enhances sustainable city planning, while the Jal Jeevan Mission focuses on water and sanitation.

Modified UDAN scheme supports regional connectivity and shipbuilding, and the other two are the increase in loan coverage and the new entrepreneurial scheme for SC/ST and women entrepreneurs to support new startups in the specialty chemicals sector.

Supporting these reforms, leaders from different companies shared their voices on our platform, putting their vision and opinions on the budget.

AGRICULTURE



Mukesh Kumar, Executive Director,
Vishwaraj Sugar Industries

“This year’s budget takes significant steps to strengthen the agricultural sector, which is the backbone of industries like ours. As a sugar manufacturer, we rely on the resilience and prosperity of sugarcane farmers, and these announcements bring much-needed support to them. The increase in the Kisan Credit Card limit to ₹5 lakh will help sugarcane farmers invest in better seeds, irrigation, and mechanization, ensuring higher yields and better financial stability.

The Mission for Cotton Productivity will revitalize India’s textile sector while boosting rural incomes, which benefits the broader agri-economy, including sugar. Similarly, the push for self-sufficiency in pulses and edible oils will promote crop diversification and stabilize commodity markets, ensuring more secure incomes for farmers. A key highlight is the new urea plant in Assam, which will ensure reliable fertilizer availability—essential for maintaining soil fertility and improving sugarcane productivity.

A stable sugarcane sector not only supports sugar production but also strengthens ethanol manufacturing, contributing to India’s energy goals. These initiatives reaffirm the government’s commitment to empowering farmers and ensuring a resilient agricultural supply chain. A strong farming sector means a stable sugar industry, and we welcome these steps toward long-term growth and sustainability for both farmers and manufacturers.”



Balram Singh Yadav, Managing Director,
Godrej Agrovet Limited

“The budget proposals showcase a comprehensive strategy to strengthen India’s agricultural sector, positioning it as a key driver in our journey towards Viksit Bharat. By addressing critical growth levers such as high-yielding, climate-resilient seeds, boosting cotton productivity, and achieving self-sufficiency in pulses, the budget lays a robust foundation for a resilient agri-economy.

The enhanced loan limit under the Modified Interest Subvention Scheme—from ₹3 lakh to ₹5 lakh—for Kisan Credit Card loans will provide vital financial support to small fisheries and dairy farmers, empowering them to scale operations. India’s position as the second-largest global producer of fish and aquaculture is further bolstered by the reduction in basic customs duty on a key input material for feed, strengthening competitiveness and sustainability in the sector.

The budget’s strategic push for self-reliance in pulses and edible oils, coupled with the new integrated program for fruits and vegetables, ensures both nutritional security and agricultural sustainability. With targeted initiatives like crop diversification and sustainable marine sector development, these measures not only enhance productivity but also reinforce the central role of farmers in driving India’s growth story.”

CHEMICAL



Anand V S, Managing Director,
NOCIL Limited

“With the Union Budget 2025-26, the Indian government has reaffirmed its commitment to simplify and enhance the ease of doing business; this is expected to have a positive impact on attracting investments. The emphasis on infrastructure development, with an allocation exceeding ₹11 lakh crore, will significantly enhance supply chain resilience and the growth of direct and indirect sectors. A strong push on the demand side through the personal income tax changes in a fiscally responsible manner is expected to boost consumption and is expected to have a positive impact for rubber chemicals.

Support for the ‘Make in India’ initiative will empower domestic manufacturers to increase their market share and export potential, helping to position India as a global leader in chemicals. Overall, these measures are expected to drive growth in the sector and contribute positively to India’s economic goals.”



Ashish Bhandari, MD & CEO,
Thermax

“The Union Budget’s strong push towards manufacturing and the Make in India initiative reaffirms the nation’s commitment to becoming a global manufacturing powerhouse. The newly announced National Manufacturing Mission, with its comprehensive policy support and execution roadmap, will streamline the sector and drive exponential growth.

Equally important is the focus on green and clean development—supporting clean tech manufacturing will be a game-changer in advancing energy efficiency and accelerating our journey towards sustainability.

Additionally, strengthening workforce skills through global skilling partnerships will help bridge critical gaps and position India as a key player in the global supply chain. With these strategic initiatives, India is well on its way to achieving sustainable, inclusive, and technology-driven industrial growth.”



Vishal Sharma, Executive Director & CEO,
Godrej Industries (Chemicals)

"In our journey to Viksit Bharat, the budget proposals announced today effectively trigger domestic consumption, production, and capability development across both urban and rural sectors. The focus on enhancing agricultural productivity and targeted support for specific cash crops will significantly boost farming incomes. Combined with tax slab modifications at the lower end, the resulting increase in spending power of the consumers will be highly impactful.

The nuanced credit facilities for the MSME sector, along with the emphasis on enhanced upskilling opportunities for the young workforce, have the potential to be game-changers. Strengthened education facilities from high school onwards are a vital step toward building a capable and future-ready population. While more could have been done on customs duty rationalization and funding for technology and R&D, the controlled fiscal deficit target of 4.4% reflects a balanced approach. With strong execution and efficient delivery of programs, our GDP growth target of 6.5-7% is well within reach—and with some luck, perhaps even higher."



Amit Mehta, Managing Partner,
Asha Ventures

"The Union Budget's focus on inclusive and sustainable growth—spanning Garib, Youth, Annadata, and Nari—reflects a strong commitment to broad-based development. The proposed Deep Tech Fund of Funds is a decisive step in catalyzing the next generation of innovation-driven startups, unlocking new frontiers in AI, robotics, and advanced manufacturing. Additionally, the government's support for Clean Tech manufacturing, particularly in EV battery and renewable energy infrastructure, aligns with India's net-zero ambitions and strengthens the domestic supply chain.

For investors, these initiatives create a robust ecosystem where Deep Tech and Clean Tech enterprises can scale with greater access to capital and policy support. The expansion of the Fund of Funds for startups and the new scheme for first-time entrepreneurs will further democratize access to finance, fostering innovation across sectors. As India strengthens its position as a global hub for technology and sustainability, Asha Ventures remains committed to supporting visionary entrepreneurs building solutions for a greener, more inclusive future."



Nikhil Mansukhani, Managing Director,
Man Industries Ltd.

"The Union Budget 2025 prioritizes India's infrastructure and manufacturing sectors with strategic initiatives like the National Manufacturing Mission and 'Make in India,' aimed at enhancing domestic production capabilities. The ₹1.5 lakh crore interest-free loan for infrastructure and PPP projects will improve logistics, reduce bottlenecks, and boost multimodal connectivity, which is crucial for industries such as steel, oil & gas, and heavy engineering.

The introduction of Bharat Trade Net and easier export credit access will streamline international trade, making Indian manufacturers more competitive in global supply chains. However, to fully capitalize on these opportunities, it is essential to ensure faster execution, sector-specific incentives, and continuous policy support. With India's manufacturing sector set to contribute 25% of GDP by 2030, these initiatives are key to driving long-term growth and positioning India as a global manufacturing leader."



Dhiren Jatakia, Head Accounts & Finance,
Covestro (India)

"The budget paves the way for sustainable growth, innovation, and a stronger manufacturing ecosystem in India. With key reforms in the power sector, MSME support, and maritime development, the budget fosters a business-friendly environment that enhances competitiveness on a global scale. It has touched upon some key areas like transfer pricing, R&D, tax, etc. Covestro (India) applauds the government's commitment to boosting manufacturing and long-term economic development and looks forward to contributing through our social growth."

RENEWABLE ENERGY



Vivek Lohia, Managing Director,
Jupiter Group

"The budget's decisive focus on accelerating EV manufacturing is a game-changer for the industry. The introduction of the Clean Tech Mission, customs duty exemptions on 35 key goods for EV lithium-ion battery production, and the anticipated GST parity on EV batteries is a clear signal that the government is committed to making India a global leader in clean mobility. By lowering production costs and strengthening domestic supply chains, these measures will significantly boost the competitiveness of Indian EV manufacturers.

The inclusion of waste and scrap from lithium-ion batteries in the exemption list further reinforces a sustainable, circular economy approach, ensuring that the EV industry grows responsibly. With a strong push for energy security, export promotion, and innovation, the budget provides a solid foundation for long-term growth. At Jupiter Electric Mobility, we are excited to leverage these initiatives to expand production, drive affordability, and contribute to India's vision of becoming a self-reliant and globally competitive EV hub."



Shekhar Singal, CEO,
Eastman Auto & Power Ltd.

“The Union Budget 2025-26 focuses significantly on renewable energy, with strong measures aimed at reducing carbon emissions and accelerating the country’s transition to sustainable energy. The increased funding for the solar and wind energy sectors, along with the implementation of new policy frameworks for green hydrogen production, is a commendable step. These initiatives are expected to enhance India’s energy security, create new job opportunities, and contribute to the nation’s efforts towards achieving its Net-Zero targets by 2070.

Furthermore, the push towards electric vehicle (EV) adoption through improved infrastructure and incentives for EV manufacturers will not only boost the renewable energy market but also help reduce the dependency on fossil fuels. The government’s commitment to setting up new energy transition projects, such as large-scale renewable power parks, will encourage private sector participation and foster innovation in the energy industry.

As a player in the renewable energy and power sector, Eastman Auto & Power Ltd. strongly supports these forward-thinking budget measures, and we are committed to contributing to the nation’s clean energy future.”

LOGISTICS



Naresh Sharma, Managing Director,
CCI Group

“While the Union Budget 2024 was a fruitful one, driven by the successful implementation of the PM Gati Shakti program, the Western Dedicated Freight Corridor, and the National Logistics Policy, the logistics sector now looks forward to more forward-thinking measures in the Union Budget 2025.

We anticipate a strong focus on fostering the adoption of emerging technologies such as IoT, AI, automation, robotics, and 5G, supported by tax incentives and financial backing. Additionally, tech-driven infrastructure like IoT-enabled transport systems, smart logistics parks, and advanced port and highway technologies will be crucial, with Public-Private Partnerships (PPP) playing a key role in expediting development.

We expect the introduction of single-window clearance systems to streamline getting approvals from various Govt agencies within time, cross-border trade, enhancing international competitiveness. We also anticipate an increased capital expenditure on green technologies and sustainable infrastructure, such as hydrogen-powered and electric vehicles, green road networks, and logistics parks, to help foster a greener, more efficient ecosystem.

In response to global trade volatility, we foresee measures like interest equalization and remission of duties and taxes on exports, which will enhance the price competitiveness of Indian exports. Overall, Budget 2025 has the potential to drive innovation, sustainability, and global competitiveness, positioning India as a logistics hub of the future.”



Manoj Jhanwar, Finance Head,
KSH Distriparks

“Inland Container Depots (ICD’s) are critical hubs in the transportation and logistics network, facilitating the movement of goods between ports and inland regions. With the continued expansion of global trade and evolving supply chain needs, the Budget 2025 should introduce targeted tax breaks or grants to incentivize ICDs to modernize their facilities, expand storage and handling capacity to handle increasing container volumes, reduce congestion at seaports and ensure smoother inland operations.

Government’s focus on ‘Gati Shakti Program’ is expected to continue in the upcoming budget and special focus may be placed on the development of green corridors (designated routes where vehicles operate with the lowest environmental impact) which will help to optimize the movement of goods and reduce logistics costs.

Also, policies are expected to make electric vehicles affordable and enhance infrastructure of charging stations thereby making an energy efficient transport system. Promoting the use of automation, digitalization and artificial intelligence for having integrated data platforms and better supply chain visibility can ensure that ICD’s remain efficient, sustainable, and competitive. Enhanced connectivity and operational efficiency at ICDs will boost the government’s ‘Make in India’ initiative with increased domestic manufacturing and exports, driving overall economic development.”



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CARRIE NICHOL APPOINTED AS ADM'S VICE PRESIDENT & CHIEF ACCOUNTING OFFICER

ADM declared Carrie Nichol as the new Chief Accounting Officer and Vice President. The company's external and management accounting and reporting procedures, internal control operations, and insurance and risk management department will all fall under Nichol's purview as Chief Accounting Officer, who will answer to Executive Vice President and Chief Financial Officer Monish Patolawala. Vice President and Corporate Controller Molly Strader Fruit, who helped Nichol make the transition go smoothly, will be leaving the company to take a new position as Vice President, of Total Rewards and HR Operations, where she will report to Chief People Officer Jennifer Weber. Nichol will take over for Fruit. Nichol has over 20 years of accounting and finance experience. She previously worked for Cargill, a renowned worldwide leader in agribusiness, where she served as Sr. VP, Chief Accounting Officer and Global Process Leader.



Ms. Carrie Nichol

ELANTAS BECK INDIA LIMITED APPOINTED ANURAG ROY AS MD



Mr. Anurag Roy

Anurag Roy was named Managing Director of Elantas Beck India Limited by the Board of Directors on February 1, 2025. With effect from February 1, 2025, Anurag Roy takes over for Srikumar Ramakrishnan, who moved to the position of Managing Director of ECKART America within the ALTANA Group. Mr. Anurag Roy has worked in the life sciences and chemical industries for more than 24 years. Mr. Roy has held important roles at Frost & Sullivan, Dr. Reddy's Labs, BASF, Jubilant Life Sciences, Godrej Astec Life Sciences, and DSM. He excels in commercial and operational excellence and has a proven track record of managing multinational corporations, especially in the Asia Pacific, Middle Eastern, and African regions. Throughout his career, he has established and led multiple manufacturing and supply sites, as well as Technology Centers.

LEADERSHIP SHIFT AT PERSTORP FOLLOWING PCG SC ALIGNMENT

Following the successful integration process that followed PCG's acquisition of Perstorp in 2022, Ib Jensen will step down as President & CEO of Perstorp Group. Gorm Jensen, who currently serves as Executive Vice President for Commercial & Innovation at Perstorp, has been appointed as the new Managing Director of Perstorp Holding AB. Dr. Debbie Chiu, COO of PCG Specialty Chemicals, emphasized, "Our ambition is clear: to become a global leading specialty chemicals company by solidifying our leadership in our four focus segments, i.e., Coating Solutions, Engineered Fluids Solutions, Personal Care Solutions, and Advanced Polymer Solutions, while also expanding our intermediates business aggressively. Our growth agenda reflects our strong ambition and commitment to progress."



Mr. Gorm Jensen

PRISCILA NOBRE APPOINTED AS INAUGURAL VICE PRESIDENT OF SUPPLY CHAIN

Carboline recently appointed Priscila Nobre as the company's first Vice President of Supply Chain. She will oversee the company's transportation, customer service, service centers, and sales inventory and operations planning (SIOP).

"Recent economic and environmental crises show us how dependent customers are on their supply chains, and how strong supply chains make strong customer relationships," Nobre said. "So, my task is clear: Build and sustain a high-performing team that earns customers' trust by creating the simplest, most seamless customer experience in the industry."

Having worked in positions in five different countries for more than 20 years at international corporations, Nobre has a track record of successfully developing and executing global supply chain strategies. Her areas of expertise include designing distribution networks, optimizing inventory levels, and spearheading transformational SIOP programs.



Ms. Priscila Nobre

PRAJ INDUSTRIES APPOINTS ASHISH GAIKWAD AS MANAGING DIRECTOR-DESIGNATE



Mr. Ashish Gaikwad

Mr. Ashish Gaikwad was appointed Managing Director-Designate by Praj Industries. Mr. Shishir Joshipura, CEO & MD, will step down on June 30, 2025, and Mr. Gaikwad will take over. Mr. Gaikwad has more than 34 years of experience in digitization, process technology, industrial automation, the shift to renewable energy, artificial intelligence, and autonomous manufacturing. He served as Managing Director of Honeywell Automation India Ltd. for more than seven years before to joining Praj Industries. With experience in project engineering, sales leadership, strategy, business management, and corporate governance, he held a variety of leadership roles at Honeywell throughout his career, which included positions in India, Southeast Asia, Asia Pacific, and the USA.

KANSAI NEROLAC PAINTS APPOINTS PRAVIN D. CHAUDHARI AS MD

Subject to shareholder approval, Pravin D. Chaudhari has been named managing director of Kansai Nerolac Paints Limited for a three-year term, beginning on April 1, 2025. After 35 years of devoted service in a variety of jobs across several regions, Anuj Jain, the current Managing Director, has decided to retire early from the company on March 31, 2025. As Managing Director for the past three years, Jain has successfully guided the business and made a substantial contribution to its advancement. Joining Kansai Nerolac as a trainee in 1993, Chaudhari has over 30 years of experience in a variety of roles. In 2008, he was named Executive Director.

He joined Pidilite Industries in 2018 to oversee their industrial operations and pigment business, managing both domestic and foreign operations while exhibiting exceptional leadership, passion, and inventiveness. In 2023, he returned to his position as Executive Officer, Head of India Business, and Deputy Chief of the R&D/Procurement Unit at Kansai Paint Co., Ltd. (KPJ), the parent company of Kansai Nerolac.



Mr. Pravin D. Chaudhari

ALPLA'S COMMITMENT TO SUSTAINABLE PACKAGING IN EGYPT AND BEYOND



Plastic packaging specialist "ALPLA" finalized integration of the site in Egypt into the Group.

By purchasing all the shares from joint venture partner Taba, ALPLA completely incorporates the Egyptian location into the Group. At its facility in 10th Ramadan City, close to Cairo, the internationally active packaging and recycling specialist produces plastic bottles, preforms, and closures for the Middle Eastern and North African markets.

Additionally, the location has served as the primary accounting service center for the Africa, Middle East, and Turkey (AMET) area since 2024. ALPLA is still making investments in North Africa's developing region. The majority shareholder ALPLA is acquiring all the shares of the joint venture partner Taba, eight years after ALPLA TABA was established in Egypt. Thus, the site's integration into the Cairo metropolitan area is completed by the international packaging and recycling specialist.

"The close cooperation with Taba has laid the foundation for our success. During our time together, we have consolidated our market-leading position. Now we are taking the next step," says Javier Delgado, Regional Managing Director AMET at ALPLA.

ALPLA produces high-quality plastic bottles, closures, and

preforms for the food, beverage, household, and beauty care industries as well as the pharmaceutical industry. In addition to international brand manufacturers, ALPLA also supplies local companies. With its start in Egypt, ALPLA expanded its portfolio to include standard packaging for pharmaceutical products and is now one of the country's leading manufacturers.

"The expertise and experience of our partner Taba helped us greatly in the successful development of this business," reports Delgado.

ALPLA is also a pioneer in recycling. The company has been processing post-consumer recycled material (PCR) for many years, thereby strengthening the local circular economy.

"Everywhere in North Africa and the Middle East, the need for safe, affordable, and sustainable packaging solutions is growing. As a system provider and technology market leader with 70 years of experience, we implement these from a single source. Our presence in Egypt plays a key role and has also been home to our central Accounting Service Hub since 2024," emphasizes Tarek Bassiouni, Regional Head of Finance & Controlling AMET at ALPLA.

ARKEMA EXPANDS HEALTHCARE REACH THROUGH PARTNERSHIP WITH ALBIS



Arkema and ALBIS collaborate for high-performance medical-grade polymer distribution.

Advanced polymers from Arkema, a world leader in specialty materials, are being added to ALBIS's portfolio as one of the top distributors of engineering and high-performance plastics. Europe, North Africa, and the Middle East are all part of their domain.

Arkema's medical line of Pebax® MED thermoplastic elastomers, Rilsan® MED polyamide 11, Rilsamid® MED polyamide 12, Rilsan® MED Clear translucent polyamide, and Kynar® MED PVDF will be distributed by ALBIS with immediate effect.

High-performance medical grade materials from Arkema adhere to ISO 10993 and USP Class VI criteria and meet strict biocompatibility standards. They offer strong solutions made especially for important healthcare applications, ranging from high-performance medical tubing and equipment to minimally invasive medical gadgets. The stringent requirements of healthcare producers are supported by these polymers, which are renowned for their flexibility, chemical resistance, and adherence to industry standards.

With our collaboration with ALBIS, we are making our advanced materials even more accessible than before to support growing demand and innovation in the healthcare market. ALBIS is known for its outstanding technical know-how and service and we look forward to a successful collaboration," said David Dupont, Vice President of the Specialty Polyamides business at Arkema, who shares the enthusiasm for the partnership.

We are very pleased to add Arkema's renowned brands to our healthcare portfolio. These high-performance medical-grade materials perfectly complement the existing offering of ALBIS: we can now provide greater value by offering an even more comprehensive portfolio of advanced polymers – including bio-based solutions – to our customers in the healthcare sector," said Mike Freudenstein, Senior Director of Marketing Healthcare & Industry Management.

COLLABORATION OF 350 MW HYDROGEN PRODUCTION & CARBON SEQUESTRATION



For its flagship low carbon hydrogen production plant (HPP1) at the Stanlow Manufacturing Complex in Ellesmere Port, Cheshire, Essar Energy Transition (EET) Hydrogen has entered an Engineering, Procurement, and Construction (“EPC”) agreement with ENKA. At the core of the HyNet Cluster, HPP1 is the first large-scale low-carbon hydrogen project in the UK, and the UK government announced in October 2024 that financing had been secured to support it. With a 350MW output capacity, HPP1 will absorb about 600,000 tonnes of CO₂ annually, which is the same as removing about 250,000 cars from the road.

The HPP1 project, the UK hydrogen industry, the HyNet Cluster, and EET Hydrogen’s advancement towards its objective of creating 4GW of low-carbon hydrogen production for industrial companies in the Northwest of England to decarbonize their operations, preserving jobs and promoting economic growth, all mark significant milestones.

Joe Seifert, CEO of EET Hydrogen, said: “Following a highly competitive tender process, we are excited to announce this critical contract with ENKA. Having been awarded over 580 contracts in 57 countries, ENKA has an excellent track record in delivering complex projects like HPP1. The team brings a wealth of experience, and we are delighted to partner with as we deliver on our ambition to become the UK’s premier producer of low-carbon hydrogen.”

Hakan Kozan, a Member of the Executive Committee at ENKA, said “We are thrilled to partner with EET Hydrogen on the HPP1 project, a transformative initiative that will play a key role in advancing the UK’s low carbon hydrogen industry and contributing to global decarbonization efforts.”

PARTNERSHIP TO REVOLUTIONIZE DIGITAL AUTOMOTIVE PAINT TECHNOLOGY



Axalta and Dürr team up to deliver advanced digital paint solutions for automotive OEMs. (Source: Dürr)

Axalta Coating Systems has announced a strategic partnership with Dürr Systems AG to revolutionize automotive paint technology. Combining Axalta’s innovative NextJet™ technology with Dürr’s robotics integration expertise, the collaboration aims to deliver precise, overspray-free digital paint solutions for light vehicle Original Equipment Manufacturers (OEMs).

Digital paint technology enables highly accurate paint placement without overspray, ensuring a maskless application for two-tone and graphic designs. Dürr will act as the robotics integrator for Axalta NextJet™ systems, providing tailored solutions to meet OEM requirements.

“The maskless application of paint for two-tone and graphics takes collaboration,” said Hadi Awada, President, Global Mobility Coatings at Axalta. “Through our partnership with Dürr, we can better serve OEM customers, building on Axalta’s coatings expertise and Dürr’s robotics integration. Together, we are driving the future of digital paint technology.”

Dr. Lars Friedrich, CEO of Dürr Systems AG, added: “We are excited to collaborate with Axalta on the next generation of digital paint. As a pioneer in overspray-free applications, Dürr understands OEM demands for customized vehicle designs. This partnership accelerates the launch of our joint technology and ensures we meet customer needs.”

Both companies bring significant experience in digital paint solutions. Axalta previously collaborated with Xaar in 2023 to advance their digital paint offerings. Xaar remains a key partner in this new collaboration between Axalta and Dürr, ensuring comprehensive solutions for the automotive OEM market. Demonstrations of Axalta NextJet™ technology integrated with Dürr’s robotics are already underway at Dürr’s test center in Bietigheim-Bissingen, Germany. Automotive OEMs are encouraged to contact their Axalta or Dürr representatives for further details.

DEPOLYMERIZING TEXTILE WASTE TO CLOSE THE CIRCULAR LOOP

E-commerce and fast fashion have created a major environmental concern, “Textile Waste”! The widely loved fashion industry is responsible for 20% of global wastewater. In the USA alone, citizens 85% of all textiles end up in dumpfills every year.¹ The other concern factoring of this is that they are not recycled!

Recycling of the textile is not a simple task. Clothes are made up of different fibers and energy-intensive ways like incineration are not the efficient routes. Despite this complexity, polycotton remains prevalent and is present in higher concentrations within the waste material. Yet, there has been no commercially viable model for the business and using the technology for a large plant scale.²

Collaboration for Solution

On this note, Avantium N.V has developed an alternative in collaboration with the Industrial Sustainable Chemistry group at the University of Amsterdam, led by Avantium Chief Technology Officer Gert-Jan Gruter. The joint study was published in Nature Communications as the first effective method for recycling both polyester and cotton components in textile waste with high efficiency.

The research was conducted based on known Avantium’s innovative Dawn technology used for producing chemicals and materials

from sustainable carbon feedstocks, like plant-derived carbon or CO₂. The technology converts non-food plant-based feedstock into glucose and lignin, proven in its pilot plant in Delfzijl (the Netherlands).

Following successful lab trials, Avantium tested the viability of breaking down and recycling post-consumer polycotton waste textiles at a larger scale. A highly concentrated HCl solution was mixed with polycotton waste, in which the cotton cellulose was fully hydrolyzed into a glucose solution, from which the solid polyester residue was easily extracted. This method enables the complete recycling of polyester and the use of cotton-derived glucose for a wide range of industrial applications, including polymers, resins, and solvents.

The resulting glucose can for example be used by Avantium to produce its lead product 2,5-furandicarboxylic acid (FDCA) or as a monomer for bio-based plastics. The high glucose yields from polycotton waste, indicate scalability and cost-effectiveness.

Avantium supported this groundbreaking project by hosting PhD students from the Industrial Sustainable Chemistry research group of the University of Amsterdam in its laboratories and its Dawn pilot plant in Delfzijl. The first author of the paper, PhD student Nienke Leenders, works on secondment at Avantium.³



Polyester residue from cotton textiles.



Post consumer polycotton after hydrolysis.

Avantium Chief Technology Officer Gert-Jan Gruter stated: "We are excited about this groundbreaking solution, which is not only providing feedstock for our own FDCA and PEF technology and aligns with our environmental objectives but also marks a crucial advancement towards achieving a circular economy. At Avantium, we are committed to perfecting this technology in collaboration with partners and broadening its application to address the global textile waste problem. Simultaneously, we aim to supply non-food glucose to support the large-scale transition toward a bio-based economy."

What's next?

While Avantium's breakthrough in textile recycling is a giant leap toward sustainability, challenges such as economic feasibility, regulatory approvals, and environmental considerations—such as the use of highly concentrated HCl—must still be addressed for large-scale adoption.

However, the high efficiency and scalability demonstrated in pilot trials give much hope for the future. As innovation continues, there is continued industry collaboration and even regulatory support, then this technology can transform textile waste management and bring us closer toward a truly circular economy supported by a low-carbon economy. Investing in that direction today helps pave the pathway to a much more sustainable and responsible fashion industry tomorrow.

Source:

1. Igini, M. (2024, May 30). 10 concerning fast fashion waste Statistics. Earth.Org.
2. Leenders, N., Moerbeek, R.M., Puijk, M.J. et al. Polycotton waste textile recycling by sequential hydrolysis and glycolysis. *Nat Commun* 16, 738 (2025).
3. Avantium Press Release. (2025, January 29). Avantium finds important solution for polycotton textile waste recycling.



Light transmission through fabric treated and untreated.

KEY CHALLENGES IN BALL MILLING FOR SEMI-VITRIFIED TILE MANUFACTURING



Ceramic tiles are an essential element of modern architecture, offering durability, aesthetic appeal, and ease of maintenance. With urbanization and infrastructure development on the rise, the ceramic tile industry has seen significant growth. In India alone, the industry generated \$364.8 million in revenue in 2021 and is expected to reach \$564.6 million by 2030, growing at a 5% CAGR.

While semi-vitrified tiles may seem like simple products, their manufacturing process is highly intricate. One of the most critical steps in this process is the preparation of raw materials, where dispersants play a key role. These additives help ensure better material consistency, smoother processing, and reduced energy consumption in production.

This article explores the role of dispersants in ceramic tile manufacturing, how they impact efficiency, and why they are crucial for ensuring high-quality tiles.

Ball Milling and the Importance of Dispersants

Ball Milling is a crucial process in semi-vitrified tile manufacturing that ensures homogeneous and uniform grinding of the raw materials. In this operation, the viscosity of the slurry and energy utilization are two paramount hurdles that affect the efficiency and product quality.

Dispersants as a chemical additive improve the flow of ceramic slurry by preventing solid particles from clumping together. In simple terms, they act like a lubricant for the mixture, ensuring a smoother and even consistency.

Careful optimization of slurry formulations can directly improve energy efficiency and reduce operational costs during production by controlling viscosity. Generally, the mixture is made up of water, ball clay, feldspar, silica, and other ceramics materials and for an effective homogeneous mixture, the viscosity should be optimized.

Without dispersants, ceramic slurries can have a higher solid-to-liquid ratio, which can in turn lead to:

- Higher energy consumption during milling
- Blockages in pipes and equipment
- Irregular particle size distribution can lead to additional processing time

Dispersants can lead to significant energy savings during ball milling. Dispersants improve particle dispersion which helps to reduce resistance, allowing faster grinding rates and reduced operational time. A well-dispersed slurry with optimal viscosity can reduce torque, decrease power consumption, and increase the slurry density from 1.60 gm/cc to 1.70 gm/cc where the output of spray-dried power increased to 15-20%.

Ball clays they are known for their light grey to cream and brownish colors in the raw state are fine-grained highly plastic and predominantly composed of kaolinite, mica, and quartz mineral composition and the presence of organic matter. For instance, the presence of lignite and other organic materials can influence the thixotropic properties.

Initially, researchers relied on Sodium silicate and Soda Ash in combination as the deflocculants as a slurry modifier. In semi-vitrified tile bodies, where ball clay content is high, such conventional deflocculants are used to achieve the required additives to assist in maintaining fluidity for successful milling. However, these compounds did not solve the mentioned problem of the higher dosage requirements. Newer organic dispersants which can perform effectively at lower dosages and provide better slurry stability, are suitable for modern manufacturers.

Other Key Variables

Henceforth, effective selectivity of the ceramic dispersants in the ball milling within the tile industry is paramount, following are a few important points to keep in mind:

- Accurate dispersant selectivity for specific ceramic material and slurry properties
- Trials runs to determine the optimal dispersant concentration
- Proper assessment of the particle size distribution, viscosity, and stability to ensure consistent quality and make necessary adjustments
- Selectivity of media to complement the effects of dispersant, ensuring efficient grinding without over-milling

Future of Dispersants in Semi-Vitrified Tile Manufacturing

With the growth of this industry, the demand for better processing additives has also grown. Some of the upcoming key trends that are shaping the future of the additive are:

- Eco-friendly dispersants which are biodegradable, low toxic, and meet the environmental regulations.
- Advanced formulations with a focus on hybrid dispersions that combine multiple functions reducing the need for additional chemical additives.
- Smart Manufacturing Integration with AI-driven quality control is helping optimize dispersant usage for consistent production.

Innovation in high-performance dispersants can be a game changer for the industry to answer the increasing competition and sustainability concerns.

Henceforth achieving a perfect balance between product quality and efficient production methodology is critical. Dispersants play a powerful role in maintaining the semi-verified forms smooth processing and higher- quality. As manufacturers look for ways to optimize production and stay competitive, investing in the right dispersant technology will be a key factor in shaping the future of the industry.

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DKSH ACTIVELY PROMOTES SUSTAINABLE AGRICULTURE IN KOCHI PREFECTURE

Enriching People's Lives by Expanding Yuzu's Global Reach

Yuzu, a highly versatile citrus fruit, has captivated chefs globally with its distinctive flavor and aroma. This enthusiasm is especially pronounced in Europe, notably in France, where demand for yuzu has risen sharply in recent years.

Kochi Prefecture: The Heart of Yuzu Production

Japan remains the foremost producer and consumer of yuzu, with Kochi Prefecture leading national production. Kochi contributes approximately 51% of Japan's annual yuzu output, which exceeds 27,000 tons. This region's favorable climate and rich agricultural traditions have established it as the center of yuzu cultivation.

Expanding Global Reach with DKSH

Since 2014, DKSH Japan has exported premium yuzu juice and oil from Kochi Prefecture to meet rising global demand. Through DKSH France, we have strengthened distribution networks, bringing high-quality yuzu products including juice, oil, and powder to diverse markets for culinary and industrial applications.

Supporting Sustainable Agriculture and Local Communities

As part of our expansion efforts, DKSH actively promotes sustainable agriculture in Kochi Prefecture. Recognizing the challenges posed by labor shortages in yuzu harvesting, we collaborate with local farmers and stakeholders to address these issues. Our initiatives include providing resources and innovative solutions to streamline harvesting practices and attract new workers to the industry. By supporting the local farming community, we help ensure the long-term viability of yuzu production while preserving the cultural and economic significance of the region.

Commitment to Social Impact and Sustainability

DKSH's efforts to promote yuzu farming are deeply aligned with our mission of "Enriching People's Lives." This initiative is a core component of our Social Impact Strategy, which aims to create lasting benefits for the communities we serve. By fostering resilient local economies and supporting sustainable agricultural practices, we contribute to the preservation of local traditions and global sustainability.



Delivering Sustainable Value for Communities

Our commitment extends beyond agriculture. At DKSH, we strive to enrich people's lives by providing access to high-quality products and services, creating sustainable value for our partners, and contributing to the well-being of the communities in which we operate. Through our initiatives, we generate jobs,

open opportunities, and support individual growth, helping communities thrive while ensuring a sustainable future for yuzu cultivation.

Courtesy: Olive Fernandes, Manager, Marketing & Communications, Performance Materials, DKSH India Pvt. Ltd.

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CLOSING THE PLASTIC-TO-PLASTIC RECYCLING LOOP: POLYCYCL'S GEN VI CHEMICAL RECYCLING TECHNOLOGY



The global plastic waste crisis has escalated due to inadequate recycling mechanisms and a linear consumption model that favors disposal over material reuse. India generates over 10.2 million tonnes of plastic waste annually, with over 40% comprising single-use plastics. Among these, flexible packaging films make up nearly 90% of the plastic waste in landfills, highlighting the urgent need for innovative recycling solutions.

PolyCycl's Innovative Approach

PolyCycl, a Chandigarh-based circular economy technology startup, has introduced its proprietary Contiflow Cracker™ Generation VI chemical recycling pyrolysis technology. This patented innovation enables the conversion of hard-to-recycle plastics - such as single-

use grocery bags and food-contaminated packaging - into food-grade polymers, renewable chemicals, and sustainable fuels. The result of over a decade of research and 150+ man-years of effort, this technology marks a major advancement toward achieving a circular plastic-to-plastic economy.

The Science Behind Contiflow Cracker™ Technology

Chemical recycling can be likened to a master builder dismantling an old LEGO creation, separating bricks, wheels, and mini-figures into their fundamental components. With these building blocks, the builder can construct something entirely new, whether a towering castle, a futuristic robot, or a sprawling cityscape. Similarly, PolyCycl's technology breaks

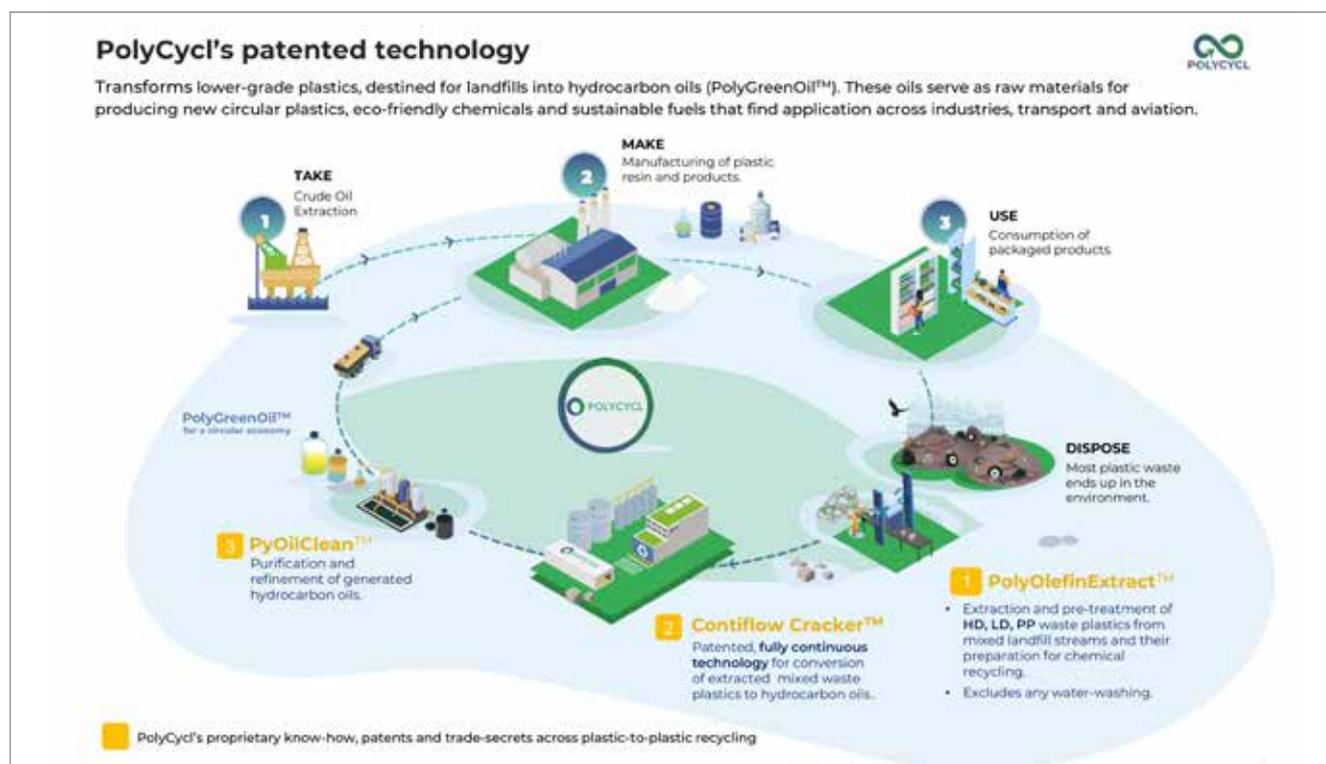
down low-grade plastics into their base hydrocarbon molecules (oligomers), which can then be repurposed into high-quality materials, including low-carbon circular plastics, sustainable chemicals, and renewable fuels.

The Contiflow Cracker™ process begins with waste plastics being fed into the system using an automated mechanism that integrates pre-drying, compaction, agglomeration and melting. During this stage, moisture and certain contaminants - such as halogens from PVC and other low-boiling volatiles - are also substantively removed. The molten plastic is then introduced into a specially designed patented reactor, where it undergoes controlled thermal heating and vaporization using a patented advanced heat transfer mechanism.

To ensure efficiency and scalability, the reactor is designed to maximize heat transfer, minimize fouling, and continuously remove solid residues from the conversion process. Heavier hydrocarbon molecules in the resulting vapors are selectively cracked before the vapor mass is cooled and condensed into liquid hydrocarbon oils. These oils are further refined using PolyCycl's proprietary PyOilClean™ technology, which reduces heteroatom contaminants, including halogens, nitrogen, and oxygen-based impurities, resulting in a high-purity output suitable for petrochemical applications.

The final products are ready-to-use circular feedstocks supplied to petrochemical companies for the production of new food-grade polymers, renewable chemicals and sustainable fuels.

Protected by multiple international patents, PolyCycl's Generation VI technology ensures that commonly used single-use plastics, particularly polyolefin packaging, no longer need to be downcycled, incinerated, or landfilled. Instead, they can be continuously recycled in a closed-loop system without degradation in material quality.



Ensuring Safety and Compliance

To facilitate global adoption, PolyCycl's technology is engineered to comply with international safety and engineering standards, including ASME, API, IS, ATEX, NFPA, and OISD. These stringent safety measures ensure optimal performance, operational reliability, and regulatory compliance across industries.

Cost-Efficiency and Scalability

The fully continuous process architecture of Generation VI allows seamless scalability, with modular processing lines capable of handling 15 to 100 tons per day (TPD) of plastic waste. Notably, the capital costs of implementing this technology are 50-75% lower than competing solutions from Europe and the U.S., while delivering a project EBITDA exceeding 50%.

Compliance with India's EPR Mandates

India's Extended Producer Responsibility (EPR) regulations mandate 10% recycled content in flexible packaging and 30% in rigid plastic packaging by 2025-26. PolyCycl's technology plays a critical role in achieving these targets by enabling the production of high-quality recycled polymers suitable for contact-sensitive applications, such as food and pharmaceutical packaging.

With three out of four Fast-Moving Consumer Goods (FMCG)

products in India utilizing flexible packaging, tackling the single-use plastic problem is integral to establishing a sustainable plastics economy. While the challenge requires multiple approaches, including improved design for recyclability and enhanced EPR enforcement, PolyCycl's chemical recycling technology represents a step-change toward building a circular plastics economy.

The Road Ahead for Circular Economy and EPR Implementation

As the demand for sustainable packaging rises and regulations push for real circular solutions, chemical recycling is stepping up as a true contender to transform waste plastics from an environmental scourge to a valuable hydrocarbon resource with endless possibilities.

India's current installed plastic recycling capacity for polyolefins stands at approximately 5.0 million tons per annum. However, only 5% of this capacity is equipped to produce high-quality closed loop recyclates. Achieving the nation's EPR targets will require significant advancements in chemical recycling technologies.

PolyCycl's Generation VI innovation is poised to bridge this gap, facilitating the production of virgin-quality recycled polymers that meet stringent standards for high-value applications.

Courtesy: Sushant Sharma & Akshay Thakur, Adfactors PR.

JOTUN: INNOVATIONS & SUSTAINABILITY
TRANSFORMING CHALLENGES INTO OPPORTUNITIES



Anders Skilbred, Global Sustainability Manager shares Jotun's vision on core principles and trends in green coating innovations and technologies.

Sustainability and Fostering R&D for Innovations

Sustainability is inherent for paint and coatings manufacturers. The designed products and solutions should be able to protect critical assets within a wide range of industries against corrosion, as well as cut carbon emissions, protect biodiversity, and preserve fuel for ships. Jotun drives towards more sustainable products with a focus on the environmental footprint by developing new raw materials such as bio-based binders and new types of chemistries far from traditional coatings.

Sustainability also paves the way for new business opportunities. The shift towards green energy is driving the development of large offshore wind farms, which require durable and high-performance corrosion protection. Additionally, the decarbonization of the global shipping fleet will necessitate highly efficient fouling protection solutions, often combined with proactive cleaning methods.

Jotun has a strong 100 years of experience in developing and innovating through research and development. Their ability to continuously drive the innovation and development of novel products meets the ever-changing needs of the market. In addition, the focus is on new coating chemistries and raw materials with lowered footprint facilitating innovations that can meet the customer's needs for more sustainable solutions impacting their footprint.

Some of the other breakthroughs the company has achieved are lifetime predictions of protective coatings, computer simulations of ship hulls and the impact of fouling protection, proactive cleaning by underwater robots, and machine learning models for image recognition of inspection photographs.

Integrating Advanced Digital Innovations

Technological advancements in the paint and coatings industry focus not only on new coating technologies and chemistries but also on digital innovations. Implementation of digital tools with machine learning and AI capabilities across organizations streamlines research and development activities, automates production processes, and enhances sales strategies.

For Jotun, which has 40 factories around the world producing more than 1 billion liters of paint every year, efficient operation is crucial. Automation integration impacts production efficiency and HSE. However, they do not replace workers with robots solely for the sake of automation. Jotun recognizes its responsibility to employees and their families, and being a responsible actor in local communities means creating and maintaining meaningful and sustainable job opportunities.

On an operational level, digital solutions are already providing actionable insights for customers, helping them take proactive measures within steel maintenance or to maintain a clean hull. Large research efforts have been dedicated to utilizing digital technologies for developing new lifetime prediction models, solutions for creating global maps of corrosivity, and hull performance monitoring algorithms.

Jotun also offers innovative technical solutions like their Hull Skating Solutions, which combine traditional coatings and antifouling with robotics to maximize hull performance in environments and operations that are among the most challenging.

Challenges in Transitioning to Sustainable Solutions

First, it is crucial to have the necessary data for ESG reporting

including scopes 1, 2, and 3. What is also critical is to have a credible transition plan (CCTP) in place with clear objectives and goals, and specific activities on how to achieve those goals to reduce the footprint of total scope 1, 2, and 3 emissions. This also includes how one formulates products and how one can adapt the assortment to meet specific attributes like lower footprint and longer lifetime. This is all a part of our focus to lower our emissions.

The company has implemented several initiatives over the years such as energy savings programs for the factories. However, its operation is only a small fraction of the total footprint. Most of the footprint is related to the raw materials used in the products. Hence, one of the specific challenges going forward is to motivate suppliers to deliver raw materials with a lower footprint over the lifetime of the product. Additionally, they are focused on creating products that are more efficient and easier to apply, enabling customers to use less material to achieve the same level of performance.

While it is possible to innovate by using raw materials with a lower environmental footprint, such as bio-based binders, there are considerations regarding product longevity. If utilizing these materials results in a reduced lifespan for the coated asset, leading to increased maintenance requirements, the overall environmental footprint throughout the product's lifetime may not significantly differ from that of traditional solutions.

Amid these challenges lie significant opportunities. Products and solutions boasting a proven low total environmental footprint may be prioritized by customers, opening avenues for new business offerings. Furthermore, products known for their long durability will also attract interest from a wide range of customers and projects, enhancing their marketability.

Meeting Compliances to Improve Performance

Jotun emphasizes the importance of understanding and influencing how regulations and new standards can drive Environmental, Social, and Governance (ESG) priorities across industries. One example is the ISO 19030 standard, initiated by the company, which establishes a consistent and transparent framework for measuring hull performance solutions in the shipping industry.

Another effort is the Clean Hull Initiative, developed in collaboration with the NGO Bellona, aimed at creating an industry standard for proactive hull cleaning to address the global challenge of biofouling. Jotun's contributions are focused on providing long-term protection against degradation and biofouling. By preventing steel corrosion and reducing fuel consumption, these efforts play a key role in advancing sustainability across multiple sectors.

Interrelations of Industries Driving Growth in the Coating Industry

Many businesses strive to position themselves as being sustainable to maintain their competitiveness, and the same is the case for the paint and coatings industry. There is a drive in the market towards more sustainable products and solutions, that also go beyond the regulatory requirements.

As an example, the growing market within offshore wind energy is driving the demand for very long lifetimes of corrosion protective coatings (> 45 years) with little or no maintenance required throughout the lifetime of the asset. Similarly, the branches of the coating industry are so widespread that the goals of other co-dependent industries drive innovation and growth in the coatings sector. On this note, Jotun believes that their products are well-developed to protect assets in the harshest environments and they are eager to explore further in new domains.

PIVOTING TO GREENER FLIGHTS & INNOVATION IN SUSTAINABLE AVIATION FUEL



Alexander Kueper, Vice President of Renewable Aviation Business at Neste, explains how the role of Sustainable Aviation Fuel (SAF) in decarbonizing aviation is transforming the global reliance on fossil fuels.

INTERVIEWED BY SHRADDHA VERMA

Neste is the world's leading producer of SAF (Sustainable Aviation Fuel), it has been making waves with its innovative advancements and strategic collaborations in the development of SAF paving the way for a more sustainable aviation industry. Considering these exciting developments, Chemical Today reached out to Neste for a deeper understanding of what's happening behind the scenes in the SAF market and how these innovations are shaping the future of aviation fuel.

Sustainable Aviation Fuel (SAF) In-and-Outs

SAF is a renewable aviation fuel that acts as a more sustainable alternative to conventional, fossil-based jet fuel. It has the potential to reduce greenhouse gas emissions by up to 80% over the fuel's life cycle compared to using fossil jet fuel. It has been widely acknowledged as a key element for the aviation industry's

ambitious emissions reduction goals, expected to deliver around 65% of the emission reductions necessary to get to net zero by 2050, the target set by the aviation industry.

The 'sustainable' in SAF not only comes from the emission reduction that can be achieved by using SAF instead of fossil jet fuel but also from the renewable raw materials used and the way these are sourced. Sustainability is an absolute requirement for SAF to remain a viable long-term solution. It is currently mostly produced from waste oils and fats but can also be produced from green & municipal waste, non-food crops and synthetically via a process that combines green hydrogen with carbon captured directly from the air ('eSAF').

SAF is a type of 'drop-in' fuel, viable to be used in existing aircraft engines and existing fuelling infrastructure without any modifications. SAF is certified for commercial use and can

currently be blended with conventional jet fuel at a maximum rate of 50%. However, a major challenge is scaling up the production of SAF, as it currently accounts for less than 1% of total global jet fuel consumption.

Neste is the world's leading producer of SAF and is expanding its annual SAF production to 1.5 million tons this year and even further to 2.2 million tons per annum with the expansion of its existing renewables refinery in the Netherlands. Neste's renewables refinery in Singapore is the world's largest SAF production facility in terms of capacity, with a production capability of 1 million tons of SAF per annum. With utmost importance to sustainability, the company has a robust system to ensure its renewable products, and the raw materials used meet the legal sustainability requirements set by local authorities in the given markets, including complaint suppliers.

Research and Innovation Behind SAF's Success

The development of Sustainable Aviation Fuel (SAF) has been driven by continuous research and innovation, with several key milestones shaping its evolution. Neste's proprietary NEXBTL™ technology (Next Generation Biomass to Liquid), developed over 25 years ago, plays a crucial role in Neste's SAF production. Using Hydrotreated Esters and Fatty Acids (HEFA) technology, it converts renewable waste oils and fats into hydrocarbons that are chemically like fossil fuels, allowing for a seamless replacement of its fossil equivalent without modifications to existing aircraft engines or fuel infrastructure.

Among the various SAF production pathways, HEFA remains the most commercially viable and widely used, with Neste MY Sustainable Aviation Fuel™ being produced entirely from renewable waste and residue materials, such as used cooking oil and animal fat waste. The approval of HEFA-SAF for use as a jet fuel in 2010 marked a significant breakthrough, and in 2011, over 1,000 Lufthansa flights successfully operated with SAF blends produced by Neste.

Beyond HEFA, other approved technologies include Alcohol-to-Jet (ATJ) and Fischer-Tropsch synthesis, while emerging pathways such as eSAF, produced from green hydrogen and captured carbon are still in early-stage development, with commercial availability expected post-2030. Neste continues to push the boundaries of SAF innovation, actively exploring power-to-liquid technologies and new renewable feedstocks, including algae, novel vegetable oils, and lignocellulosic materials, to further enhance the scalability of SAF production.

Neste's NEXBTL technology enables the production of various renewable fuels, including SAF and renewable diesel, as well as renewable feedstock solutions for the polymers and chemicals industries. Although SAF and renewable diesel share similar production processes, their fuel specifications differ significantly—SAF must meet stringent safety and quality standards set by organizations like ASTM to ensure its suitability for aviation.

More Sustainable Option for Reducing Scope 3 Emissions of Operations

While SAF is primarily used by airlines, SAF also presents an opportunity for companies with extensive business travel or global air cargo operations to reduce their Scope 3 emissions. These emissions can be a significant part of an organization's carbon footprint, especially for organizations like financial or consultancy companies or brand owners with global production.

By purchasing SAF, for example via the Neste Impact solution, businesses can reduce their aviation related emissions and actively contribute to their sustainability goals and decarbonization efforts. Neste Impact provides companies with a structured way to reduce emissions, but also credibly track and report emission reductions achieved through SAF usage, reinforcing transparency and credibility in corporate sustainability initiatives.

International and Government Collaborations Paramount to Overcome Hurdles

The primary hurdle in scaling up the adoption of Sustainable Aviation Fuels (SAFs) is their higher cost compared to fossil jet fuel, which remains a significant barrier to widespread use. SAFs are approximately two to three times more expensive than conventional jet fuel, making it challenging for airlines operating in a highly competitive market to transition unless industry-wide alignment is in place.

This underscores the need for governments creating long-term regulatory frameworks that ensure market stability, drive investment in SAF production, and help airlines manage the cost impact. Encouragingly, global policy developments are taking shape.

The European Union has implemented the ReFuelEU Aviation Regulation, mandating using a SAF blend starting at 2% in 2025 and growing stepwise to 70% by 2050, while the United States has introduced supportive measures at both federal and state levels. However, the Asia-Pacific region lags behind, though several countries, including India, are working on policy initiatives to support SAF adoption.

To accelerate progress, governments, industries, and organizations like Neste must collaborate to establish robust policy frameworks that create demand certainty, incentivize investments, and accelerate the integration of SAFs into aviation.

India's SAF initiatives and global outlook for coming years

SAF demand has increased globally but there is an urgent need for accelerating the usage and production. SAF holds immense promise for the Indian aviation industry, which could achieve a more sustainable aviation sector while ensuring its continued growth and development. The Indian Ministry of Petroleum & Natural Gas announced SAF targets of 1% by 2027 and 2% by 2028 for all international flights which showcases the positive action taken by the Indian Government. Additionally, the government of India introduced an excise duty reduction for blended aviation turbine fuel used for flights under the Regional Connectivity Scheme (RCS). These are encouraging steps by the government of India which recognizes the role that SAF can play in decarbonizing India's aviation sector.

Accelerating the implementation of SAF as a more sustainable fuel will be crucial for the global aviation industry to reach its goal of "Net-Zero Carbon Emissions" by 2050. Yet despite this promise, it has its own set of challenges to reach the target. SAF is a key lever but government policies are crucial in ramping up production and usage. The aviation industry has embarked on a transformational journey to a more sustainable future. Still, it can only reach that if all stakeholders take responsibility and cooperate as the need for action has never been greater.

DR. SEVERIT ON “KEEP CHANGING”: PIONEERING FLEXIBLE AND RESPONSIVE INNOVATIONS IN SPECIALITY CHEMICALS



Dr. Petra Severit, Chief Technology Officer at ALTANA AG, discusses her leadership journey from research to innovation in the specialty chemicals industry. She highlights the importance of early STEM education, shares insights into the future of the chemical sector, and offers valuable advice for the next generation of women leaders in the chemical industry.

Speakers Background

Dr. Petra Severit has more than 25 years of international leadership experience. Her career spans various countries and functions such as R&D, sourcing, sales, strategy, and general management in the automotive and chemical industries. As Chief Technology Officer (CTO) and Executive Management Member of the specialty chemicals group ALTANA, she spearheads cross-divisional innovation and know-how transfer.

Dr. Severit has served on the Scientific Advisory Boards of CENIDE since 2022 and DWI – Leibniz Institute for Interactive Materials since 2021. She also is a member of the Enterprise Board of Big Chemistry, an initiative to build a fully automated, robot-based laboratory. The goal is to use large datasets to train new algorithms to predict the properties of molecular systems. Dr. Severit holds a PhD from the Fraunhofer Organization with an emphasis on polymer materials and composites.

Leveraging Intercultural Leadership to Drive Global Growth

It is this intercultural leadership that happens to be pivotal in creating growth and innovation in today's interconnected world. An open, intercultural working environment will improve the exchange of ideas, know-how, and experiences, making it very crucial in understanding global markets and customer needs.

This approach is also deeply rooted in the corporate values of openness, trust, appreciation, and empowerment at ALTANA. In this way, the company creates an inclusive and collaborative culture, connecting people across the globe and tapping into broad competencies—ranging from chemistry and formulation to scaling up and production. It enables the efficient development of innovative solutions for customers. One example is the Cross-Divisional Development Program in Corporate Innovation (CDDPI), an internal program whose participants not only work on exciting research topics but also get to know the interfaces between different areas - from R&D and business development to product or innovation management.

Inspiring Women Through Academia and Industry Contributions

Dr. Petra Severit emphasized the necessity of bringing scientific research and applying R&D together to develop meaningful, market-driven innovations. "My involvement in scientific advisory boards has further enriched my journey. For example, my appointments to CENIDE at the University of Duisburg-Essen and the DWI - Leibniz Institute for Interactive Materials have allowed me to contribute my expertise in nanoscience and interactive materials. Similarly, as a member of the Big Chemistry Enterprise Board, I've leveraged my scientific background to address market demands and capitalize on digitalization trends."

ALTANA is a signatory of the UN Global Compact, committed to promoting women both in the industry and within the organization and achieving this in the course of the corporate "Keep Changing" Agenda for the future by focusing on people, ensuring everyone can understand their potential. It includes increasing diversity and exemplifying core values. Post to this smooth feedback culture and various development opportunities are also important.

Dr. Petra Severit also further stressed the importance of earlier inclusion of the STEM subjects for the right guidance and creating interest. Working on this, ALTANA promotes various STEM programs and Dr Severit also participates in university as a part-time lecturer. "I'm convinced that students in general, but female students, are being motivated by my work as ALTANA CTO, where I combine technology and business in the industry."

Pivotal Leadership Moments and Evolution

Each career step has shaped my leadership approach, particularly my appointment as ALTANA's Chief Technology Officer (CTO) in 2018. This role has allowed me to combine my passion for technology and innovation with my commitment to empowering teams. Leading a group of talented individuals dedicated to developing customer-centric solutions is a deeply fulfilling experience.

ALTANA's focus on innovation has inspired me to foster a culture where creativity and collaboration thrive. This approach ensures

that we continue to deliver cutting-edge solutions while nurturing a workplace where every individual can grow and contribute meaningfully to our collective success.

Specialty Chemicals Market and Transformational Developments

Germany's specialty chemicals market has undergone significant transformations, mirroring trends seen globally. In all markets, including Germany, the U.S., and Asia, it has proven advantageous to invest in the future irrespective of economic circumstances. To this end, ALTANA is consistently investing approximately 7 percent of its sales in R&D (2023: €197 million) which surpasses the industry average and underscores a corporate culture that enables innovation.

Significant progress has also been achieved with double-digit growth, driven by organic efforts and acquisitions within the first six months of 2024. Among global investment projects, noteworthy developments include the construction of a state-of-the-art innovation, laboratory, and seminar complex at Wesel in Germany, a new production building in Deventer in the Netherlands, the expansion of capacity in Zhuhai, China, and an enhancement at the U.S. site in Wallingford, near New York. These milestones reflect the transformational journey of the specialty chemicals sector in Germany and beyond and its alignment with broader global trends.

Role of Specialty Chemicals in Green Innovation

Specialty chemicals' successful sustainable transformation depends on its carbon-free footprints. The sector plays an important part in achieving climate protection targets by driving innovation. ALTANA is committed to driving innovation while minimizing its environmental impact. The company is contributing to sustainability both through its operations and its products. For example, ALTANA has developed solutions that enhance the recyclability of packaging and support the reliable operation of large-scale wind turbines, helping customers make their products more sustainable through innovation. This commitment highlights the role of the specialty chemicals industry, and ALTANA in particular, as a key enabler of sustainability goals.

ALTANA is committed to sustainability, targeting to reduce greenhouse gas emissions to net zero by 2050 and reducing its Scopes 1, 2, and 3 emissions by 90%. The company has promised to reduce its total direct influence (Scopes 1 and 2) to 90% by 2040. The commitment aligns with the Paris Climate Agreement and has been verified by the Science-Based Targets Initiative (SBTi). The company has reduced Scope 1 and 2 emissions by approximately 70% from 2014 to 2023 already. It will offset any remaining emissions in Scope 1 and 2 starting in 2025 by supporting external climate projects.

Major industries are undergoing a green transformation; hence, sustainably innovative specialty chemicals with efficient processes and green solutions will be in motion throughout the year. As in the trending hype of EVs in the automotive sector that propelled other segments of industries like Electrical Insulation Systems, one of the main products of ALTANA AG. The year is yet to unfold and will be at the forefront of stimulating new ways of working, even in research and development.

GREEN SKILLS TO BRIDGE THE EMPLOYMENT GAP IN RENEWABLE ENERGY



India is facing a critical shortage of trained professionals in its renewable energy sector, which is acting as a major bottleneck to the country's efforts towards achieving sustainable energy goals. In the wake of increased demand for green technologies, mainly wind and solar power, trained personnel are desperately needed to fulfill the needs of the sector. This skill gap is hindering the full potential of India's renewable energy transition.

To respond to this challenge, Suzlon Group has entered a collaboration with the Andhra Pradesh State Skill Development Corporation (APSSDC) to develop India's largest green skill development program. The plan involves training 12,000 young professionals over the next four years on specialized skills in wind power manufacturing, electrical and mechanical engineering, blade technology, and operations and maintenance. Of the 12,000 trainees, at least 3,000 will be women, thereby ensuring gender inclusivity in this traditionally male-dominated industry.

This would bridge the much-needed skill gap in India's renewable energy sector by providing youth with comprehensive theoretical knowledge and practical experience. The comprehensive classwork and on-site application of knowledge and skills will prepare

participants to assume critical roles in industries, thereby giving India a broader potential for a greener future.

Suzlon also promotes quality education. It develops curriculum in association with ITI, diploma, and degree engineering colleges. The curriculum developed and delivered through all these collaborations ensure that globally acknowledged content is well integrated into their training programs so that students undergo a world-class educational experience about renewable energy.

Shri Nara Lokesh, Minister for IT & Human Resources Development, emphasized the significance of such initiatives, stating, "Our goal is to create 2 million local jobs in the next five years, which will significantly contribute to India's renewable energy ambitions."

Suzlon is helping to address the increasing workforce challenges in the renewable energy sector by helping develop the green skills with this strategic partnership. Besides job creation at the local level, it would help ensure long-term growth for India's renewable energy industry and be able to contribute to future generations in building a more sustainable and energy-efficient tomorrow.

REDUCING CARBON FOOTPRINT IN TEXTILES WITH BIO-BASED BINDERS



Vanalya on Freepik.

The textile industry is one of the world's largest emitters, accounting for 6-8 percent of the global carbon output. The sector thus faces extensive pressure to reduce its environmental footprint against the rising global demand from consumers for sustainable products. A major means to achieve this is through the application of bio-based materials that can reduce the carbon footprint of textile products.

Arkema has now introduced its range of bio-based acrylic binders designed specifically for textile printing and finishing applications. These binders contain up to 30% bio-based content and have been proven to reduce the carbon footprint of the resulting textiles by as much as 40% in comparison with traditional resins.

The use of bio-based materials is increasingly becoming popular in the textile industry as companies seek alternatives to traditional chemical solutions. Companies can reduce their reliance on fossil fuels and lower their carbon emissions by incorporating renewable

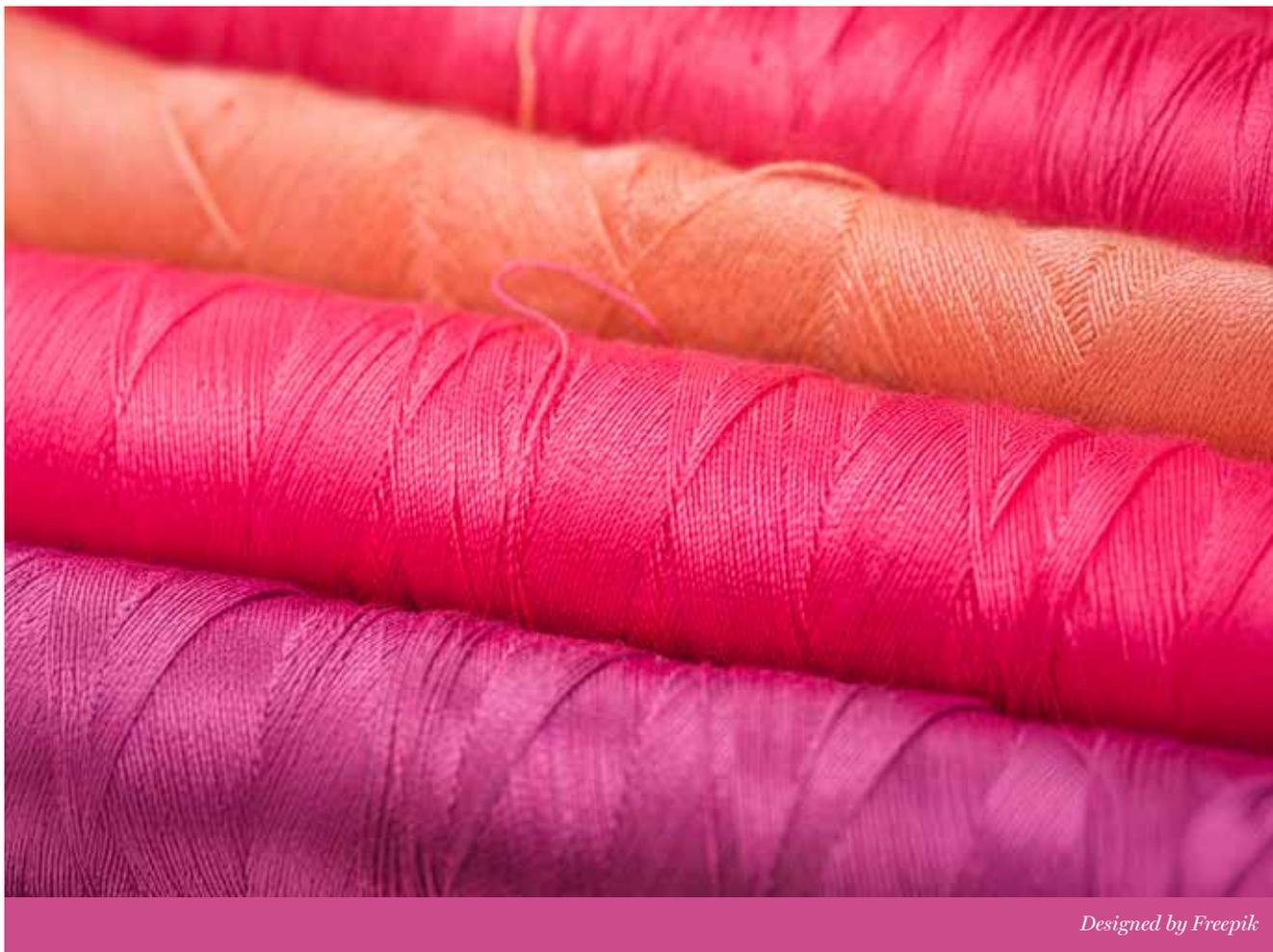
resources into production processes. One example of how the textile industry can move toward more sustainable practices is Arkema's ENCOR® binders.

Helene Pernot, Global Sustainability Marketing Director at Arkema, emphasized the importance of these innovations, stating, "Bio-based solutions set the stage for the next generation of more sustainable textile products."

Besides the sustainability advantages, these binders provide better performance with superior color stability, washing resistance, and durability. In response to the increasing demand for sustainable textiles, Arkema's bio-based binders promise to help brands reduce their environmental impact without sacrificing product quality.

This commitment of Arkema toward renewable feedstocks and the enhancement of biodegradability for future products will focus on developing a circular, sustainable lifecycle for its products.

LEVERAGING CIRCULAR ECONOMY WITH BIO-CIRCULAR MATERIALS IN FASHION



Designed by Freepik

The fashion industry is transitioning into a whole new paradigm based on more sustainable, circular business models. For a truly sustainable model, the sector must break off its dependence on non-renewable resources to instead create things that can be recycled, reused, and recycled in a true closed-loop manner.

Archroma, which offers sustainable chemical solutions for textiles, is part of the BioCircular Materials Alliance. This alliance was co-founded by Spiber Inc., a pioneer in biomaterials, to integrate bio-based fibers, dyes, and finishing chemicals into the supply chain of the fashion industry, thus addressing the need for a circular and more sustainable ecosystem.

The Materials BioCircularity Database is the first initiative under the BioCircular Materials Alliance. It is meant to help manufacturers and brands measure the recyclability of the

materials used in their products. Clear, reliable data on the biocircularity of fibers and chemicals empowers brands to make more sustainable choices in their production processes.

Archroma's PLANET CONSCIOUS+ vision is in line with the mission of the Alliance. The company is dedicated to developing textile solutions that are safer, more durable, and easier to recycle. Such innovations include those in dyes, finishing chemicals, and other treatments for textiles, which have less environmental impact from cradle to grave.

With this move, Archroma will position itself as a major player in furthering sustainability in the fashion industry. The commitment by the company to improve the environmental footprint of textiles and to support the development of a circular economy will be critical to achieving the sustainability goals of the industry.

TRANSFORMING METHANE INTO GRAPHENE AND HYDROGEN FOR A SUSTAINABLE FUTURE



Graphene can revolutionize different sectors; among them are energy, electronics, and construction. Its use can be seen in battery-based electric vehicles, solar panels, and even construction materials, stronger and more durable than previously used conventional ones.

ADNOC Gas has made a major step toward decarbonizing the energy sector by successfully deploying pioneering technology that converts methane into graphene and hydrogen. Developed by Levidian, the LOOP technology captures carbon from methane and converts it into graphene, a material with a wide range of potential industrial applications.

This pioneering technology is now online at ADNOC Gas's Habshan Gas Processing Plant, marking the first deployment of its kind in an operating gas facility. The LOOP unit is capable of producing over 1 tonne of graphene and 1 tonne of hydrogen per

year, with future installations scaling up to 15 tonnes annually.

The introduction of this technology aligns with ADNOC Gas's commitment to supporting global decarbonization efforts and advancing the UAE's climate goals. Mohamed Al Hashemi, Chief Operations Officer of ADNOC Gas, said, "By transforming methane into valuable graphene and clean hydrogen, we are unlocking new value from natural gas, driving decarbonization and supporting the UAE's industrial growth."

This project is part of ADNOC Gas's broader strategy in exploring innovative technologies to reduce the carbon intensity of natural gas. Using AI and digital twins, ADNOC Gas will optimize energy consumption and maximize production of graphene from future installations while further enhancing the potential of this breakthrough technology.

WHAT CAN 1 MILLION METRIC TONNE CAUSTIC SODA DO?



By supporting the construction of 1 Million Wind Turbines it can help fuel India's renewable energy revolution

The recent capacity expansion project at our manufacturing facility in Jhagadia, Bharuch, Gujarat, pushed up our overall annual installed capacity to 1 Million Metric Tonne of Caustic Soda! To put that into perspective, that is enough Caustic Soda to support the construction of 1 Million Wind Turbines, which could together generate 2500 GW of wind energy (while the total installed capacity of wind energy in India (as of March 2024) was only 45.88 GW), sparking a renewable energy revolution in the country.

At DCM Shriram Chemicals we are poised to deliver sustainable solutions for India.

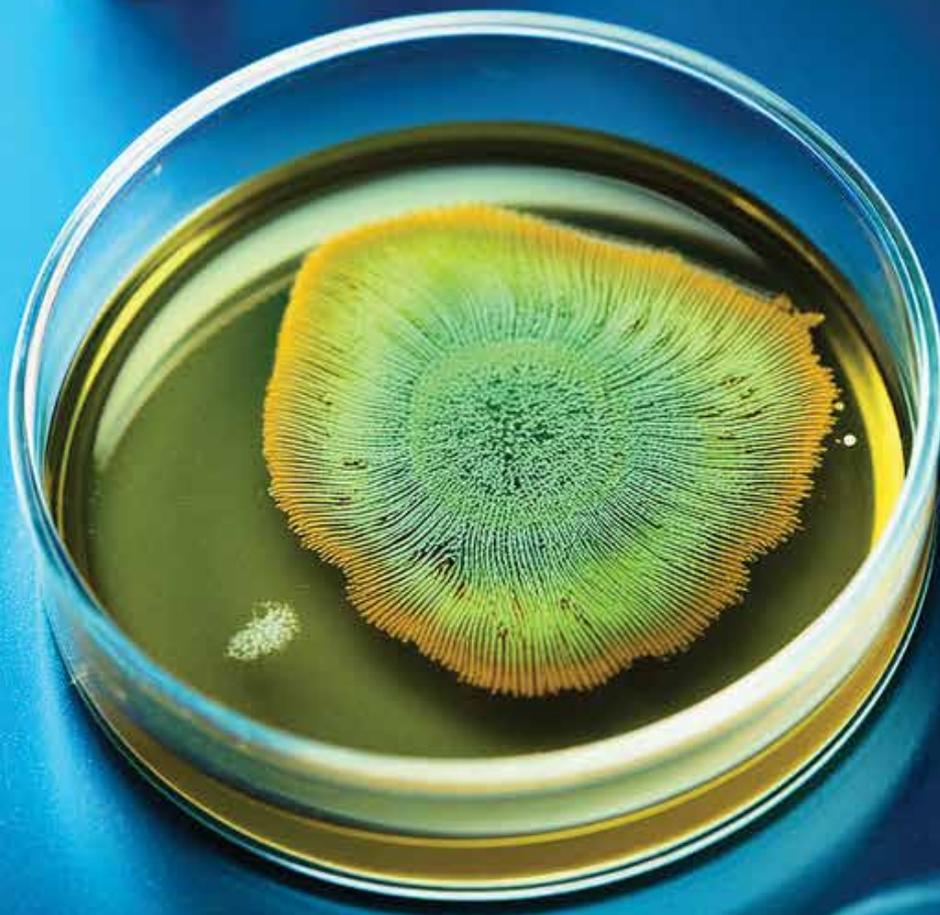
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DCM SHRIRAM
CHEMICALS
Delivering Sustainable Solutions

MICROBE DEFENDERS: ROLE OF BIOCIDES ACROSS INDUSTRIES

Crucial anti-microbe agents maintaining product integrity and shelf-life



Chemical substances or microorganisms that prevent, deter, or control the growth of harmful microorganisms or bacteria on a given surface are referred to as Biocides. Their primary purpose is to control organisms that pose a risk to human or animal health or that can damage natural or synthetic products. Yet, the concept of biocides is often misconceived. Are biocides the same as pesticides?

These terms are often used interchangeably, which can lead to confusion. For instance, people might ask, “Are biocides used on plants?” or “Are pesticides included in my newly bought antimicrobial paint?” The answer is no.

Pesticides encompass a much broader range of substances and include both biocides and plant protection products. Biocides are used for non-food purposes, while plant protection products are specifically for food and feed.

Groups and Common Chemicals

According to European legislation, biocides are classified into four main groups: disinfectants & general biocidal products, preservatives, pest control, and antifouling or embalming products. Biocides are used in diverse categories including water treatment, animal feed preservatives, disinfection of food equipment and surfaces, preservatives in cosmetic products, laundry detergents, hygiene products, the healthcare industry, slime prevention in paper and pulp, biofilm prevention, corrosion prevention, and even as agents that inhibit bacterial and fungal growth in both wet and dry paint formulations.

Basic Chemicals like halogen, metallic clusters, organosulfur, and organic acids are part of the biocides market, which is divided into segments based on product categories, end-use applications, and geographical location. Hypobromous acid, sodium bromide, hydrogen peroxide, QACs, Bronopol, and isothiazolinones are examples of common biocides.

Trends in the Sectors

In the next 5 years, the sector promises a rate of 4.2% growth each year in which cosmetics, cleaning items, and detergents are the primary driving factors. When looking at who uses these products at the highest consumption, water treatment, and paint & coatings industries are the biggest contributors to sales, with water treatment accounting for 26% of the market share.

Biocides are used in paints and coatings for in-can preservation, microbial growth prevention, dry film preservation, and preventing the growth of fungi. They are also used to treat wastewater effluents produced during the production process. Whereas, in water systems, it is used to stop antifouling, film formation, and bacterial or algal contamination. These systems include cooling towers, swimming pools and spas, industrial water treatment systems, municipal drinking water treatment facilities, and paper production operations.

Regions with Strong Competition

In North America, stringent U.S. water quality regulations drive demand for EPA-registered biocides, particularly in water treatment plants and wood preservation. Asia Pacific, led by China, sees strong demand for water treatment, cleaning products, and high-end paper production, though competition from commodity chemicals may impact growth.

Europe is experiencing market consolidation due to high product registration costs and the enforcement of Biocidal Product Regulations (BPR), limiting harmful biocides. In Latin America, the shift toward water-based paints and coatings boosts consumption, while ultra-low sulfur fuel standards contribute to growth in marine applications.

The Middle East and Africa, with Saudi Arabia as a key player, witness demand from the freshwater sector and petrochemical industries, with emerging opportunities in food, personal care, and HVAC.

Overall, the biocides market is influenced by regional regulations, industry-specific demands, and the push for environmentally friendly solutions.

Key Innovators

Key global players in the market include Troy Corporation, Neogen Corporation, BASF SE, Solvay SA, Lubrizol, Lanxess, and others. Over the years, increased product innovation by different multinational corporations to broaden their product line and reduce the risks associated with biocides has resulted in increased product usage. And so does the burden on compliance and sustainability has double fold.

Advancements in Green Biocides

Expanding applications have forced the research & development of biocides to focus on extensive work of innovating Green Biocides. Biocides may have toxic, carcinogenic, or endocrine-disrupting properties and have bioretention that poses a hazard to the environment.

Sustainable options like plant-based biocides like essential oils from thyme, oregano, and eucalyptus, show antimicrobial activity with being biodegradable and low toxicity. Enzymatic biocides, such as lysozyme and protease, derived from sustainable sources of biotechnology targeted the microbes directly.

Also being explored are bacteriophages - the natural viruses to target bacteria precisely without the risks of resistance. Further, green nanotechnology utilizes antimicrobial nanoparticles of silver, copper, and zinc incorporated in coatings and materials for long-lasting protection. These advances are safer, more eco-friendly alternatives to traditional biocides while minimizing the risks to environmental and human health.

Governing Directives for the correct application of Biocides

In India, the Insecticides Act of 1968 and the Insecticides Rules of 1971 govern the registration, sale, and use of biocides, including insecticides. The Central Insecticides Board & Registration Committee (CIB&RC) oversees the registration process. A comprehensive regulatory framework specifically for biocides is still being developed, but as of October 2023, the Indian government introduced the Insecticides (Prohibition) Order, 2023, which restricts the sale, distribution, and use of specific insecticides, as well as defining penalties for non-compliance and requiring the cancellation of registration certificates for certain insecticides.

The European Chemicals Agency (ECHA) plays a pivotal role in shaping the regulatory landscape of biocides within the EU. Through its streamlined third-party consultation process, ECHA aims to enhance the transparency and robustness of the assessment of biocidal active substances. This initiative is integral to ensuring that the EU regulatory framework remains responsive to emerging risks associated with biocides, while promoting the identification and adoption of safer alternatives.

Need to think ahead

As the demand for effective and safe biocides increases, industries are looking toward innovation, sustainability, and compliance. The shift toward greener alternatives and stricter regulations ensures that biocides remain both effective and environmentally responsible.

Moving forward, companies must balance efficiency with safety, adopting best practices to meet evolving standards. With continued research and responsible use, biocides will continue to play a vital role in various industries, helping maintain hygiene, product integrity, and environmental safety.

CONVENTIONAL PLASTIC ALTERNATIVE NEEDS TO BE COMPETITIVE



In recent times, concerns over the environment and regulatory pressure have led more businesses and consumers to opt for bio-based packaging materials. More and more renewable resources, including corn starch, sugarcane, and cellulose, are being used for packaging food and beverages, personal care products, and retail goods. Government policies and stricter regulations against conventional plastics are further fueling this change. Advances in biopolymer technologies also allow for the development of high-performance bioplastics with increased durability and protection properties, suitable for a wide range of packaging applications.

The other segment is made up of materials like polylactic acid (PLA), starch blends, PBAT, PBS, PHA, polycaprolactone, and cellulose acetate. Here, starch-based plastics and PBAT were the dominating segments, followed by the availability of natural resources like potato, tapioca, wheat, rice, and corn. PLA is likely to be the fastest-growing bioplastic category during the forecast period. It can be used with incredible success in many diverse industries, such as packaging, agriculture, electronics, and textiles. The production of PLA also emits much fewer carbon emissions than other traditional plastics, making it gain popularity more quickly.

Market and Trends

The global bioplastic packaging market was valued at approximately USD 19.55 billion in 2024, with expectations of a compound annual growth rate (CAGR) of 17.24% from 2025 to 2030. The main factors driving the expansion of the market are the increased preference for renewable and bio-based materials, a rise in demand from the flexible packaging sector, and the positive environmental properties of bioplastics, such as lower carbon emissions and faster decomposition. However, despite these benefits, the market faces the issue of cost competitiveness of bioplastic packaging as compared to its conventional plastic counterpart.

Government policies around the world are proving to be a significant driving force for the bioplastic packaging market. Many countries have implemented bans or restrictions on single-use plastics, opening opportunities for bioplastic alternatives. For example, the European Union's Single-Use Plastics Directive, among others in North America and Asia, is driving the shift toward biodegradable and compostable packaging solutions. Such regulations promote adoption and spur innovation in the bioplastics sector.

The biggest opportunities come from developing Asia, Africa, and Latin America. The cities are booming there, the middle class is swelling, and environmentally friendly packaging attracts business and customers alike. Therefore, growth can be seen for bioplastic packaging in large food packaging volumes and retail markets.

Market Challenges

One of the main challenges for the widespread adoption of bioplastics is the relatively high production cost compared to traditional plastics. The use of specialized raw materials and manufacturing processes increases the cost, which can be a discouraging factor for businesses. Additionally, the absence of efficient recycling and composting infrastructure in many regions hampers the proper management of bioplastic waste. Without proper industrial composting facilities, many biodegradable materials cannot decompose as they are supposed to, thus negating their environmental benefits.

Key Application Areas

Type: Flexible Packaging had a market share of 58.11% of industry revenue in 2024. Innovation in bioplastic technology and improvement in packaging practices are also expected to boost the demand for bioplastic flexible packaging further. Consumers in North America and Europe are in favor of light, attractive, and visually appealing packaging solutions for snack food and beverages, thereby making bioplastics an ideal option for snack food and beverage packaging.

Utility: Packaging for food and beverages held the highest revenue share in 2024 at 58.95%. Growing demand for packaged food is expected to spur the demand in this market, coupled with a higher number of quick-service restaurants across the world. The European Commission's attempts to regulate polymer use in food packaging are also prompting the consumption of bioplastics. Examples include PLA plastic bottles, which are both robust and compostable.

Regional Market Trends

North America: Large corporations and retailers in North America are actively adopting bioplastic packaging to meet sustainability targets and address consumer preferences. Initiatives such as the U.S. Plastics Pact and Canada's zero plastic waste policies are promoting the transition to biodegradable packaging. Investments in biopolymer research and manufacturing infrastructure are further supporting the market's growth.

United States: States like California, New York, and Washington have introduced bans on single-use plastics, spurring demand for bioplastics. Federal initiatives, such as the USDA's Biopreferred Program, are also fostering advancements in bio-based packaging materials.

Europe: Accounting for 32.73% of total revenue in 2024, the region's regulatory framework, including the European Green Deal and Plastics Strategy, is accelerating the shift toward sustainable packaging solutions. Financial incentives for renewable materials and strong consumer demand for eco-friendly products are further bolstering market expansion.

Asia Pacific: Rapid industrialization and urbanization in countries like China, India, and Southeast Asia drive the market in the region. Rising environmental consciousness and government support for sustainable packaging initiatives are also propelling the industry. Additionally, the expansion of e-commerce and food delivery services is driving the demand for durable and sustainable packaging materials.

Germany: The country's waste management policies and commitment to renewable materials are advancing biopolymer technologies. Collaborations between research institutions and industry players are further strengthening Germany's position as a leader in bioplastic packaging.

Key Players

The bioplastic packaging market is highly competitive, with key players investing in research and development to improve cost efficiency and performance. Major players in the industry include: Amcor Plc., Novamont S.p.A, Alpha Packaging, Constantia Flexibles, Mondi, ALPLA, etc. These companies are driving the industry trends, focusing on innovation and sustainability to ensure that bioplastic packaging continues to gain traction as an eco-friendly alternative to conventional plastics.

Source: Grand View Research

A VERSATILE SOLVENT FOR MODERN INDUSTRIES

Market Overview

Acetone market growth showcased USD 6.6 billion in 2024 with a CAGR of 5.2% for the period 2025 to 2034. This momentum being gained in the industry is attributed mainly to the enormous applications of acetone in the chemicals, pharmaceuticals, automotive, and cosmetics industries. Acetone is used as an excellent solvent in paint, coatings, and even for first-aid disinfectants and adhesives, keeping its demand steady. The acceleration of industrial development from these economies would give a strong impetus for further growth. Notable applications of acetone in pharmaceuticals are drug formulation and extracting processes.

Major industries in construction, automotive, and electronics are making big contributions. Additionally, the rise of sustainability brought about a change in production processes with increasing national attention on bio-based acetone from renewable feedstocks. This transition gushes sustainability aiming for the hearts of the consumers growing preferences towards eco-friendly products. The use of acetone for plastics and synthetic fibers is incriminating its support to be always in the limelight.

Sustainability and Technological Advancements

There is a progressive trend toward bio-based acetone production methods as awareness about environmental issues gains increased traction. This trend would foster enduring market growth as industries seek cleaner alternatives to the long tradition of petrochemical-based acetone. New opportunities arise from the increasing use of acetone in the manufacture of lightweight materials, such as automotive composites. In pharmaceuticals and personal care, acetone's utilization in formulations and extractions matches evolving consumer demands for functional and sustainable products.

Segment Analysis

Technical-grade acetone, valued over USD



3.8 billion in 2024, is predicted to grow at a CAGR of 5.3% during the forecast period. This segment is mainly driven by acetone's wide applications in the industrial sector, where high purity is not critical. The suitability and cost-effectiveness of acetone have made it a solvent of choice for paints and coatings, adhesives, and cleaning products. Furthermore, technical-grade acetone is used significantly in plastic and synthetic fiber production.

The solvents segment was worth USD 2.7 billion in 2024, with a projected CAGR of 5.4% from 2025 to 2034. The primary use of acetone as a solvent in paints, coatings, adhesives, and cleaning products continues to power its dominance in the market. The automotive industry particularly uses acetone for vehicle refinishing and degreasing. Acetone finds important applications in pharmaceuticals and cosmetics, where it is used in drug formulation and beauty product manufacturing, such as nail polish removers.

Regional Insights

In 2024, the U.S. acetone market was valued at over USD 1.3 billion, and will

witness a 4% CAGR growth. The U.S. currently dominates the acetone market, owing to its vast-standing industrial infrastructure, coupled with large demand in critical sectors like automotive, pharmaceuticals, and cosmetics. Also, the U.S. is one of the largest acetone producers, aided by major innovations in bio-based acetone production. The promotion of sustainability and continued compliance with regulations ensure that it will remain a market leader. With the demand for automotive products and pharmaceuticals on the rise, the U.S. continues to play a key role in the global market.

Competitive Landscape

Some key players in the acetone market include ALTIVIA, Arkema, Cepsa Quimica, Honeywell International, INEOS, LyondellBasell Industries, Mitsui Chemicals, SABIC, Shell plc, Solvay, and The Dow Chemical Company. These companies contribute significantly to acetone production and innovation, especially by employing sustainable manufacturing processes.

Source: Global Market Insights

UNPRECEDENTED GROWTH OF GRAPHITE FUELED BY THE FUTURE OF ENERGY, TECHNOLOGY, AND SUSTAINABILITY



Graphite's Promising Journey in the Global Market

Graphite, once considered just a mundane material for pencils, has evolved into a critical commodity in numerous industries. Its unique properties, including high thermal conductivity, electrical conductivity, and flexibility, have made it a key player in the technology, energy, and manufacturing sectors. As demand continues to grow, the graphite market is poised for significant expansion. This article delves into the key aspects driving the growth of graphite, from market size projections to regional trends and future innovations.

According to Persistence Market Research, China accounted for about 70% of global natural graphite production in 2016 but is expected to lose market dominance as other countries increase supply. The growing demand from industries like electric vehicles, lithium-ion batteries, and nuclear reactors is driving graphite market growth. The electric vehicle sector alone is set to increase graphite demand by 200%. Additionally, graphite's role in the automotive industry and nuclear pebble bed reactors is expanding. However, a slowdown in the steel industry could impact graphite consumption. Overall, the market is growing, with China maintaining a significant share, but environmental factors and government policies may affect future growth.

Graphite's Role in Electric Vehicles and Battery Technologies

One of the most significant growth drivers for the graphite market is the booming electric vehicle (EV) industry. Graphite is a crucial component of lithium-ion batteries, which are integral to powering EVs. As the demand for EVs increases, so does the need for high-quality graphite for battery production. Furthermore, advancements in battery technology, including solid-state batteries, are expected to enhance the need for graphite in energy storage applications.

In addition to electric vehicles, graphite is also seeing significant demand in energy storage solutions such as grid-scale batteries, which are essential for the efficient storage of renewable energy. With global initiatives pushing for greener alternatives and sustainable energy sources, the demand for graphite in these sectors is expected to remain strong in the coming years.

Key Applications of Graphite in Industrial and Technological Sectors

Graphite's versatility extends far beyond the automotive and energy sectors. It is widely used in various industrial applications, including lubricants, crucibles, and refractories. In the steel industry, graphite is crucial for producing high-quality castings

and components due to its high melting point and ability to withstand intense heat.

In addition to traditional applications, graphite is now making waves in the technology sector. The rise of smartphones, smart devices, and wearables has spurred demand for graphite in the production of capacitors, conductors, and electrodes. Graphene, a single layer of graphite, is also a key material in the development of next-generation electronics, adding to the market's growing relevance in the tech world.

Geographical Trends: Leading Regions in Graphite Production

The graphite market is characterized by diverse regional dynamics, with certain countries emerging as leaders in production and consumption. China dominates the global graphite production scene, accounting for nearly 70% of the world's supply. This is attributed to the country's vast natural resources and strong manufacturing capabilities.

Other significant players in the graphite market include Brazil, India, and Canada. Brazil is known for its high-quality natural graphite, which is widely used in various industrial applications. India and Canada also contribute substantially to global graphite production, with a focus on both natural and synthetic graphite.

In recent years, several countries are looking to secure their graphite supply chains, recognizing its strategic importance in clean energy transitions and advanced technologies. As such, there is a growing push for exploration and development of graphite mining operations in various parts of the world, including Africa and Australia.

The Growing Demand for Synthetic Graphite

While natural graphite has traditionally dominated the market, synthetic graphite is gaining increasing traction. This is due to its higher purity levels and specific properties that make it ideal for applications requiring superior quality, such as in electric vehicle batteries and specialized electronic components.

Synthetic graphite is produced from petroleum coke and is mainly used in the production of anodes for lithium-ion batteries. As the demand for high-performance batteries continues to rise, synthetic graphite is poised to play a critical role in the supply chain, particularly for high-end applications in energy storage and electronics.

Sustainability and Environmental Impact of Graphite Production

As with many natural resources, graphite mining and production come with environmental considerations. Traditional mining methods can have significant environmental impacts, such as habitat disruption, water pollution, and carbon emissions.

To mitigate these effects, the graphite industry is increasingly adopting sustainable practices. The push for eco-friendly technologies has led to the development of cleaner mining techniques, more efficient processing methods, and recycling initiatives to reduce waste and energy consumption. Additionally, efforts are underway to find alternative sources of graphite, including recycling used batteries and repurposing industrial waste.

The rise of electric vehicles and renewable energy technologies has placed greater emphasis on the sustainability of graphite sourcing.

As governments and corporations aim for carbon neutrality, sustainable graphite production will be a key focus area in the coming years.

Innovation in Graphite: Advancements and Emerging Technologies

The graphite market is not only expanding due to increasing demand but also due to innovations in the material itself. One such advancement is the development of graphene, which has gained significant attention for its unique properties, including strength, flexibility, and conductivity. Graphene is being hailed as a revolutionary material for industries ranging from electronics to healthcare.

Researchers are also working on improving the efficiency of graphite in various applications. For instance, enhancing the performance of graphite in batteries is a key focus for scientists. Innovations in graphite production methods, including the use of advanced synthetic routes and recycling processes, are expected to reduce costs and make the material more accessible for widespread use.

Challenges and Opportunities in the Graphite Market

Despite its promising outlook, the graphite market faces several challenges. The reliance on a few key countries for production, particularly China, creates risks in terms of supply chain disruptions. Geopolitical tensions, trade disputes, and environmental regulations are factors that could impact global graphite supply.

However, these challenges also present opportunities for diversification and innovation in the graphite market. As demand continues to rise, new sources of supply will emerge, and technological advancements will improve production efficiency. Companies that can successfully navigate the complexities of the global graphite supply chain will find themselves well-positioned for future growth.

Conclusion: A Bright Future for Graphite in a Changing World

Graphite is no longer just a material used for pencils and lubricants. As industries evolve and technologies advance, the demand for graphite is set to rise dramatically. From electric vehicles and energy storage to electronics and sustainable production practices, graphite is playing a vital role in shaping the future of multiple industries.

As we move toward a more sustainable and technologically advanced world, graphite's importance will only continue to grow. The graphite market is entering an exciting phase, and companies that focus on innovation, sustainability, and securing diverse supply chains will thrive in the coming years.

With its numerous applications and the increasing focus on clean energy and advanced technologies, graphite is well-positioned for a bright future ahead.

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BALANCING ENERGY DEMAND AND SUSTAINABILITY IN BLACK DIAMOND

Coal is still one of the prime elements of the energy sector of India, largely influencing regional economies. In 2025, India's coal market is likely to produce 1.55 trillion kWh of electricity, at an annual rate of 4.83% from 2025 to 2029. The western region has the largest coal energy capacity, which amounts to nearly 75,000 megawatts, followed by the northern region with approximately 56,700 megawatts.

The industry has helped in the GDP growth and provides raw materials for industries, but its environmental impacts have devastated many communities. Coal-fired power plants are still one of the largest sources of pollution, with India recording PM_{2.5} concentrations of 50 µg/m³ in 2022, ten times higher than WHO recommendations. In addition, mining activities have contributed to land degradation, affecting nearly 30% of India's geographical area.

Market Analysis and Growth Trends

India's coal market is expected to reach 1.50 billion tons in 2030, with an estimated growth of 1.04 billion tons in 2025 at a CAGR of 7.57%. The demand is rising due to the increase in electricity demand, increased power generation capacity, and rapid industrial and infrastructural developments across the country. At the same time, government policies aiming to promote renewable energy may confront the growth of the market. Lignite resources remain an unexploited opportunity, mainly in Tamil Nadu, Rajasthan, and Gujarat. Tamil Nadu alone holds about 79% of India's lignite reserves, and increased mining activities in these states could provide substantial market opportunities.

Increasing Thermal Power Generation: A Key Market Driver

Coal remains the main source of fuel for India's thermal power plants, serving all industries, transport, and residential consumers. India is the world's second-largest coal producer, consuming most of the coal produced to generate electricity.

As per ministry data, by July 2023, India imported 87.97 million tonnes of coal that comprised total imports of 237.67 million tonnes of coal in 2022-23. The total



Image by maniacvector on Freepik

installed capacity for coal-based electricity generation stood at 205 GW in April 2023 and constituted 49.3% of the total installed capacity across the country. This high consumption of coal assumes importance in the present energy scenario of India.

Major projects in the pipeline include the Patratu Super Thermal Project in Jharkhand, with a generation capacity of 4,000 megawatts, and the Uppur Thermal Power Project in Tamil Nadu, set to add 1,600 megawatts by 2023. The latter project, developed by Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO), has an investment cost of USD 1.7 billion. These developments indicate that coal will remain a dominant energy source in the foreseeable future.

Government Policies and the Shift Towards Renewables

The Indian government has brought in many policies to boost renewable energy capacity, with the target of having 450 GW of installed capacity by 2030. It is due to the fact that coal-related air pollution and associated health risks were alarming. India reduced its imports of thermal coal by more than 5.5 million tons in 2024 compared with the previous year. However, the increased consumption of lower-grade domestic coal increases emissions, and it is posing a challenge to climate goals. The government is positive about having a coal trading exchange in 2025 to smoothen coal transactions and enhance market efficiency. Details are currently being finalized.

According to the International Renewable Energy Agency, India's renewable energy installed capacity reached 162.96 GW

in 2022, marking an annual growth rate of 10.8%. As a signatory to the Paris Climate Agreement, India has committed to achieving 40% of its electricity capacity from non-fossil fuel sources by 2030. As part of this goal, the country has set an ambitious target of installing 175 GW of renewable energy capacity by 2022 and 450 GW by 2030.

The MNRE has also introduced several schemes to facilitate this transition, such as the Solar Park Scheme, the 300 MW Defense Scheme, and the 500 MW Viability Gap Funding (VGF) Scheme. Although these schemes promote renewables, they also lead to a gradual decline in coal dependence, which may restrain market growth in the long term.

Major Players in the Indian Coal Market

The consolidated Indian coal market is where a group of few major companies produce, distribute, and generate a large amount of energy. A few of the key players in the Indian coal market are Adani Group, Coal India Limited (CIL), JSW Energy Ltd, NTPC Ltd, Jindal Steel & Power Ltd, etc.

Conclusion

Coal remains critical to India's energy security and economic growth. Amidst and alongside the expansion of India's coal-based power capacity, growing environmental concerns and policy shifts in favour of renewable energy are reshaping the market landscape. The sector walks a razor's edge balancing the rising demand for energy and the objectives of sustainability.

Source: Mordor Intelligence and Statista



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ADVANCING SUSTAINABLE CREATIONS WITH POWER OF GEN AI



Generative Artificial Intelligence (Gen AI) technology has made a significant impact on the cosmetic and personal care industry, transforming it in innovative ways. A recent collaboration between two major companies in this sector aims to leverage Gen AI for faster and more innovative research and development.

Leaders Redefining AI and Innovation

IBM and L'Oréal, the world's leading beauty company, announced a collaboration to leverage IBM's generative artificial intelligence (GenAI) technology and expertise to uncover new insights in cosmetic formulation data, facilitating L'Oréal's use of sustainable raw materials, for energy and material waste reductions.

This one-of-a-kind endeavor will create a unique AI foundation model designed to greatly boost L'Oréal Research & Innovation teams' capacity to achieve superior performance and customer satisfaction in every cosmetic category and worldwide. The formulation foundation approach, which redefines AI innovation at the nexus of beauty, chemistry, and technology, is thought to be the first of its type in the industry.

To unlock a future where science and technology can inform or help prioritize solutions that are both environmentally responsible and innovative, the partnership combines L'Oréal's unmatched expertise in cosmetic science with IBM's state-of-the-art artificial intelligence technologies for scientific discoveries. Investigating sustainable, sustainably sourced raw materials is essential when creating consumer goods to protect Earth's natural resources. By deriving most of its product formulae from bio-sourced ingredients and/or the circular economy by 2030, L'Oréal hopes to meet its L'Oréal for the Future goal.

AI Model Training on Key Formulation Datasets

The AI model will use many previous records of formulations and component data points to accelerate multiple tasks performed by the R&D team, including the formulation of new products, reformulation of existing cosmetics, and optimization for scale-up production, tools that will better equip L'Oréal's 4,000 researchers worldwide over the next several years.

The consulting team from IBM will support L'Oréal in its aim to redefine innovation strategies. Understanding the behaviors of renewable ingredients in cosmetic formulas will help L'Oréal build out more sustainable product lines with diversity and customization.

Such specialized models are a type of AI algorithms trained on a broad set of unlabelled data, capable of performing various tasks and applying information from one situation to another. These models have significantly advanced the field of natural language processing (NLP) technology over the past several years, and IBM is pioneering applications of foundation models beyond language, in areas such as chemistry, time series, and geospatial modalities.

IBM's AI technology has the potential to augment L'Oréal's creativity in finding new cosmetic formulations to transform the beauty industry. L'Oréal, together with IBM's expertise and technology, will craft sustainable, delivering products that will be as unique as the people who use them daily.

Words form leaders in the integration of AI and Cosmetic

"As part of our Digital Transformation Program, this partnership will extend the speed and scale of our innovation and reformulation pipeline, with products always reaching higher standards of inclusivity, sustainability, and personalization", declared Stéphane Ortiz, Head of Innovation Métiers & Product Development, L'Oréal Research & Innovation.

"Building on years of unique Beauty science expertise and of data structuring, this major alliance with IBM is opening a new exciting era for our innovation and development process", said Matthieu

Cassier, Chief Transformation & Digital Officer, L'Oréal Research & Innovation.

"This collaboration is a truly impactful application of generative AI, leveraging the power of technology and expertise for the good of the planet. At IBM, we believe in the power of purpose-built, customized AI to help transform businesses. Using IBM's latest AI technology, L'Oréal will be able to derive meaningful insights from their rich formula and product data to create a tailored AI model to help achieve their operational goals and continue creating high-quality and sustainable products," said Alessandro Curioni, IBM Fellow, Vice President Europe and Africa and Director IBM Research Zurich.

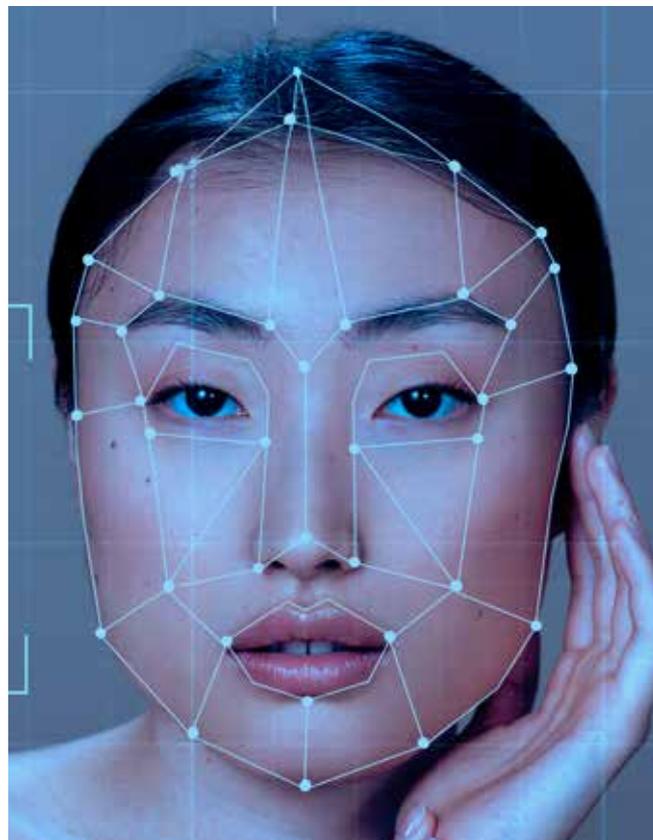
"This alliance between highly specialized expertise in artificial intelligence and cosmetics seeks to revolutionize cosmetic formulation. It embodies the spirit of AI-augmented research, emphasizing sustainability and diversity", declared Guillaume Leroy-Méline, IBM Distinguished Engineer, Business Transformation Services CTO, IBM Consulting France.

Such ambitious innovations and the interconnectivity of companies represent a significant step toward addressing the current climate and resource crisis. The collaboration between these leaders in their respective fields demonstrates the potential for integrating quality standards along with a commitment to transparency and responsibility.

Source:

IBM and L'Oréal to Build First AI Model to Advance the Creation of Sustainable Cosmetics. (2025, January 16). IBM Newsroom.

<https://newsroom.ibm.com/2025-01-16-ibm-and-loreal-to-build-first-ai-model-to-advance-the-creation-of-sustainable-cosmetics>



TAPPING SOLAR POWER FOR GREEN HYDROGEN PRODUCTION



Image by Oleksandr Ryzhkov on Freepik

Flinders University, in collaboration with researchers from South Australia, the US, and Germany, has made a breakthrough in green hydrogen production. The team has discovered a new solar cell process that could play a key role in creating green hydrogen using solar power. The process, featured in their study published in *The Journal of Physical Chemistry C*, explores the potential of using a new “core and shell Sn(II)-perovskite” oxide solar material for efficient water splitting. This could be a game-changer for producing pollution-free hydrogen, a crucial step toward sustainable energy.

The innovative solar material is combined with a catalyst - developed by Professor Paul Maggard’s US team - to split water into hydrogen and oxygen in this study. This catalyst could possibly help oxygen evolution reaction; one of the most essential steps for green hydrogen. Based on these results, it is suggested that this new material might improve stability and performance of water-splitting technologies, essential for carbon-free hydrogen production.

Lead author Professor Gunther Andersson from the Flinders Institute for Nanoscale Science and Technology explains, “This latest study is an important step forward in understanding how these tin compounds can be stabilised and effective in water.” The new material absorbs a wide range of sunlight energy, which can help power reactions that produce fuel. Professor Paul Maggard adds, “Our reported material points to a novel chemical strategy

for absorbing the broad energy range of sunlight and using it to drive fuel-producing reactions.”

While compounds of tin and oxygen have already been used in catalysis, for medical images, their reactivity with water and oxygen has so far restricted the application. This research finds a barrier overhanging it-it could open up broader applications in green hydrogen production.

The focus of research in solar energy globally is on developing cost-effective and high-performance systems to replace traditional silicon-based panels. One of the goals is to produce low-emission hydrogen from water using solar power. Hydrogen can be generated through electrolysis, a process that splits water into hydrogen and oxygen using electricity, or through thermochemical splitting, powered by concentrated solar energy or waste heat from nuclear reactors.

This new study builds on previous work by Professor Maggard, now based at Baylor University. The article, “Chemical and Valence Electron Structure of the Core and Shell of Sn(II)-Perovskite Oxide Nanoshells” (2024), highlights the work of Flinders University and University of Adelaide experts, including Professor Greg Metha, who is also exploring photocatalytic technologies for hydrogen production.

Source: Flinders University. (2024, December 23). Solar step forward for green hydrogen. News.

REARRANGING WASTE PLASTIC STRUCTURE INTO HIGHER-PERFORMANCE MATERIALS



Credit: Adam Malin/ORNL, U.S. Dept. of Energy

Scientists at the Department of Energy's Oak Ridge National Laboratory (ORNL) developed a procedure for "upcycling" discarded plastics into higher-performance materials. In doing so, they edited polymers in these waste plastics to create new macromolecules with valuable properties more valuable than the original materials. This single innovation might mark one huge step in solving the gigantic problem of plastic waste because about 450 million tons of plastic are discarded worldwide every year, and most of it is not recycled.

The method developed by the ORNL team involves a rearrangement of polymer building blocks, which constitute the chains in plastics, thereby customizing properties. This reorganization may alter the strength or heat resistance in one case, flexibility in another, and much more depending upon the application at hand. Like other groundbreaking chemical processes, it is akin to the Nobel prize-winning CRISPR technology which edits DNA strands.

"This is CRISPR for editing polymers," said Jeffrey Foster, the lead researcher at ORNL. "However, instead of editing DNA, we are editing polymer chains. This isn't the typical plastic recycling 'melt and hope for the best' scenario." The team worked on common waste plastics, such as polybutadiene, found in rubber tires, and acrylonitrile butadiene styrene (ABS), used in products like toys, keyboards, and kitchen appliances.

The team's approach addresses a major issue in plastic recycling: most discarded plastics are not recycled efficiently. "This is a waste stream that's not recycled at all," said Foster. "We're addressing a significant component of the waste stream with this technology, which could have a big impact on conservation of materials."

First, the scientists dissolve the waste plastics in a solvent and, through the addition of a ruthenium catalyst, induce

polymerization—a chemical process that joins polymer subunits together—to make valuable additives control the material's properties. In addition, it has been noticed that this process consumes less energy and is conducted at lower temperatures compared to conventional recycling, therefore having a smaller footprint in terms of emissions.

The team's method also has a high "atom economy," meaning nearly all the material used in the process is recovered. This contrasts with traditional recycling, where polymers often degrade with each reuse, making them less useful. The ORNL process preserves and enhances the properties of the polymers, allowing them to produce stronger and more flexible plastics.

Foster's team now works on further scaling up of the process aiming to extend its application to such challenging types as thermosets, including especially epoxy resins and vulcanized rubber—the most difficult among plastics to be recycled because they have a tightly cross-linked structure of molecules that is hard to break.

"This concept could be extended to any polymer that has some sort of backbone functional group to react with," Foster explained. If successful, this method could significantly reduce the environmental impact of plastic waste and help create a more sustainable circular economy, where materials are reused instead of discarded.

The researchers also plan to explore more sustainable solvents for industrial applications and optimize the process to ensure its environmental friendliness.

Source: Polymer editing can upcycle waste into higher-performance plastics | ORNL. (2025, January 17).

NEW COATING ENHANCES LITHIUM-ION BATTERY PERFORMANCE



El Kazzi developed a process that converts the climate-damaging trifluoromethane gas into a protective coating for high-voltage batteries to improve their performance. © Paul Scherrer Institute PSI/Mahir Dzambegovic

A research team at the Paul Scherrer Institute (PSI) in Switzerland has developed a sustainable method to improve the electrochemical performance of lithium-ion batteries. This new process could significantly enhance the efficiency of batteries used in electric vehicles and other applications. The findings were published in *ChemSusChem*, showcasing the potential of this breakthrough in increasing battery performance.

Lithium-ion batteries are central to efforts in decarbonization and global researchers are working to improve their capabilities, especially in energy density, through increasing the operating voltage of a battery. As Mario El Kazzi from the PSI Center for Energy and Environmental Sciences explains, “If the voltage increases, the energy density also increases.” But when it surpasses 4.3 volts, “there are huge degradation processes in the cathode-electrolyte interface” that damage the cathode material and lead to reduced battery performance with time.

To solve this problem, El Kazzi and his team came up with a solution by coating the cathode with a thin, uniform protective layer. This new method stabilizes the surface of the cathode, preventing damage from oxygen release, dissolution of metals, and other harmful reactions. The experiments conducted by the team showed that with this protective coating, the battery could operate at voltages up to 4.8 volts without degradation.

The method uses a byproduct in the production of plastics, trifluoromethane gas, CHF₃. In laboratory experiments, the researchers contacted the surface of the cathode with lithium carbonate and CHF₃ at 300°C, which reacted and led to the displacement of lithium at the interface by LiF with the formation of a protective layer. Most importantly, the lithium ions within the

cathode are not extracted and can move freely between cathode and anode during charging and discharging cycles and therefore maintain the capacity of the battery.

The protective coating was tested in electrochemical experiments, and the results were promising. Batteries with coated cathodes performed significantly better than those with untreated cathodes. The impedance, or resistance, at the cathode interface was about 30% lower after 100 charge-discharge cycles. “This is a clear sign that our protective layer minimises the increase in resistance caused by the interfacial reactions,” said El Kazzi. Additionally, the coated batteries retained more capacity, with over 94% of capacity retention after 100 cycles, compared to only 80% for unprotected batteries.

This coating process not only improves battery performance but also offers a potential solution to climate concerns. Trifluoromethane is a potent greenhouse gas, significantly more harmful than carbon dioxide. By converting this gas into a valuable protective layer, the PSI team has found a way to recycle CHF₃, reducing its environmental impact and contributing to a circular economy. El Kazzi noted, “Converting CHF₃ into a LiF protective layer is an efficient solution to monetise the gas.”

This new protective coating shows great promise for enhancing the energy density of various battery types, including nickel- and lithium-rich high-voltage batteries. The universal nature of the coating could make it a crucial development in the future of battery technology.

Source: Lorenz-Meyer, A. (2025, January 6). New protective coating can improve battery performance. PSI.

RESEARCHERS DEVELOP REUSABLE AND BIODEGRADABLE SUPERGLUE ALTERNATIVE



Researchers at Colorado State University (CSU) have developed a new adhesive polymer that is not only stronger than current commercial superglues but also biodegradable and reusable. The findings, published in *Science*, reveal how the naturally occurring polymer poly(3-hydroxybutyrate) (P3HB) can be re-engineered to create a more sustainable bonding agent. This innovation offers a potential solution to the global plastic waste problem, as adhesives are widely used in industries such as automotive, packaging, electronics, and construction, contributing significantly to plastic pollution.

The P3HB is a natural, biobased polymer that microbes produce under certain conditions. Initially, it was not adhesive; however, the research team led by University Distinguished Professor Eugene Chen was able to discover how to chemically alter the structure and thereby transform it into a kind of strong adhesive. When compared with traditional petroleum-based adhesives, the re-engineered P3HB easily outperforms in strength when used to bond on common materials such as aluminum, glass, and wood. Additionally, the adhesive's strength can be adjusted to meet different application needs.

This research falls into Chen's overall work toward making biodegradable, chemically recyclable, and sustainable substitutes for the more conventional plastics. According to him, "oil-based adhesives, like Gorilla Glue or J-B Weld, are almost impossible to recover as they tend to bond well to materials; conversely, P3HB gives the same bonding strength with some even superior in strength yet can be easily degraded and widely applicable in any field."

Ph.D. student Ethan Quinn and postdoctoral researcher Zhen Zhang were key contributors to the study, focusing on the creation and testing of the new material. They developed a sample P3HB glue stick and tested its effectiveness using a commercially available glue gun to seal cardboard boxes. "We were able to show that it far outperforms typical hot-melt adhesives, holding up to 20 pounds compared to 15 pounds for existing options," Quinn said.

Biodegradability is one of the large advantages with P3HB. In contrast, conventional adhesives can remain in place for decades before breaking down in the environment. In contrast, P3HB, under different conditions such as landfills, salty ocean water, and soils, will break down naturally. Thus, this adhesive can be allowed to decompose without harmful residue. Besides, the P3HB adhesive can be recovered, reprocessed, and reused, thereby making it even more sustainable.

The research team at CSU, in collaboration with the National Renewable Energy Laboratory (NREL), is now focusing on commercializing the polymer to make it widely available. Professor Chen mentioned that they are working on ways to reduce production costs and improve environmental impacts as part of their efforts to scale up production. With ongoing support from the Department of Energy's BOTTLE Consortium, this breakthrough could significantly change the future of adhesives.

Source: Rhoten, J. (2025, January 16). Research shows potential replacement for common adhesives that is reusable, biodegradable. College of Natural Sciences.

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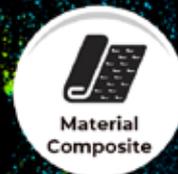
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INNOVATING PFAS REMOVAL: RESINS ENGINEERED FOR PRECISION AND EFFICIENCY

Purification of PFAS (per- and polyfluoroalkyl substances) contaminated water is a global challenge for both producers and end-users. Efficient and cost-effective processes are required to remove PFAS from groundwater, surface water, and wastewater flows. The use of PFAS selective ion exchange resins enables this kind of decontamination in technologically sophisticated processes that can be applied on a large scale. It ensures PFAS removal down to the limit of detection in the ppt range.

The Challenge

PFAS: This is a group of critical additives for the sustainable energy transition e.g. used in lithium-ion batteries, fuel cells, and solar panels. Since the 1950s it was applied in fire-extinguishing foams, as an impregnation agent for textiles and paper, and in lubricants. PFAS are “persistent chemicals” that do not decompose in the environment and therefore accumulate over time.

To counter this, many countries have set strict concentration limits for waste, ground, and drinking water. To meet these standards, powerful remediation technologies are needed.

They 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 of properties – for instance, molecular mass, 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.

Ion Exchange: A Highly Configurable Solution

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. Notably, 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 percent compared with activated carbon filtration is

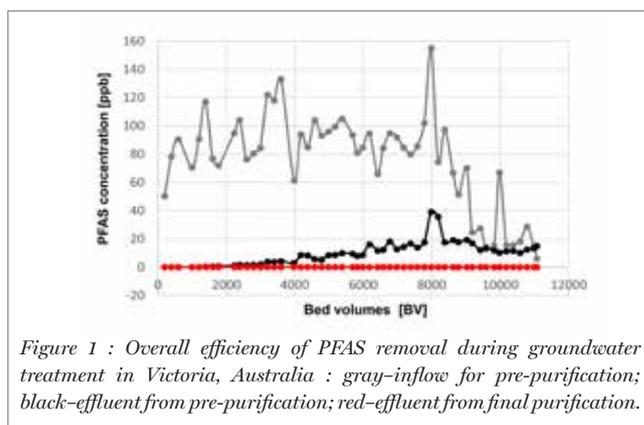


Figure 1 : Overall efficiency of PFAS removal during groundwater treatment in Victoria, Australia : gray–inflow for pre-purification; black–effluent from pre-purification; red–effluent from final purification.

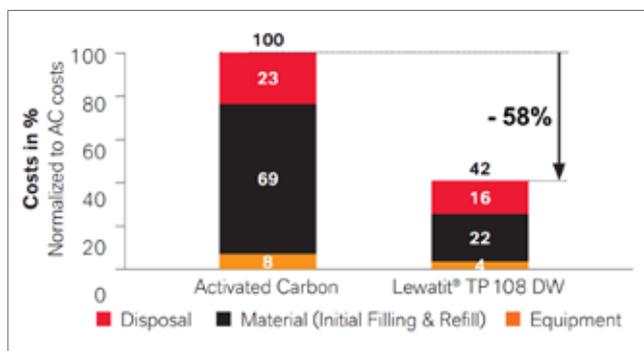


Figure 2 : Comparison of total costs (orange – equipment investment; black – filter material over five years; red – disposal) for the use of activated carbon and IEX (Lewatit® TP 108 DW) for removal of perfluoroheptanoic acid (PFHpA) from extinguishing water; mobile unit for approximately 275 m3/d.

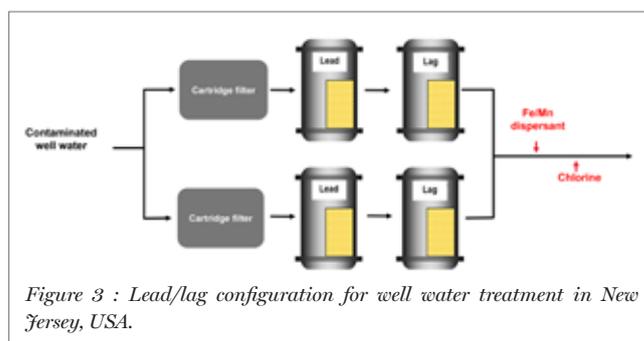


Figure 3 : Lead/lag configuration for well water treatment in New Jersey, USA.

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.

Further economic advantages of IEX resins could arise if these resins are regenerated and PFAS in the regeneration 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% aqueous methanol with the addition of 1% 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. For instance, groundwater is successfully 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 (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.

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 drinking water requirements.

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.

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) with significantly longer cycle time compared to competitor resin and GAC.

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, hydrophobic interactions of the aromatic polymer backbone can occur with the non-polar, fluoridated PFAS “tail” (Figure 5).

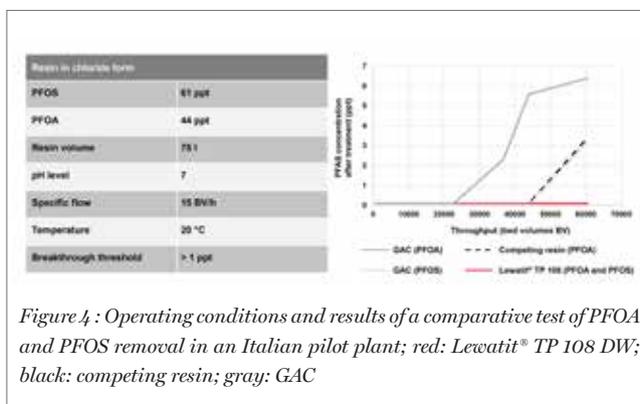


Figure 4: Operating conditions and results of a comparative test of PFOA and PFOS removal in an Italian pilot plant; red: Lewatit® TP 108 DW; black: competing resin; gray: GAC

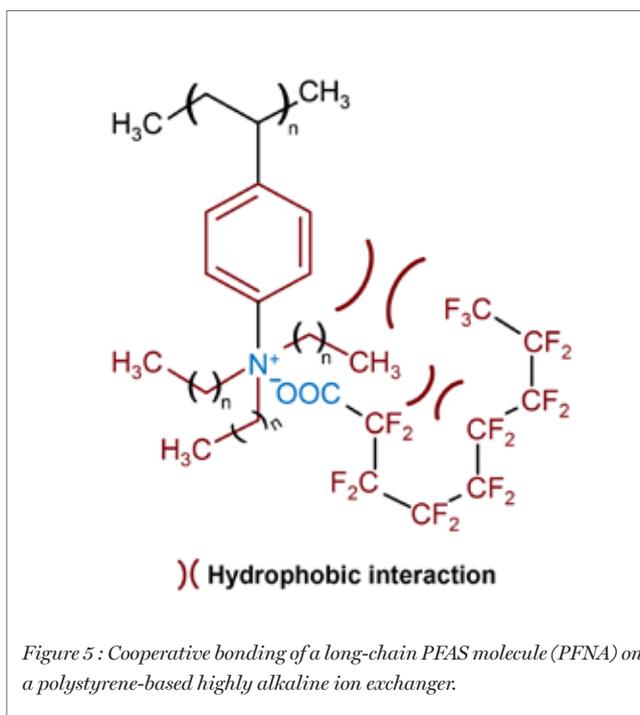


Figure 5: Cooperative bonding of a long-chain PFAS molecule (PFNA) on a polystyrene-based highly alkaline ion exchanger.

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).

In particular, short-chain PFAS are inadequately adsorbed to GAC and are easily displaced again. With IEX resins it is possible to use both strong and weak base anion 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 14.5 g/l for perfluorobutanoic acid (PFBA).

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PFAS FREE DISPERSION FOR FLOOR CARE MARKET

ECO-SHIELD™ NF100 dispersion for use in the floor care market. ECO-SHIELD™ NF100 is an innovative dispersion designed to replace PFAS-based wetting aids in floor finish products and promote leveling and uniform film formation on hard-to-wet surfaces including low-surface-energy substrates and contaminated surfaces. The Barentz Technical Team has spent three years developing this essential ingredient for the market. After extensive laboratory and market testing, Barentz is now prepared to introduce this PFAS alternative to the floor care industry. It is a low viscosity wetting and leveling agent that acts as an interfacial tension modifier, reducing surface tension. When added to a coating formulation ECO-SHIELD™ NF100 enables the coating to more uniformly wet out a variety of surfaces -including low-surface-energy substrates, surfaces with defects, and dirty surfaces. ECO-SHIELD™ NF100 has been pre-approved for EPA's Safer Choice program. It is free of APEO's, and phosphates and is low VOC. This additive enables the development of sustainable formulations without compromising performance.



Barentz

GREEN-COLORED POLYPROPYLENE SOLUTION FOR HOT AND COLD PIPE APPLICATIONS

SABIC's green-colored VESTOLEN P9421 grade offers enhanced properties at high pressures and temperatures with improved durability and reliability. It has high thermal stability and is specifically formulated for high heat-resistance performance. The grade's long service life makes it the material of choice for manufacturing cold and hot water pipes and fittings for transporting drinking water. The new polypropylene material is a tailored compounded solution that meets specific pipe application requirements, fulfills the market needs in domestic piping systems, and ensures a combination of quality, versatility, and durability, making it a preferred choice for a variety of pipe applications. The commercially available SABIC green-colored VESTOLEN P9421 grade has gone through multiple rigorous tests and has been demonstrated in final applications with different value-chain partners in Saudi Arabia.



SABIC

THERMALLY CONDUCTIVE EPOXY ADHESIVES

EP53TC is a two-component epoxy designed for bonding, sealing, coating, and small potting applications where efficient heat dissipation is essential. This advanced epoxy is formulated with a specialized filler, ranging from 5 to 30 microns in particle size. With a mixed viscosity of 45,000-65,000 cps at room temperature, this flowable system can fill small voids, making it ideal for heat dissipation applications. EP53TC complies with ASTM E595 NASA low outgassing requirements and provides reliable electrical insulation with a volume resistivity exceeding 1014 ohm-cm. The material boasts a thermal resistance of 10-15 x 10⁻⁶ K•m²/W and a thermal conductivity of 2.3-2.6 W/(m•K). It also features dimensional stability with minimal shrinkage during curing and a low coefficient of thermal expansion of 14-16 x 10⁻⁶ in/in/°C. Mechanical properties include a tensile strength between 5,000 and 7,000 psi, a tensile modulus greater than 1,000,000 psi, and a Shore D hardness of 85-95. Its service temperature range spans from -100°F to +300°F (-73°C to +149°C). A moderate heat cure is required to achieve the full range of properties for EP53TC. The recommended cure schedule is 2 hours at 80°C followed by a post-cure at 125°C for 90-120 minutes.



Master Bond

ADVANCED LIGHT CURE ADHESIVES FOR MEDICAL DEVICES

The medical device industry is under increasing regulatory scrutiny regarding the use of PVC materials containing Di(2-ethylhexyl) Phthalate (DEHP), a known endocrine disruptor. In response, regulatory bodies such as the FDA's Center for Devices and Radiological Health and the EU Medical Device Regulation (MDR) 2017 have pushed for minimizing DEHP exposure, prompting manufacturers to shift toward alternative flexible materials like thermoplastic elastomers (TPEs). However, the adoption of TPEs presents unique assembly challenges since traditional methods such as solvent welding and existing adhesives often fail to provide the required bonding strength. Henkel introduces two advanced light cure adhesives: Loctite AA 3952 and Loctite SI 5057. These adhesives are specifically formulated to bond TPE substrates effectively, overcoming the limitations of conventional bonding techniques. Loctite AA 3952 and Loctite SI 5057 provide enhanced bonding performance by ensuring strong and durable adhesion to TPE-S and TPE-O materials, which are commonly used in medical devices. They offer excellent resistance to environmental factors, maintaining high performance even under prolonged heat and humidity aging conditions.



Henkel

NO PFAS INTERNALLY LUBRICATED COMPOUNDS FOR HEALTHCARE APPLICATIONS

The EcoLube™ MD range of PFAS-free internally lubricating compounds was introduced by Americhem, Inc. especially for use in medical devices and other healthcare applications. Building on the success of Americhem's 2024 EcoLube™ launch, EcoLube™ MD provides a number of benefits for medical applications. The vital demand for efficient wear and friction reduction is met by EcoLube™ MD, a sustainable, non-PFAS solution. Without the use of PFAS components, EcoLube™ MD pre-lubricated engineered compounds and alloys are made to assist manufacturers in lowering the coefficient of friction for plastic-on-plastic and plastic-on-metal applications, reducing noise during operation, and reducing wear and friction of moving plastic parts. Syringe pumps, prosthesis, surgical robots, minimally invasive surgical instruments, and more are examples of end-use applications. By breaking down the barriers of traditional lubrication, EcoLube™ ushers in a new era of integrated performance. This ground-breaking technology provides long-lasting lubrication from within by integrating functional additives that have been precisely formulated into the material. Numerous functional additives address particular uses, creating a flexible EcoLube™ product portfolio that may address a broad range of lubricating issues. AEC's strict Process Change Management commitments, locked formulation promise, and EcoLube™ MD biocompatibility testing and medical certification compliance make it a simple choice for a range of medical applications.



EcoLube™

TEXTURE ADDITIVE FOR POWDER COATINGS

The most recent addition to Micro Powders' line of PTFE substitutes is MicroTex® 950, a texture enhancer for powder coatings. For high-performance, safe, and compliant powder coatings, MicroTex® 950 is the answer. Like PTFE texturizers, this new component offers consistent fine texturing and can reduce gloss by one digit. In chemistries such as polyester/TGIC, polyester/HAA, and polyester/epoxy, early field testing has demonstrated successful outcomes. These additives are frequently less expensive than their PTFE-containing counterparts and function just as well or better. This choice demonstrates the company's commitment to offering state-of-the-art additive technology that complies with international environmental, health, and safety standards and is consistent with its core values.



Micro Powders, Inc



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TRANSFORMING CHEMICAL PROCESSING WITH INNOVATIVE DISTILLATION SOLUTIONS: POPE SCIENTIFIC

The chemical processing industry is transforming. Sustainability, efficiency, and evolving market demands are changing the way chemical processing industries are managed. How do companies handle supply chain disruptions, scale up production without hiccups, and integrate AI for smarter processing?

Here's an exclusive interview with Dean Segal, VP of Sales & Marketing, Pope Scientific, Inc. on optimizing distillation, enhancing refining processes, and future-proofing operations.

Global Equipment Market Variables and Growth

The Global Chemical Processing Equipment market is currently valued at ~USD 65 B and is expected to reach ~USD 104B by 2032. This huge globally diverse market finds its utility in each industry, can be difficult to break into a singular granularity of only the Oil & Gas, Fuels, and Lubricants market. This industry's processing equipment market depends on many dynamic variables. Global politics, sourcing, embargos, tariffs, and wars hinder growth. The market's evolution includes increased skewness towards chemical processing applications such as electronics, electric storage, pharma, foods, agriculture, biofuels, biomaterials, and recycling.

Addressing Technical Challenges with Efficient Machinery

A common challenge in the lubricant, fuels, and petrochemical industry is the separation and purification of complex mixtures. Newly manufactured fuels and lubes, synthetic or bio-based, are heat-sensitive and degrade under conventional methods.

Pope's Wiped Film Stills are designed for processing heat-sensitive, high molecular weight, and boiling point compounds efficiently with little or no degradation resulting in significantly improved processing and quality. The hybrid series wiped film-fractional column distillation systems are designed to handle heat-sensitive materials with close boiling point components, allowing increased separation with greater purity and yield.

Short Case Study of Innovation

A supplier of specialty Fluorosilicone lubricants for aerospace applications needed to devolatilize and remove unreacted monomers to near undetectable levels. All attempts at doing so resulted in unacceptable amounts of thermal degradation of the target product.

Upon contacting Pope Scientific, trials were run on Pope's lab scale Wiped Film Molecular Short Path Stills leading to zero degradation, untraceable light contaminants, and excellent purity and yield. Pilot trials and distillation toll processing were carried out, followed by the customer's procurement of a modular turnkey processing skid. They found that this distillation system provided similar results for their other silicone polymer products, including the removal of undesired cyclic components.

Lab-to-Plant Scale Transformations

Lab Scale trials do miss some factors that do not pertain to small scale and are of utmost importance while scaling up. Heat transfer, mass balance, physical behavior, volume-to-surface area



Dean Segal, VP of Sales & Marketing, Pope Scientific, Inc.

ratio change, and energy calculations are few of the key factors that need to be pre-estimated for an efficient and safe scale-up. Proper physical and chemical change estimation is paramount as it optimizes production, product quality, investment, and profitability.

The company designs state-of-the-art turnkey pilot plant skid modules to ensure that results from small-scale setups provide meaningful scale-up information that is consistent and predictable for the correct sizing of high-investment capital production installations. Pope's pilot plants utilize stainless steel units of a size and design that act very similarly to much larger scale systems and provide data that is linear to evaporator surface area, thus sizing and procuring the production equipment to match throughput requirements is accurate.



Pope Scientific Turnkey Wiped-Film Molecular Distillation System with Degassing Stage for Specialty Synthetic Lubricant Final Purification.

Optimizing Efficiency with AI

In multi-stage system processing, there are multiple choices for sequencing and mass-balancing strategies. AI can play a role in production optimization, along with piloting and processing modification. In addition, by leveraging machine learning algorithms, processors can gain a deeper understanding of distillation processes, enabling real-time adjustments, and continuous improvement in operations including maintenance for reduced downtime.

Equipment to Facilitate Sustainability

Re-refining of used lubricants and bio-based fuels has seen a pragmatic rise and interest globally due to rising environmental regulations. Technologies such as vacuum distillation and molecular distillation are instrumental in purifying reclaimed base oils, contributing to waste reduction and energy efficiency. Pope Scientific is committed to supporting these initiatives by providing equipment that facilitates sustainable processing practices, thereby aiding our clients in achieving their net-zero and waste-reduction targets.

Helping Businesses Stay Productive Despite Supply Chain Challenges

Pope Scientific offers processors flexibility in managing their operations, helping them navigate supply chain disruptions effectively. Its toll-processing services allow companies to outsource distillation and purification processes without the immediate need for capital investment in equipment, ensuring continuous production despite supply chain constraints. For those looking to bring processes in-house, the scalable distillation equipment—ranging from lab and pilot-scale systems to large industrial-scale units—gives companies greater control over their production.

Pope's laboratory-size distillation systems enable processors to help develop new and improved products at liter scale, before pilot scale trials. By investing in larger-volume distillation systems, processors can increase throughput, meet growing demand, and reduce reliance on third-party suppliers for purified products. Additionally, our modular turnkey systems are designed for quick deployment and easy integration into existing production lines, minimizing downtime and improving adaptability in response to market fluctuations. With Pope Scientific's solutions, refiners and petrochemical processors can enhance operational resilience and maintain production efficiency despite global supply chain challenges.

Outlook on Important Advanced Processing

Recycling Technologies are on the rise given the crucial role of minimizing environmental impact by developing eco-friendly, biodegradable lubricants and adopting processes that minimize environmental impact. Biobased methods for processing fuels and lubricants will showcase growth at a faster rate than petrochemicals-based methods, especially for South America, Africa, Asia, and Oceania regions.

Natural resources and climate significantly influence the modernization of lubricant and fuel refining processes, with distillation being crucial. Key components include fermentation, conversion, and separation, where distillation often plays a final role. As new products contain larger and more complex molecules, careful processing is essential, especially in thermal operations like distillation. With over fifty years of experience in distilling heat-sensitive materials, Pope is equipped to support customers from concept to commercialization.

HIGH-SPEED TUBULAR BOWL CENTRIFUGE: A COMPLETE OVERVIEW

Equipment designing in industries like biotechnology, pharmaceuticals, food and beverages, and chemical processing is quite complex and challenging. Effective separation of a mixture containing fine particles or immiscible liquids requires sophisticated pieces of equipment; Sharpplex's High-Speed Tubular Bowl Centrifuge has been designed to solve such technical challenges.

Components

- **Tubular Bowl:** The core component of the centrifuge is the tubular bowl, a long, cylindrical chamber typically made from stainless steel or other high-strength, corrosion-resistant materials. The tubular bowl is designed to rotate at extremely high speeds, creating a strong centrifugal force. For easy removal of the bowl, open-door construction can be provided.
- **Inlet and Outlet Ports:** The centrifuge is equipped with an inlet port where the mixture to be separated is introduced into the tubular bowl. There are also outlet ports for the separated phases, typically one for the clarified liquid and another for the denser phase or solid particles. In case of clarification, suspended solids are separated on the wall of the bowl, and clarified liquid comes out from the outlet.
- **Drive System:** The drive system includes the electric motor, belts, and pulleys that power the rotor. This system is engineered to deliver the high rotational speeds necessary for effective separation.
- **Bearing and Suspension System:** To ensure smooth and stable operation, the centrifuge is equipped with high-quality bearings and a suspension system that minimizes vibration and noise. This system also helps to extend the lifespan of the equipment by reducing wear and tear. Bearing assembly is self-lubricated and grease packed.
- **Control Panel:** An integrated control panel allows operators to manage and monitor the centrifuge's operations. This panel includes controls for adjusting the rotational speed, monitoring system performance, and setting operational parameters.
- **Safety Features:** High-speed tubular bowl centrifuges are equipped with several safety features, including automatic shutoff mechanisms, vibration sensors, and protective enclosures to ensure safe operation at high speeds.

Functionality

The separation process starts when the mixture is loaded into the tubular bowl through the inlet port. This mixture can consist of a liquid-liquid, liquid-solid, or a combination of phases. Once the process starts, temperature heating or cooling coils can be installed around the bowl. As the rotor spins the tubular bowl at high speeds, the centrifugal force generated pushes the denser components of the mixture outward toward the walls of the bowl. The lighter components form a separate layer closer to the center of the bowl.

This creates distinct layers in the mixture based on density. For example, in a liquid-liquid separation, the heavier liquid will be forced to the outer edge, while the lighter liquid will remain closer to the center. Post-separation, the distinct phases are continuously discharged through their respective outlet ports. The clarified liquid is typically collected in a designated container.

One of the key advantages of tubular bowl centrifuges is their ability to function in continuous operation mode, making them



highly efficient for large-scale industrial processing. Unlike batch systems, these centrifuges do not require frequent shutdowns, ensuring seamless workflow and higher productivity.

Applications

- **Biotechnology and Pharmaceuticals:** Purification of biological products such as separation of cells, protein, and other biomolecules from fermentation broths or cell culture media.
- **Food and Beverage:** Clarifying fruit juices, separating cream for milk, and extracting essential oils from plant materials.
- **Chemical Processing:** Separate fine particles from liquids, purify chemical solutions, and recover valuable components from waste streams.

Advantages

These centrifuges offer several benefits, making them a preferred choice for industrial separation processes:

High Separation Efficiency: The intense centrifugal force generated by the high rotational speeds allows for the efficient separation of the particles and immiscible liquids, resulting in high-purity outputs.

- **Continuous Operation:** The ability to operate continuously makes high-speed tubular bowl centrifuges ideal for large-scale industrial processes, reducing downtime and increasing productivity for liquid-liquid separation.
- **Versatility:** Suitable for a wide range of mixtures and are adaptable to various applications.
- **Compact Design:** Suitable for installation in facilities with limited space.
- **Low Maintenance:** Durable construction and high-quality components, reduce frequent maintenance, operational costs, and downtime.

In summary, high-speed tubular bowl centrifuges are essential tools for achieving efficient and effective separation of mixtures in various industrial applications. Their ability to handle continuous operation, coupled with high separation efficiency, makes them invaluable in processes requiring the purification, clarification, or concentration of different phases.

Courtesy: Sharpplex Filters (India) Pvt. Ltd.

Efficient Catalyst/Carbon Filtration in Pharma / Chemical Industries



Pulse Jet Candle Filter

(Self Cleaning Type)



- **M**aximum recovery of Platinum/ Palladium/ Raney Nickel Catalyst.
- **H**ermetically sealed filter and hence No loss of solvent.
- **W**ashing of cake is very effective due to uniform cake thickness formed on candles.
- **C**ake can be removed by back washing or back blowing in slurry or dry form.
- **N**o manual handling at all.
- **C**ake can be taken directly to autoclave from filter in closed circuit hence no loss of catalyst.
- **F**ilter media is cleaned every time you back wash the filter.
- **N**o bearings, no rotating parts.
- **V**ery high flow rates.



AN ISO 9001:2015 COMPANY

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CE



OIL-FREE AND SILENT SCROLL PUMPS FOR CLEAN WORKING ENVIRONMENTS

For applications needing more pumping capacity, the Agilent IDP-35 and IDP-45 dry scroll pumps are made to offer silent, effective, oil-free, and worry-free vacuum solutions. The new IDP-35 and IDP-45 pumps provide clients with several significant advantages that are in line with the high standards of existing Agilent IDP scroll pumps. They ensure a cleaner working environment and remove the possibility of contamination and oil leaks because they are oil-free and run silently. Furthermore, it requires little, easy, and infrequent maintenance—only every two to three years. Additionally, these new Agilent pumps offer a more environmentally friendly option than oil-sealed pumps, which were previously the sole choice at these higher pump speeds. Because of the energy-efficient pumps, hazardous waste disposal and dangerous oil emissions are no longer necessary. Agilent's dedication to sustainability and offering eco-friendly solutions is in line with this. Notably, new intelligent features that improve convenience and control are included with the IDP-35 and IDP-45 pumps.



Agilent Technologies Inc.

PRECISE TAP DENSITY MEASUREMENT FOR INDUSTRIAL APPLICATIONS

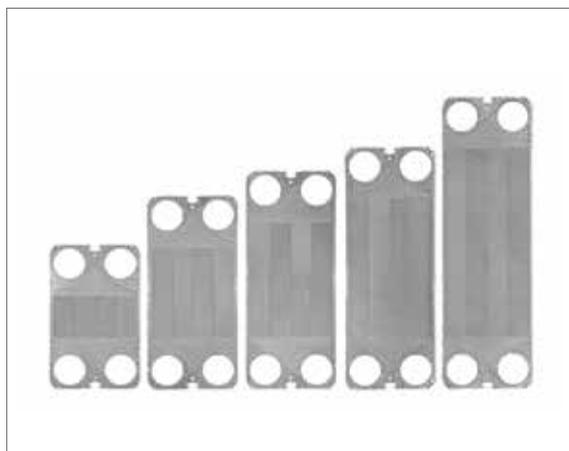
New benchmarks in tap density measurement are set by Anton Paar's Ultratap 500 and Ultratap 500 Twin. The new Ultratap 500 series is perfect for demanding applications in industry and research because it combines accuracy, robustness, and silent operation. The density of a powder, granules, or pellets following tapping-induced compacting is referred to as tap density. It is crucial for evaluating the flowability, compression characteristics, and storability of powders since it shows how much space the material requires under specific circumstances. The device offers a long service life with a guaranteed 25 million taps with consistent calibration accuracy. It meets the requirements of the two most important pharmacopeias (USP and Pharm.Eu) as well as valid ASTM and ISO standards. TruLock straps enable quick changeover between different cylinder sizes from 5 to 1000 milliliters, and magnetic drop-height adapters ensure easy operation. An additional competitive advantage is the optional Noise Reduction Cabinet, which reduces noise levels by up to 99 % more efficiently than comparable instruments.



Anton Paar

HEAT EXCHANGER PLATES FOR HIGH-INTENSITY PERFORMANCE

The Capella heat exchanger plates are designed to deliver high-intensity heat transfer for maximum efficiency. These advanced plates allow fewer units to achieve the same performance, making heat exchangers more cost-effective and efficient. They are ideal for industrial applications requiring durable heat transfer solutions, such as HVAC systems and Industrial Data Centers (IDC). Optimizing heat exchanger functionality helps minimize both operational and capital expenditures. Key Benefits of APV Capella Plate Heat Exchangers include enhanced heat transfer efficiency and decreased energy consumption without sacrificing performance. Requiring fewer plates results in a more economical plate heat exchanger solution. Streamlined plate design ensures efficient operations in manufacturing environments. The Capella plate's next-generation design provides performance and cost benefits, enabling customers to optimize operational efficiency while reducing environmental impact. The new Capella plates underscore APV's commitment to delivering innovative and sustainable heat exchanger solutions, continuing its legacy as a pioneer in heat transfer technology.



SPXFLOW

HOLLOW FIBER ULTRAFILTRATION MEMBRANE FOR BIOPHARMACEUTICALS

The separation membrane module designed for biopharmaceutical manufacturing offers over twice the filtration performance of traditional modules by minimizing clogging, is set to elevate biopharmaceutical yields to over 90% while improving purification quality. Toray's innovative module integrates a depth filter composed of multiple types of nonwoven fabric with a hollow fiber ultrafiltration membrane. The depth filter benefits from Toray's expertise in air filter technology, optimizing fiber thickness and void structure to enhance impurity removal and permeability. The ultrafiltration membrane incorporates hollow fibers treated with Toray's anti-fouling, surface-hydrophilization technology, developed for artificial kidney applications. This advancement reduces protein adhesion and clogging, ensuring consistent performance. Testing confirms that the module delivers biopharmaceuticals with purity and quality levels matching or surpassing existing standards. Its enhanced design cuts the loss rate in purification by half, achieving yields of around 90%. Furthermore, reduced clogging enables continuous filtration for over twice as long as conventional membranes, stabilizing product quality while lowering manufacturing costs. Toray's miniaturization of hollow fiber membrane modules also contributes to space-saving in production setups, supporting more efficient biopharma manufacturing processes.



Toray Industries

ZERO EMISSION ELECTRIC DUMP VALVE

ASCO™ zero-emissions electric dump valves is an industry-first fully electric solution for separators, scrubbers, and compression units. ASCO zero-emission electric dump valves employ ultra-low-power electric actuation, removing the reliance on well gas and eliminating fugitive emissions. Unlike conventional valves, these valves are designed to be emissions-free with no valve packing, ensuring compliance with environmental standards. The valves offer precise actuation in just 50 to 75 milliseconds, compared to the several seconds required by traditional models, virtually eliminating the risk of gas blowby. This capability allows Laramie Energy to better maintain vessel static pressure, which has contributed to increased natural gas production. Additionally, the valves require only 1.2 watts (W) of power, a 98.75% reduction compared to retrofitted electric systems using 96 W.



Emerson

MODULAR PUMPING STATION FOR VARYING SIZE CANISTER

The system introduced by Lutz Pumpen featuring a detachable battery-powered motor, enables users to equip multiple canisters with pumping stations, allowing for flexible switching between them, all while ensuring safe and automatic liquid transfer. The newly designed pump tubes are compatible with the most widely used canister sizes. They come in lengths of 400 mm, 500 mm, and 700 mm and feature S60 and S70 threads commonly found in tank technology and chemical applications. The pump tube is constructed from polyethylene (PE), while the hose and fittings are made from polyvinyl chloride (PVC) — materials that ensure high durability and chemical resistance. The shaft is built from stainless steel, providing exceptional mechanical strength and resistance to corrosion. Once the pump is inserted into the canister, users can easily attach the B2 Battery motor from Lutz Pumpen with a quick-release fastener and begin pumping immediately. The motor, which operates on a brushless DC design, delivers 260 watts of power, reaching speeds up to 12,000 revolutions per minute and providing a pumping capacity of up to 6 liters per minute, even for liquids with a maximum viscosity of 400 mPas. A single charge of the replaceable battery is sufficient to empty a 200-liter canister up to twelve times in approximately 35 minutes.



Lutz Pumpen

BUILDING RESILIENT CHEMICAL TRADE WITH TRANSPARENT AND ADAPTIVE SUPPLY CHAINS

Trade growth predictions and growing challenges

Chemical Trade is poised for significant growth, and market researchers' predictions on it support this fact. South Africa, Indonesia, Brazil, etc are one of the few emerging markets largely driven by the increasing demand.

But with this growth, more complexities are yet to unfold and add to other current issues like geopolitical tensions, trade tariffs, and environmental concerns. It can affect how chemicals are transported and traded. For logistics companies, this means adapting quickly, improving efficiency, and finding sustainable solutions to safely handle the rising demand.

Strict Safety regulations, risk of hazardous material spillage, and ever-growing compliances make the scenario more complex. Each country has specific guidelines for trade, and chemical handling which can lead again to delays or complications.

In such cases, the proper training of the manpower becomes important. Teaching the staff about the guidelines and ensuring safety is paramount. Fulcrum helps solve these problems by offering customized solutions, using technology to track shipments, ensuring compliance with all safety standards training its team members to safely handle and segregate Haz cargo. The ability to adjust quickly to these rules is key to making operations smoother and more efficient.

Optimizing Chemical Logistics with Technology

Technology is a game-changer in chemical logistics, especially when it comes to tracking shipments in real time, monitoring inventory, and ensuring the safety of products. Tools like GPS tracking, IoT sensors, and data analytics help companies keep a close eye on every part of the supply chain. This level of visibility allows businesses to respond quickly to issues like delays or temperature changes, ensuring chemicals are transported safely and efficiently. Technology will continue to evolve and further optimize chemical logistics, making it faster and more reliable.



The logistics sector is experiencing significant changes, driven by small disruptions in ever-evolving technologies. These advancements are transforming the industry in ways we could not have imagined decades ago. **Mr. Sadegh Jalali, Managing Director of Fulcrum Shipping and Logistics**, shares his insights on the current trends and challenges the market should prepare for.

Investing in Eco-Friendly Solutions

With sustainability becoming a major concern, reducing the carbon footprint in chemical transportation is essential. Companies can take steps like optimizing routes to save fuel, using electric or hybrid vehicles, and switching to greener modes of transport such as rail instead of trucks. Logistics companies need to invest in eco-friendly solutions, even if they come at a higher cost initially, because long-term, they help both the environment and the company's reputation, and the government should support them by offering some kind of subsidies.

Diversification to Minimize Disruptions

The trend toward decentralization and diversification is reshaping how chemical companies manage their supply chains. Instead of relying on one region or supplier, companies are spreading out risks by sourcing from multiple areas.

This makes the supply chain more resilient to disruptions like trade wars or natural disasters. It can benefit the sector in the long run and companies should adapt by building flexible supply chains and by using data to predict and manage potential risks more effectively.

Fulcrum repositioning as per the current trends

Several exciting trends are emerging in global chemical logistics, such as automation in warehouses, the use of blockchain for more transparency, and a stronger focus on sustainability. These trends are all about making the supply chain more efficient and reliable while reducing environmental impact. Fulcrum, with its focus on technology and sustainability, seems well-positioned to capitalize on these developments. By embracing these trends, they can help customers stay ahead of the curve in a rapidly changing market.

UNDERSTANDING FIRE HAZARDS IN CHEMICAL MANUFACTURING: PREVENTION AND PROTECTION SOLUTIONS

In the Chemical Industrial Processes, Fire Hazards are an inseparable risk part of the manufacturing operation cycles. Chemical production pathways, while maintaining safety in all forms and sustaining the business, are paramount, and every business domain needs to follow them. Fire Safety and Fire Risk are the opposite side of the same coin. One cannot be fought off while neglecting the other side.

An important factor of fire risk is “self-existent & self-evolving,” while “fire safety” is intentional and needs to be established and sustained by an ardent & dedicated management commitment to ensure & enhance the adequacy of relevant safety performance at the ground level.

Fire Losses, Fault of Nature?

As per the reports and press release the statistics are quite clear. In the year 2021, 6500 employees died as per the report of the Ministry of Labour. From 2014 to 2017, 8004 Fire Incidents occurred resulting in 6368 human deaths.

Who is responsible & accountable for such a huge fatality? Can India, as a developing country, afford to cope with such fire-related losses?

When fire safety is legal compliance, negligence & indifference are still responsible on the part of safety compliance and enforcement. What are the moral and social responsibilities of those deemed “responsible” regarding the “relevant victims” who lost their lives in their work environments?

Fire, as a form of energy, will inevitably occur when there is an interaction between fuel and oxygen in the presence of sufficient heat. Yet, as human beings, we often fail to “extinguish the fire before it consumes us.” This failure can be attributed to emotional factors such as prioritization, budgeting, a lack of time to learn, outsourcing, unprofessional contract systems, attitudes of “it’s their responsibility,” and a lack of leadership vision that recognizes safety as an inseparable part of quality management.

Priority: Fire Prevention or Fire Protection?

Industrial Fires radically differ from domestic fires in terms of fuel involved, sources of ignition, fire spread factors, heat releasing rate, toxic gas emission, radiation & explosive potential. So, the potential to prevent fire and the unexpected loss per square meter area in an industrial structure is always on a higher scale. Hence the priority is naturally for Fire Prevention followed by Fire Protection and Fire Response.

All these three strategies are three layers of Fire Safety Management in the order of priority. The objective of fire prevention is to ‘prevent fire occurrence’ in the workspace; the objective of fire protection is ‘fire suppression’ at the incipient stage itself so that fire loss can be minimal.

Fire Prevention principles are under practice, in many industries, by adopting Work Permit Systems, Toolbox, LOTO, SOP, Safety

Review Management Meetings, Risk & Opportunity Analysis, Audits (Internal & External), and the use of AI Applications for predictive management mode, etc. But the practical problem, which is visible in many industries, is the failure to verify & monitor the effectiveness of such fire prevention measures in practice.

Fire Protection is established either by auto fire detection and suppression systems, as per the code requirements, and providing manual interruption to fire by providing & using fire extinguishers, and fire hydrants systems including required passive fire protection systems such as Fire Resistance Walls, Fire Doors, Fire Seals, Compartmentations, segregations or separations and fire-retardant applications including adequate safe egress & access provisions.

The objective of the Fire Response strategy is to prevent fire spread when the installed auto fire suppression system becomes useless. When fire becomes uncontrollable, then initiating an evacuation process to lead and direct all the occupants/employees into a place of comparative safety. Evacuation is not merely a formal requirement, but a real-time need to escape the occupants from a hazardous work environment. However, it should be practiced professionally and designed to the site-specific need.

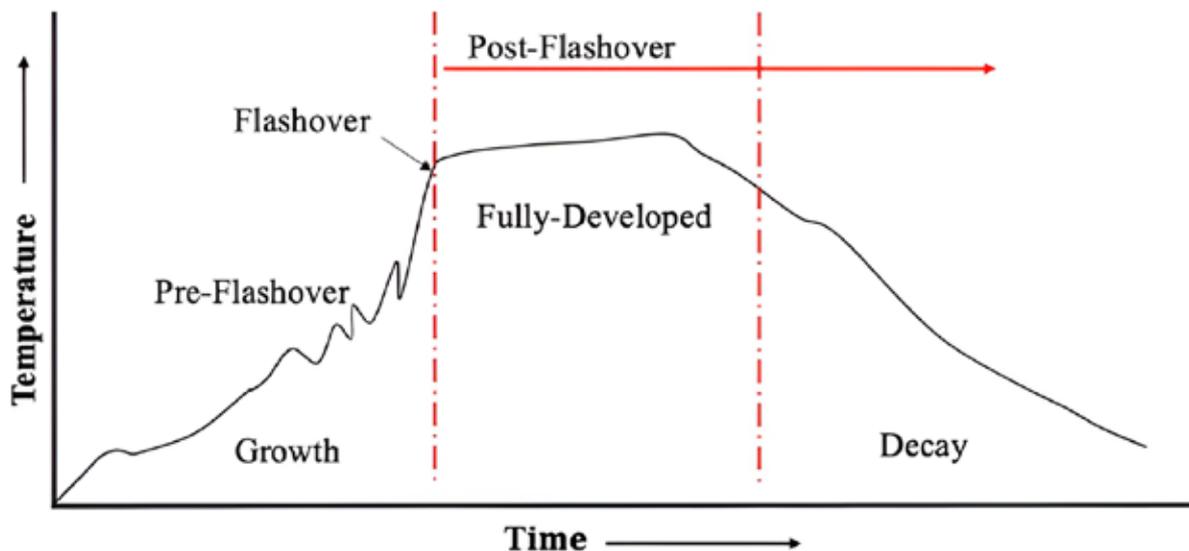
Four Stages of Fire

Fire behavior and its characteristics remain consistent worldwide, but the approach to fire safety management varies between national and local practices. Understanding fire behavior is essential for developing effective fire prevention strategies and fire protection systems within an organization.

A. Ignition Stage of Fire: A fuel begins to burn when it reaches the necessary temperature, which is known as the Flash Point Temperature. This heat, from an ignition source, transforms the fuel (solid or liquid) into vapor, which can then mix with oxygen in the air. The reaction that occurs is a vapor-phase chemical process. When the fuel and oxygen mix in the right proportion and the temperature reaches the Fire Point Temperature, combustion occurs, marking the Incipient Stage of fire.

B. Growth Stage of Fire: Once burning starts, the exothermic reaction generates heat that ignites nearby fuels. These fuels, upon reaching their flash point, vaporize and mix with oxygen to form a burning mixture. This moves toward the flaming zone, where further heating up to the fire point temperature sustains the burning. This continuous heat generation makes the fire self-sustaining, meaning no external heat source is required.

C. Developed Stage of Fire: As the fire grows, the cyclic heat generation increases its size, accelerating the spread. The fire continues until the fuel/oxygen/heat supply is interrupted. When all the available fuel vaporizes and reaches fire point temperature, a flashover occurs, engulfing the room in flames. This fully developed fire, or flashover, generates intense heat that makes firefighting and rescue impossible, causing significant damage to people and property.



Evolution of fire models for estimating structural fire resistance - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Stages-of-fire-in-a-compartment_fig1_351434250

D. Decay Stage: This is the stage, wherein the size of the fire decreases owing to want of fuel, oxygen, or heat. It is almost a self-extinguishing stage.

Learning from the Stages of Fire:

The following insights are to be considered for better planning & practice of fire safety management:

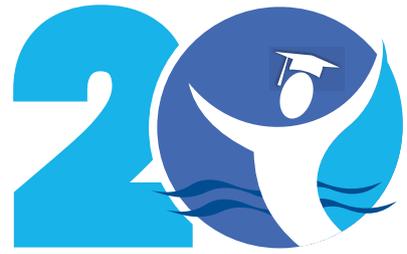
- The Incipient stage of fire signals a failure in fire prevention practices within an industry. It's crucial to identify gaps and implement corrective actions to improve fire prevention efforts.
- In an industrial environment, preventing fires is more important than firefighting. Real-time sensors can monitor parameters such as over-temperature, high pressure, under pressure, gas/liquid overflow, and flammability range. These sensors can trigger predictive management actions to prevent unwanted incidents.
- The transition from the Incipient to the Growth stage indicates a failure in automatic fire detection and suppression systems. Causes may include malfunction, inadequate coverage, or increased fire load. Often, employees are unable to effectively utilize available resources. Identifying and addressing these gaps is key to improving fire safety practices.
- Reaching the fully developed stage of fire reflects failures in human intervention, such as a lack of trained personnel, poor emergency response, inadequate infrastructure, and insufficient safety reviews. These deficiencies must be corrected to enhance overall fire safety management.

Words from Author

I like to conclude with what Mr. Bertrand Russell, a great British Philosopher and Noble laureate, said, "Tiger is more beautiful than a Sheep, but we prefer it behind the bar". The implied value is, "Modern Buildings and manufacturing Industries are more useful and needful in the public interest. However, they always involve inbuilt hazards and inherent fire risk factors. So, the fire risks always must be kept at an acceptable level". In fact, this is known as 'Safe Building' / 'Zero Risk Building'. One should mind that "Zero Incident" is a target but it does not represent "safe processing". So, the focus must be shifted to "safe process management" which may result into zero incident.

M.Namasivayam

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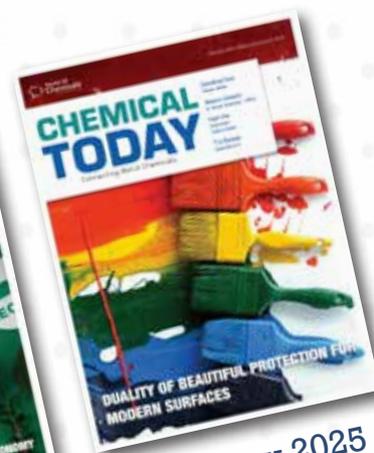
- Flavour & Fragrance
- Petrochemicals
- Pigments
- Biolubricants

Equipment Section

- Measurement
- Pumps & Valves
- Packaging



January 2025



February 2025

May Issue

Sector Focus

Construction/ Adhesives/ Ceramics

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ADVERTISING INDEX

COMPANY NAME	PAGE NO.	COMPANY NAME	PAGE NO.
Utkarsh Odisha 2025 Website : https://mio.investodisha.gov.in/index.php	Front Inside	INACOATING 2025 E-Mail : info@gem-indonesia.com Website : https://www.inacoating-exhibition.net/	54
IPIUA Association Mobile Number : +91 9810024136 E-mail : secretary@ipua.in Website : www.putechindia.com	05	INAGRICHEM 2025 E-Mail : info@gem-indonesia.com Website : https://www.inagrlichem-exhibition.net/	59
INDIA PAINT & COATING EXPO Mobile Number : +91 9342185915 E-Mail : expo@mediaday.co.in Website : https://paintandcoatingexpo.com/	12	Sharplex Filters (India) Pvt. Ltd Mobile Number : +91 8928795270 E-Mail : sales@sharplexfilters.com Website : www.sharplex.com/vertical-pressure-leaf-filter.htm	63
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Plastasia 2025 Mobile Number : +91 7619267070 E-Mail : Info@plastasia.in Website : www.plastasia.in	25	Kimberlite Water Plus Pvt. Ltd. Mobile Number : +91 9620132467 E-Mail : info@kimberlitewaterplus.com Website : www.kimberlitewaterplus.com	Back Inside
DCM Shriram Ltd Mobile Number : +91 9811689102 E-mail : shradhathani@dcmshriram.com Website : https://www.dcmshriram.com/our-businesses/chlor-vinyl-business	38	World of Chemicals Mobile Number : +91 9620220027 E-Mail : sales@worldofchemicals.com Website : http://www.worldofchemicals.com	Back
CII Surface & Coating Expo 2025 Mobile Number : +91 9363905015 E-Mail : madhan.mp@cii.in Website : http://www.ciisce.in/	47		

GLOSSARY

COMPANY NAME	PAGE NO.	COMPANY NAME	PAGE NO.
ADM	13	Henkel	58
Adnoc	37	Jotun	28
Agilent Technologies Inc.	64	Jupiter Group	10
ALBIS Distribution GmbH & Co. KG	16	Kansai Nerolac Paints Limited	14
ALPLA	15	Kimberlite Chemical India Pvt. Ltd.	21
Altana AG	32	KSH Distriparks	11
Anton Paar	64	L'Oreal	48
Archroma	36	Lanxess	55
Arkema S.A.	16, 35, 58	Lutz Pumpen	65
Asha Venture	10	M.Namasivayam	67
Avantium N.V	19	Man Industries Ltd.	10
Axalta Coating Systems Ltd.	18	Master Bond	57
Barentz	57	Micro Powders Inc.	58
Biocides	39	Mordor Intelligence and Statista	46
Carboline	14	Neste	30
CCI Group	11	NOCIL Limited	9
Colorado State University (CSU)	53	Oak Ridge National Laboratory (ORNL)	51
Covestro (India)	10	Paul Scherrer Institute (PSI)	52
DKSH India Pvt. Ltd.	24	Persistence Market Research	44
Dürr	18	Perstorp	13
Eastman Auto & Power Ltd	11	PolyCycl	26
Elantas Beck India Limited	13	Pope Scientific, Inc.	60
Emerson	65	Praj Industries	14
ENKA	17	Sabic	57
Essar Energy Transition (EET) Hydrogen	17	Sharplex	62
Flinders University of South Australia	50	SPX FLOW, Inc.	64
Fulcrum Shipping and Logistics	68	Suzlon	34
Global Market Insights	43	Thermax	9
Godrej Agrovet Limited	9	Toray Industries	65
Godrej Industries (Chemicals)	10	Vishwaraj Sugar Industries	9
Grand View Research	41		



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