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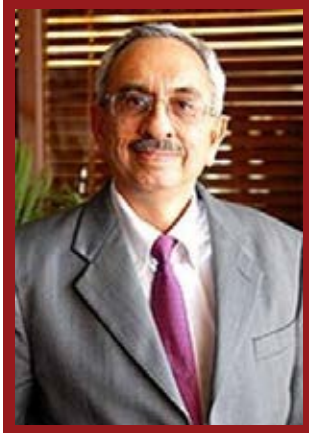
COVER STORY

Transform Indian Chemical Sector from Trade Deficit to Trade Surplus by 2030

Rajendra V. Gogri
CMD, Aarti Industries Ltd



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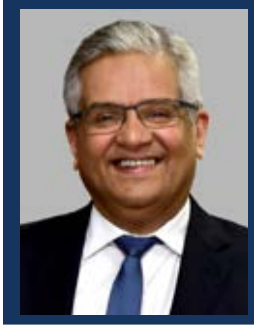

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VC & MD, Clariant Chemicals (India) Ltd

Indian Industry must make an effort to meet Global Standards

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Managing Director
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Sanjay Trivedi
Director, Indian Home and Personal Care Industry Association Chairman, Trivedi Groupe

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Aim for Larger Share in the Global Chemical Value Chain

Parag Jhaveri
CMD, Yasho Industries

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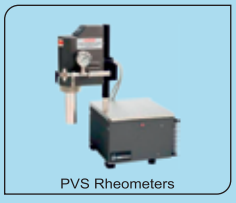
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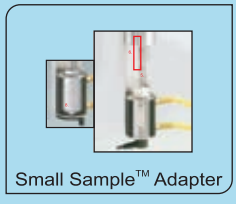
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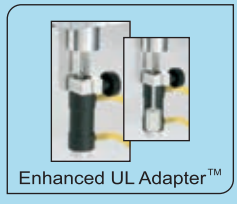
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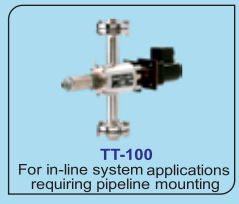
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Transform Indian Chemical Sector from Trade Deficit to Trade Surplus by 2030

By 2030, with the right mix of policy initiatives, the chemical sector has the potential to create a Net Trade Surplus of $80 billion. If we fail to take proactive measures and capitalize on current opportunities, we may end up with a net trade deficit of $70 billion which will be detrimental to the economy.

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Looking Forward

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The Chemical Industry which covers more than 80,000 commercial products has been an integral part of the global economic landscape. The Chemical Sector in India was valued at $125 billion in sales and $147 billion in terms of consumption in 2018. However, the Indian market is very small in the global context. India only contributes ~ 3% of the Global Chemical industry, which is valued at $4.1 trillion. In comparison, the Chinese Chemical Market Size is $1.45 trillion which is ~40% of the Global Market. In 2018, the export performance of the Domestic Chemical Industry was $34 billion against imports of $56 billion (38.1% of total consumption) registering a net trade deficit of $22 billion.

The Indian Intermediate and Specialty Chemical (I&SC) Sector

The I&SC Sectors, primarily operated by the MSME sector and a few large companies, provide vital products to key downstream industries like agriculture, automobiles, textiles, paints, paper, soaps and detergents, pharmaceuticals, rubber, etc. The products are either manufactured in large dedicated plants or are produced in a batch or continuous multipurpose plants. This is a highly knowledge-intensive industry with key emphasis on Quality, Safety, Health & Environment (QSHE) and Skilled Manpower. In 2018, I&SC sector alone had exports of $28.2 billion against Imports of $44.5 billion leading to a net trade deficit of $16.3 billion. The Indian Potential for growth in I&SC sector remains untapped and with special government focus, the I&SC sector can transition from being a net importer to becoming a net exporter.

India as an alternative sourcing destination to China

Easternization: Over the past 2 decades, in a bid to remain competitive, several chemical companies from the West outsourced manufacturing to low-cost foreign destinations, leading to the Easternization of the Sector. China and India were the primary beneficiaries of this shift in global chemical production. This

SWEET SPOTS FOR INDIA

- Critical Mass and Ability to Invest
- Increase in Domestic Demand
- Preference of Global Players to de-risk their Supply Chain from China
- Equalization of Indian and Chinese Cost
- Strategic and Tactical Raw Material Sourcing from India

occurred due to a combination of lower labor costs, easy regulatory compliance, low R&D expense and low capital investment. China, however, benefited significantly from this movement whereas India only benefited in a smaller way. The statistics show that in 2006, the EU, the US and Japan together held a 57% share which reduced to 33% in 2016.

Over the years, India's importance in I&SC Sector has been on the rise. A number of factors have placed India in a sweet-spot to participate in a bigger way in meeting the global need for chemical products.

1. **Critical Mass and Ability to Invest:** The Indian chemical industry ranks 6th globally and has established itself as a major player in the Global Chemical Value Chain. Indian manufacturers have increased R&D efforts, have set up global scale plants and have demonstrated that they can compete globally even against China. Several Indian Companies are eager to Invest to create global sized plants to cater to the growing domestic and global market.

2. **Increase in Domestic Demand:** India continues to make a mark on the world map as a manufacturing destination and is home to several manufacturers of global scale across diverse sectors. India which has an 18% share of the global population is an emerging economy with a young population that is rapidly urbanizing. About 34.5% of the Indian population stays in urban areas and approximately 68% of the population is of working age (between 15-65 years). However, India's per capita Chemical Consumption is $103 (5.05% of per capita GDP and 20% of average global per capita chemical consumption) which is significantly lower compared to other developed countries. Due to increased Urbanization and the influence of the Western Countries, domestic chemical consumption is expected to increase significantly in the next 10 years.

3. **Preference of Global Players to de-risk their Supply Chain from China:** The earlier Chinese Model was growth at low cost which was achieved by mushrooming of multiple companies setting up large and medium-scale plants. This was possible due to the easy availability of capital, export incentives and easy regulatory permissions at the cost of environmental pollution and low investment in process safety. Most chemical value chains across the

world, especially in intermediates and specialty chemicals sectors, depend heavily on Chinese manufacturing. However, in the past decade, a series of disruptions in supply from China has led to the various chemical companies seeking alternate Raw Material Sourcing options throughout the supply chain. The list of disruptions have had a significant impact on raw material availability

a. Tightening of Environment Regulations and Investment in ETP's
b. The US-China Trade War
c. Increasing Safety Incidents
d. COVID - 19
e. Rising Labor Costs

The increasing uncertainty and unpredictability in sourcing from China have all contributed to reducing the economic incentive of 100% relying on China as the world's chemical factory.

4. **Equalization of Indian and Chinese Cost**: Before 2012, the Chinese industry governed the product pricing and the costs were very cheap. However, due to numerous factors cited above, Chinese product costs have increased. If we break up the cost structure between India and China, there might be variation in different segments. To provide a qualitative comparison against the Chinese cost, Indian cost component is high wrt. to interest and logistics cost, on par in terms of environment-related cost and low wrt. labour costs and capital investment cost. Overall, the Indian cost is now on par with the Chinese cost. Additionally, the Indian cost is significantly cheap compared to the opex and capital investment costs of developed countries like the USA, Europe, Japan etc. This makes India a strategic destination for long term raw material sourcing and setting up new manufacturing assets.

5. **Strategic and Tactical Raw Material Sourcing from India:** Global giants are looking at other investment destinations such as India, Latin America and Eastern Europe to mitigate the China risk to their supply chains. However, apart from India, none of the other destinations has the dual foundation of a broad-based chemical industry ecosystem and a captive market comparable in size to China. MNC's have therefore created a strong mandate to increase sourcing from India by entering into mid-long term supply contracts. A number of enquiries are also floated for the development of new molecules which

are currently not produced in India or are key intermediates to innovator molecules for global chemical majors. Their strong confidence to source from India in a reliable manner at a competitive price is on account of multiple factors

a. Improving QHSE standards of Indian companies

b. Availability of skilled talent pool to develop and operate complex and hazardous chemical processes

c. Positive Actions by Government

   i. Ease of Doing Business (EODB) and Make In India -India's ranking in EODB improved significantly from 142 in 2014 to 63 in 2020, a testimony to India's rising attractiveness as the worlds' business destination of choice.

   ii. India has publicly declared its resolve to improve manufacturing in India through the "Make in India" campaign and has targeted to grow manufacturing share of GDP from 16% to more than 25% by 2025.

   iii. Corporate Tax Rates: Competitive Tax Rates at 25.17% and Incentive to new manufacturing units with Tax rates of 17.01% if the production starts before 2023.

d. Other Factors: Access to ports, robust legal and regulatory framework, depreciated currency against Chinese and US currencies

Policy Structure to Turbo Charge Domestic Growth

The government has taken significant positive steps to boost Make in India initiative. Although India has exhibited the potential for growth, the fact of the matter is I&SC sector has a net trade deficit of $16.3 billion. The growing trade deficit can be countered with a four-pronged comprehensive strategy and policy structure to boost exports and reduce imports while simultaneously reinvigorating the domestic demand and appetite for consumption

1. **Rationalize Duty Drawback Structure**

   The Export industry has two avenues to utilize Export Incentive Scheme - procure raw material (RM) in Advance License or export finished product (FP) in the Duty Drawback scheme. Duty Drawback rates were set so as to incentivize exporters to

Chemical	Price (INR/kg)	Duty	%	Cost
Typical Imported Raw Material Cost	0.6	Import Duty	8.25%	4.95%
Finished Product Price	1	Duty Drawback	1.50%	-1.5%
Disadvantage through Duty Drawback				3.45%
Required Duty Drawback to Compensate for RM Import Duty				4.95%

Table 1: A Typical Example and Proposed Duty Drawback

purchase locally available material v/s importing it via Advance License. However, multiple times, the Exporters prefer importing RM under Advance License even though RM is available in India because duty drawback on the FP is less than the import duty component in RM Cost. This has created the situation of Deemed Duty Inversion and the Indian Industry is losing on volumes. For Eg: Ortho Anisidine, P Nitroaniline, 3,3-DCBH has excess capacity in India and these products are also exported. However, the Dyestuff and Pigment Exporters prefer to import them under Advance License due to mismatch in Duty Drawback rates with downstream FP leading to loss of domestic sales. In order to encourage Exporters to buy locally and compensate them for locally procured RM, the standard rate for duty drawback needs to be corrected to avoid Deemed Duty Inversion. A Typical Example and Proposed Duty Drawback is as follows

The government should comprehensively review the assessment basis of duty drawback and rationalize in such cases. This will have a significant impact by reducing imports, reduction in the trade deficit and giving a boost to domestic industry thereby improving scale, employment and tax revenues.

2. Streamlining Environmental Clearances

The nature of these specialty plants is to make multipurpose products. Due to the ongoing nature of technical improvements, these plants have the flexibility to increase capacity in the same setup or add new products of different capacity. Obtaining the product mix approval itself takes 4-6 months thereby reducing competitiveness and leading to missed market opportunities. For Eg: The opportunity to capitalize during the supply vacuum created from China

due to the tightening of Environmental Norms is missed as the Industry does not have the requisite regulatory permissions to ramp-up capacity and obtaining these permissions is a time-consuming process. The current rule/ EC notifications do not permit any construction until an Environmental Clearance (EC) is obtained. This is creating delays in starting up of Projects. However, MoEFCC is mulling to introduce a Tatkal scheme whereby EC can be granted on a fast track basis for deserving cases or a single window so that export orders are not affected; such policy decisions are a welcome move. In addition to these, the government can take the following policy decisions to rationalize and simplify the approval process

- Faster EC: Stage-wise clearance in which a firm may be allowed to begin construction after filing the application. This will save significant time in setting up the Project reducing the time to enter the Market significantly improving Project Viability. This can be initiated in cases where Public Hearing is not required.
- Simplified Statutory Approvals for Expansion:
- Moving to a product-agnostic effluent/ emission-based permission
- Zero Liquid Discharge (ZLD) does not generate any liquid effluent and thereby does not contribute to pollution. This enables recycling of water which is a critical natural resource. Freedom can be provided for capacity expansion for ZLD units as long as they meet air emissions & solid waste norms.
- Marine Discharge should become a standard norm:
- Marine Discharge is a cheap and effective global practice to manage the effluent without impacting the environment. The current Marine Discharge norms are not as per global standards. The standards need to be reviewed accordingly.
- India has signed the Paris Agreement 2016 pledging of Carbon Dioxide. Marine Discharge should become a norm over ZLD as the latter has significantly higher Carbon Footprint.
- Increase Marine Discharge points through pipelines in states where Chemical Clusters are present
- Allow Marine discharge by GPS monitored Road Tankers to marine discharge points for effluent qualifying marine norms.

3. Increase Import Duty for Entire Value Chain

The I&SC sector imports $44.5 billion worth of Raw Materials and contributes to Net Trade Deficit of $16.3 billion. This is largely due to non-availability of key feedstocks as the Integrated Petrochemical complexes are unable to allocate and provide feedstock to the downstream industries. Though the Import Value is high, the current domestic demand is unable to justify Global Scale Plants. This is due to the low duty drawback making it advantageous for the Exporters to Import the Raw Materials rather than procure it locally. To achieve global scale plants, the downstream industry would need to have Raw Materials available locally for a secure, reliable supply chain. This is impacting the investment across the Value Chain from Basic Chemicals to I&SC. To accelerate the Investment Cycle across the Value Chain, bold policy decisions need to be taken which are mentioned as follows

- Increase Duty on all chemicals by a minimum of 10% across the Value Chain for a 10 year period. To avoid creating an adverse impact to the export industry and assuming that the raw materials comprise an average of 60% in the product cost, the additional increase in duty should be offset through additional duty drawback of 6%. This will still be within WTO Norms.

Trade Type	Value (B$)	% Duty Increase	Duty Impact (B$)
Imports	56	10.00%	5.6
Exports	34	-6.00%-	-2.04
Net Inflow to Govt			3.56

Table 2- Impact of increase in duty

- Provide FTA protection to the Chemical Sector for a 10 year period. This will provide stability in creating the Business Case and remove any challenges of duty inversions.

These policy decisions will provide better economic viability for Basic Chemicals to Invest to cater to the downstream demand which suffers from a scale disadvantage. This will also lead to additional duty revenue of $3.6 billion to the government.

The increased Duty will have a negligible impact on Inflation as the Cost of these chemicals in the end-use industry is only 3-5% of Total Cost. A simple calculation suggests that the maximum impact on Inflation will be only 0.2%

Inflation Impact	
Chemical Consumption % of GDP	5.05%
Import as % Consumption	38.10%
% Increase in RM Price	10%
Inflation Impact	0.2%

Table 3 - Impact of inflation

Revised Duty Structure for 10 years will provide good visibility for a long term period which will create a win-win situation to accelerate investment cycle across the entire chemical value chain

4. Research and Development Support with Tax Credits

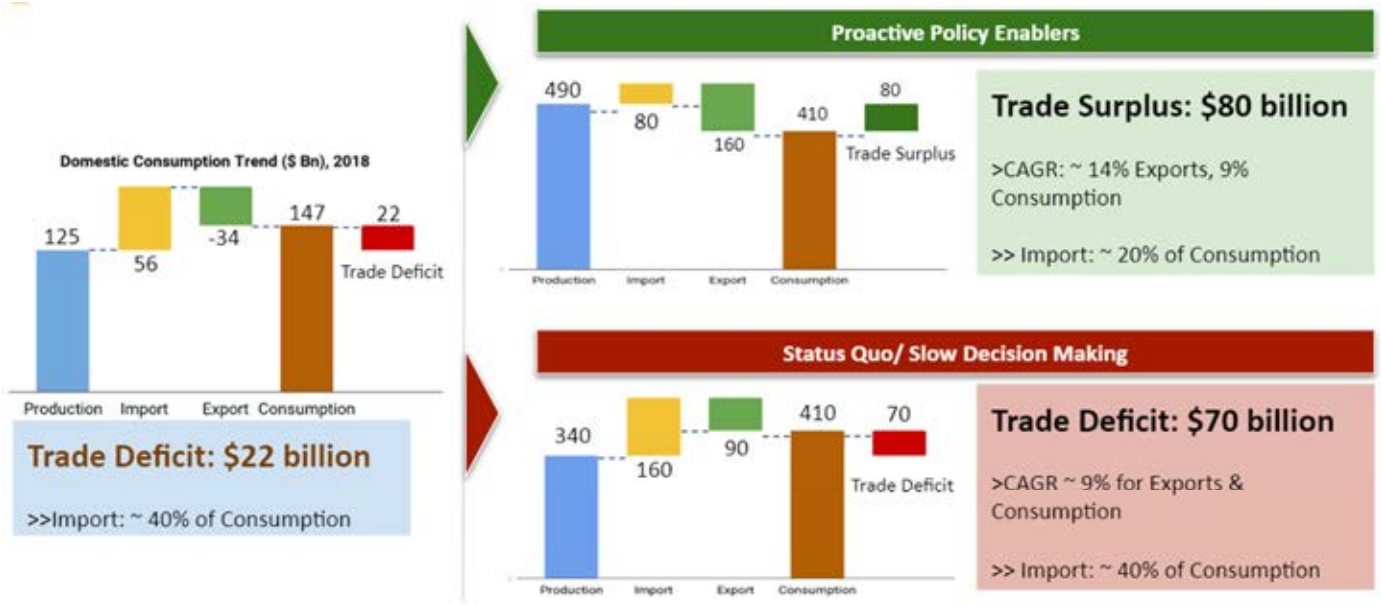
The Indian Industry spend on Research is only 1-2% compared to a global average of 5-7%. The Research Institutes work in isolation rather than collaboration with the Industry as adequate incentives are not available to encourage collaboration. On account of this poor collaboration and inadequate R&D, many "high value-added" products are not made in India. The government can take the following steps to encourage collaboration

- Creation of Chemical Innovation Fund (CIF): Government should create a Chemical Innovation Fund where the chemical industry can additionally contribute 33% of CSR corpus to this fund.
- CIF should be used in the following areas
- The government through Make in India initiative should offer a minimum of 5% incentive on the Finished Product for the introduction of new products in India for the first 5 years on R&D Effort and initial product stabilization.
- Open Research: The results of R&D through Chemical Innovation Fund can be made open to all domestic industry players (a similar system is prevalent in China which was one of the key reason for Chinese becoming competitive in Global Markets)

This will enable smaller firms to benefit from the technical expertise available in larger organizations without having to reinvent the wheel. Over time and through collaboration with technical institutions and research labs, it can create a knowledge ecosystem that will raise the competitiveness of the Indian industry as a whole

Conclusion

The year 2020 presents challenges as uncertainty grips the world with the outbreak of COVID-19 pandemic. In the COVID-19 scenario, India which stands



at the cusp of a new growth curve has projected a more resilient and diversified economy to fight the crisis. In the conquest of a $5 trillion economy, the chemical sector can play a crucial role in occupying significant share in GDP. A holistic outlook with an integrated value chain view coupled with old policy reforms and execution focus can catalyze a virtuous cycle of growth. This can help realize India's potential to become (a) the manufacturing hub for global chemicals by choice, (b) transition from trade deficit to trade surplus and (c) create significant job opportunities.

By 2030, with the right mix of policy initiatives, the chemical sector has the potential to create a Net Trade Surplus of $80 billion. If we fail to take proactive measures and capitalize on current opportunities, we may end up with a net trade deficit of $70 billion which will be detrimental to the economy. The below graph illustrates the possibilities for Year 2030.

With proper attention, support from the government and right mix of policy initiatives which is the need of the hour, the Indian Chemical Industry has the potential to become the next IT or Pharma sector contributing significantly to the Exports and the possibility to rank amongst top 3 countries in the world in terms of chemical production by 2030. ■

Focus on Reversing Climate Change and Reducing Inequality

Even before the pandemic hit India, the competitive situation of the Indian chemical industry was improving. China increased its environmental regulation, closing many non compliant factories and forcing some to relocate to unpopulated areas thus increasing transport costs.

Mr. Nadir Godrej
Managing Director,
Godrej Industries Ltd

This proved to be a big boost to the Indian chemical industry particularly agrochemicals, pharmaceutical intermediates and specialty chemicals. Not only did India become more competitive in final products, it was possible to indigenise intermediates that were more economical to import from China earlier. Post the pandemic buyers would like to diversify their sources and India is in an excellent position to capitalise. Contract research and manufacturing is also a growing opportunity. Most chemical companies are constantly investing and this will continue.

The pandemic is forcing the government to initiate fundamental reforms and I hope there will no longer be unnecessary regulation that impedes growth. At the same time we need strict environmental regulation focused on outcomes and not unnecessary procedures. It is both imperative and efficient to maintain the highest environmental standards from the design stage itself rather than clean up waste streams. With a philosophy of waste is wealth there will be no pollution.

While it is true that China is better at large scale manufacturing, India is likely to focus on knowledge intensive manufacturing. Both multinationals and Indian companies are likely to invest in India particularly in agrochemicals, pharmaceuticals and specialty chemicals.

The pandemic is forcing the government to initiate fundamental reforms and I hope there will no longer be unnecessary regulation that impedes growth. At the same time we need strict environmental regulation focused on outcomes and not unnecessary procedures. Manufacturers who subscribe to responsible care, zero discharge and green chemistry should be given a green light. It is both imperative and efficient to maintain the highest environmental standards from the design stage itself rather than clean up waste streams. With a philosophy of waste is wealth there will be no pollution.

In the future all industries including the chemical industry will have to focus on reversing climate change and reducing inequality. Innovation to solve these problems and provide new products will be vital. The future of the Indian chemical industry will be very bright ■

Future of the Home Care Industry - Post Covid 19

Sanjay Trivedi
Director, Indian Home and Personal Care Industry Association Chairman, Trivedi Groupe

The Corona Virus (COVID 19) which originated from Wuhan China in December 2019 has resulted in a global pandemic effecting over 188 countries and close to 7 million people. The impact of the virus has caused countries to recalibrate their operations through regulatory measures which include lock downs and circuit breakers resulting in economic slowdown and growth hovering in the negative zone.

In India, Hon'ble Prime Minister announced the first lock down on March 23, 2020 with immediate closure of all activities excluding supply of essential goods. This 14-day lock down has been extended by staged lock downs to over 60 days with several states announcing closure till end June 2020.

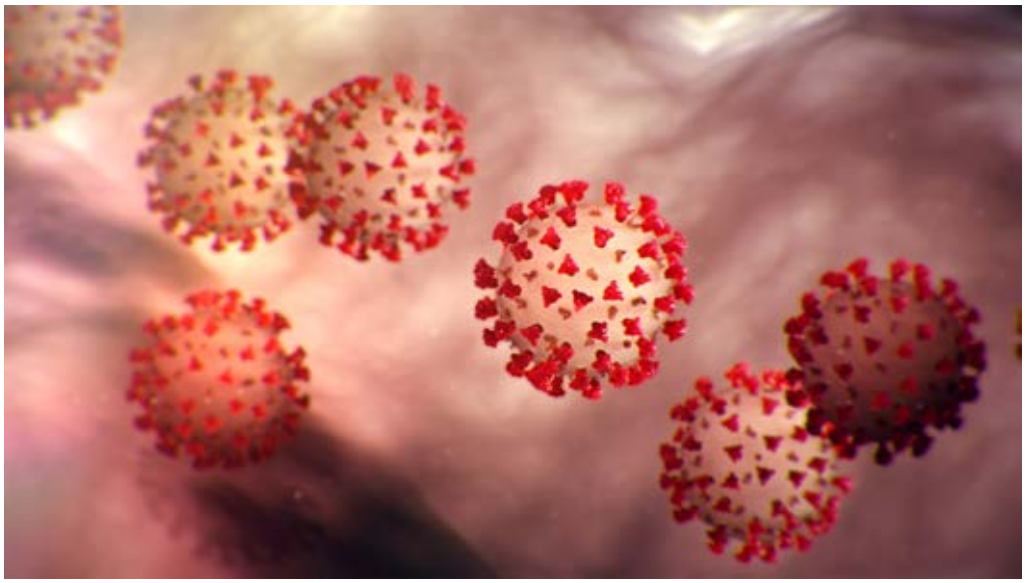
The home care Industry, which makes essential products like soaps, cleaners, sanitizers, and disinfectants has been impacted adversely with resumption of activities to around 50% in early June 2020. The small-scale sector has been hit the hardest with challenges of logistics and supply chain management despite a robust demand for end products. The

unforeseen movement of migrant workers has also caused major disruptions and business is expected to operate under a new normal where automation of processes, digital supply chains and e-commerce are now the new buss words.

The clarion call by Hon'ble Prime Minister for Atmanirbhar Bharat in tandem with Swatcch and Swastha Bharat coupled with fiscal stimulus is expected to create Indian brands for the world. However, the challenges of doing business have compounded and many small-scale industries will close or consolidate to larger economies of scale. The new normal will require a change in the way of doing business with an increased focus on liquids and concentrated products which use less minerals and fillers, use less water and are energy efficient. The use of plastics and the impact on the environment will see stricter rules and regulations in their use and disposal. The focus will shift from cost to performance of end products combined with logistics for delivery of products across the country. Standards will need to be rewritten and chemicals management will see a revised focus on making of green products which are more sustainable.

India with a large and young population does provide the growth drivers but the approach toward Atmanirbharta (self-reliance) will need to be moderated with realism, pragmatism instead of protectionism, on open free trade economy instead of import controls. We will need to regulate imports from bordering countries to provide an impetus to local industry, but we have a long wish list before us. Our infrastructure overhaul is a prerequisite. Regulations will need to be reduced. The ease of doing business will need to be demonstrated.

The new normal will require a change in the way of doing business with an increased focus on liquids and concentrated products which use less minerals and fillers, less water and are energy efficient. The focus will shift from cost to performance of end products combined with logistics for delivery of products across the country. Standards will need to be rewritten and chemicals management will see a revised focus on making of green products which are more sustainable.



Taxes will need to be rationalised to provide the growth drivers. Economies of scale will need to be created. Technology innovations will need to be incentivised. Sops to SME sector will have limited impact as quality will need to the focus. Japan, S Korea, and China have demonstrated that there is no substitute to consistent quality to win the consumers hearts and find a way to their wallets. Brands will not matter as much as affordable products which perform with less water and reduced efforts for cleaning or washing.

The home care Industry is at a pivotal point. If it trips by doing business as usual, it will sink. If it innovates, keeps quality as a benchmark and focus on what the consumers need, it will succeed. Regional players will emerge as growth points provided the Govt provides the support and infrastructure required to the product outreach. We will also need to focus on the environment and have policies towards a circular economy for plastics and their recycle and reuse. Green technologies will have to emerge based on bio sciences, enzymatic technologies and use of locally available ingredients.

India is resilient and the population at large is enlightened with the digital connects to meet the vision of a vibrant and dynamic India taking a lead through diligent and pragmatic policies supported by the Government and Hon'ble Prime Minister call for less Government more Governance to fulfil a vision of a self-reliant nation. We have the nationalist fervour for making this happen but there is a gap between the cup and the lip where action must replace words and rhetoric must be replaced by tangible actions moderated with reality. ■

Continue to Innovate to Maintain High Standards of Quality

Adnan Ahmad, VC & MD, Clariant Chemicals (India) Ltd *shares his views on the current crisis and the opportunities for the Indian chemical industry. He strongly believes that Make in India initiative is a significant step undertaken by the Government of India that has echoed with the country's manufacturing sector. It is also perceived as the positive turning point for employment and growth of the sector in the country.*

Adnan Ahmad
VC & MD, Clariant Chemicals (India) Ltd

What are your thoughts on the growth of chemical industry globally and in India?

The chemical industry is the basic building block for all industries, and hence a key component of any developing society. Globally, the industry has grown steadily over the years, with a shift in its center of gravity to China. Moreover, the Indian chemical industry is also a key contributor to the country's GDP growth as it employs over two million people, impacting more than 8000 commercial products.

As per a Mckinsey report, between 2006 and 2019 the compound annual growth rate (CAGR) in total returns to shareholders (TRS) for India's chemical companies at 15% was twice that of the global average for the industry and over two and a half times the average of the global equity market. Between 2016 and 2019, when India's economy faced headwinds, the chemical industry maintained a CAGR of 17 percent, with sectors such as agriculture, infrastructure and personal care enabling this strong performance.

India offers a wide range of investment opportunities for chemical companies. To successfully participate in growing the manufacturing base for chemical in India, companies will have to:

- Focus on Sustainability in manufacturing. This would require environmentally responsible processes and input materials, with a renewed focus on self-regulation by the industry.
- Continue to Innovate to maintain high standards of quality and bring in efficiencies to drive down costs and make the industry more globally competitive. Getting the right balance

Owing to the abundance of resources, low cost of manpower and supportive government measures, India is an attractive alternative for manufacturers. To transform our country into a global manufacturing hub, it is important that we invest sufficiently in R&D as well as infrastructural development. Only if we invest in research and innovation, will we be able to compete globally. Additionally, we can only pass on the benefits of our innovation, if we have the capabilities to provide it at an economically feasible scale.

between automation and skilled labour will enable success in this area.

- Support the Make in India initiative by sharing inputs with the Government that will enable us to create a more conducive environment to manufacture and ship out products to the world. Building scale in our plants will also accelerate the growth of India as a critical manufacturing powerhouse for Chemicals

While the COVID pandemic has slowed the momentum towards growth for our industry, we must look ahead at the inevitable growth that the Indian consumer will bring to Indian industry in the coming years.

The future of the Indian economy is not in doubt as it continues to grow to become amongst the top three markets globally. The goal of building a USD 5 trillion-dollar economy remains, although the time frame changes.

After the launch of Make in India by our Honorable Prime Minister how much has the industry progressed and what are the major bottlenecks that have to be removed for India to evolve as an attractive long term investment destination for the indigenous as well as global chemical industry?

The chemical industry in India provides the basic ingredients and raw materials for a number of industries including paints, detergents, agrochemicals and pharmaceuticals. The Make in India initiative was a significant step undertaken by the Government of India and has echoed with the manufacturing sector in India. It is also perceived as the positive turning point for employment and growth of the sector in the country. The program was designed to reduce the turnaround time with regard to clearances of new manufacturing projects; help in the development of adequate infrastructure and help brands, both domestic and international, to do business in India with ease. We are yet to see a significant improvement in the turnaround time for approvals. However, the digital transformation of many of these processes seems to be addressing this challenge.

Furthermore, the Petroleum, Chemicals and Petrochemicals Investment Region (PCPIR) policy that was announced in 2007 needs to be further accelerated since we need more of such initiatives in India. Moreover, we would need to quickly get the “plug and play” concept in order to promote more foreign and local investments, which will provide further impetus to the economy, especially in the backdrop of the current pandemic.

We will all benefit with the improvements

in infrastructure and rapidly developing industrial parks for the chemical industry and higher efficiency in the logistics of imports and exports. Another important factor would be to impart skill trainings to the workforce. Furthermore, focus on ease of doing business, especially in rural areas where much of the chemical manufacturing is largely prevalent will be of great help.

Though many MNCs have set up their production facilities in India, China has always enjoyed the larger share of manufacturing operations for the most (?). In the current scenario, although India is trying to invite investments across multiple sectors for MNCs to make a big switch, how attractive an option would this be for chemicals & specialty chemical manufacturers? What major challenges do you foresee, that will still need to be addressed for investors to set up manufacturing facilities in the country?

It is far easier to setup an industry in China than it is in India and the need of the hour is to bridge the gap. The scale of industries is enormous in China, which enhances their competitiveness. Their infrastructure has developed greatly over the last three decades while India has lagged in this sphere. Moreover, China has woken up to the negative impacts that irresponsible manufacturers can have on the environment and hence, we in India need to self-regulate to ensure that we don't follow the same fate as firms in China in the past.

Owing to the abundance of resources, low cost of manpower and supportive government measures, India is an attractive alternative for manufacturers. To transform our country into a global manufacturing hub, it is important that we invest sufficiently in R&D as well as infrastructural development. Only if we invest in research and innovation, will we be able to compete globally. Additionally, we can only pass on the benefits of our innovation, if we have the capabilities to provide it at an economically feasible scale.

However, owing to the global economic slowdown, there may be an impact on investments in the short term. Additionally, growth in the specialty chemical sector will also rely on how end-user industries such as packaging, agrochemicals, personal care and consumer durables stabilize and grow further. With the Make in India 2.0 initiative, the government has also actively been adopting measures to ensure growth across key sectors and allied industries. ■

Indian Specialty Chemicals Market to be Driven by Sustainable, Eco-friendly Products

Specialty chemicals are low-volume, high-value products that are sold based on their quality or utility, rather than composition. They may be used primarily as additives or to provide a specific attribute to the end product. Specialty chemicals are likely to be prepared and processed in batches, with a focus on value addition to the end product and the properties or technical specifications of the chemical.

The specialty chemicals industry can be categorized into a mix of end-use-driven and application-driven segments. In terms of attractiveness, the various segments across specialty chemicals differ in competitive intensity, margin profiles, defensibility against raw material cost movements, and growth.

The specialty chemicals industry is driven by both domestic consumption and exports and finds applications in home and personal care chemicals, water chemicals, construction chemicals, etc. According to Frost & Sullivan's analysis, the Indian specialty chemicals market is currently valued at $22 billion and is expected to grow at a CAGR of 11.6% over the coming years. The growth of the market is in conjunction with the overall growth of the Indian economy. The "Make in India" campaign is also expected to add impetus to the emergence of India as a manufacturing hub for the chemical industry in the medium term.

Key Factors Pushing the Market

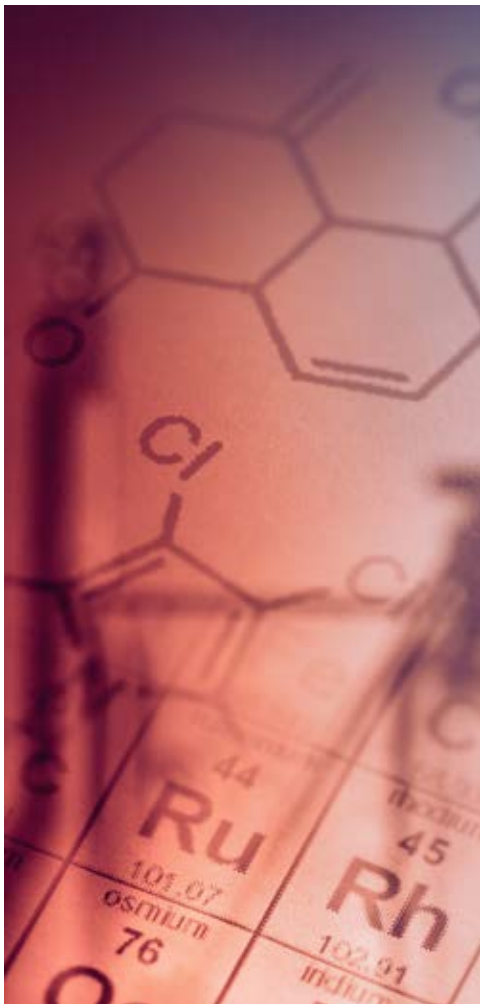
Dyes and pigments, agrochemicals, and textile chemicals form the overall specialty chemicals market in India. These key segments are expected to witness sharp growth in the coming years in India. The current strategy of most pigment producers is to use their local facilities for high-end performance colorants for new and niche markets, and source non-differentiated dyes and pigments from low-cost facilities based in China and India.

Increasing awareness levels among farmers on optimal usage of agrochemicals, resulting in higher yields and an improvement in rural income encouraged by various government schemes, will drive the demand for agrochemicals in the coming years. India is the second-largest exporter of textiles globally.

Rising global and domestic demand for high-quality textile products, growing textile production, favorable government policies, and increasing garments sourcing from India by international brands are boosting demand for textile chemicals in the country. The future growth opportunities in the textile specialty chemicals industry will be primarily driven by diversified and value-added specialty chemicals that provide sustainable, eco-friendly solutions.

Opportunities for India on the Global Stage

Exports are on the rise as India becomes a central manufacturing hub for chemicals. The tightening of environmental norms (e.g. REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) regulations) in developed countries and the slowdown in China are contributing to the growth of exports. China's specialty chemicals market has seen a downturn in recent years due to various factors, primarily the introduction of stringent environmental norms. Tightening environmental protection added new business operating costs and led to factory closures in high-polluting sectors, which weighed on industrial production. Stricter environmental regulations have negatively impacted industrial output since 2017. Also, the recent trade friction between the United States and China has reduced Chinese exports.



The labor cost (hourly cost of compensation) in China was lower than

that of India until 2007. However, from 2005-2015, the average labor cost in China increased by 19%-20% CAGR, against 4%-5% CAGR in India. Over the past five years, this cost has more than doubled compared to India, rendering Chinese manufacturers uncompetitive vis-à-vis India in terms of labor cost.

All these factors are pushing up the CAPEX and OPEX costs, making Chinese chemical companies less competitive in the export market. This slowdown provides an opportunity for India to enhance its share in the global export market.

Commoditization and Environmental concerns

Major challenges facing this industry are commoditization and environmental concerns. The commoditization of specialty surfactants is a huge issue across the specialty chemicals industry, which causes reduced margins and shorter shelf life of specialty surfactants. However, producers are modifying their

business models by offering various types of surfactants, each customized to specific needs. For example, in hair care, different shampoos are formulated to address dandruff, breakage, dry scalp, etc. Environmental concerns and increasing demand for green products by consumers will eventually lead to demand for ingredients either derived from vegetable oils or made using sustainable green manufacturing processes. Although this trend is more pronounced in the US and European markets, it is gradually picking up pace in developing markets such as India.

Growth opportunities critical for success in light of COVID-19

COVID-19 has wreaked havoc on the global pharmaceutical supply chain. The Indian government plans to increase domestic production to avoid reliance on China, which accounts for 65% of India's API imports. The current situation presents an opportunity for domestic players to scale-up, develop alternative sources of supply and investment in backward integration.

Increased emphasis on sanitation and cleanliness has led to a surge in demand for cleaning chemicals, personal hygiene, and personal care products including soaps, surface cleaners, and hand sanitizers. There has been a spike in demand for disinfectants, sanitizers, and soaps in particular, which has led to Indian FMCG companies launching new products to keep up with the demand.

The consumption of essential commodities such as food and medicines has increased due to fear-mongering and hoarding of stocks. The demand for plastics is expected to grow in the medium to long term as companies need to keep pace with the consumer demand for clean packaging options. SKU (stock keeping unit) sizes are also expected to increase until there is a cure.

The rise of Green Chemicals

The concept of green chemicals in India is evolving. Rising pollution and harm caused to water bodies due to the emission of harmful chemical effluents into water are leading to sustainability concerns. With increasing awareness of the ill-effects of certain chemicals on humans and the environment, there is a growing trend in the chemicals industry to shift toward "green" chemicals or, more accurately, sustainable chemistry. These are products that are bio-degradable and show a

significant reduction in environmental impact when applied. This can be either through reducing energy and water consumption in the process or reducing the chemical and biochemical oxygen demand of the waste generated, which reduces treatment costs and doesn't damage the environment.

The classification of "green" or "sustainable" is measured across the life cycle of any chemical product, including its design, manufacture, application, and disposal. The products can be used for various applications, such as food ingredients, home, and personal care products, water treatment, and industrial cleaning products. The demand for green chemicals is particularly high in the textile industry, which is one of the major end-users. Indian companies are adopting green and environmentally friendly standards, starting from raw materials to manufacturing processes. This is expected to gain momentum going forward.

Another challenge is the high initial cost of such products, which is a major hurdle in getting service providers and consumers to accede and adapt to the change toward environmentally friendly chemicals. Although green chemicals are more expensive, their longevity results in a higher ROI.

The inevitable green chemical wave

Low-cost labor and raw material availability are advantages enjoyed by Indian manufacturing companies. Increasingly, though, specialty chemical companies are focusing beyond these traditional cost advantages. Product development capabilities have become progressively more important across various segments and differentiate the top and bottom performers. The green chemical wave is inevitable, and it is just a matter of time before the adoption of these new-age products becomes mandatory and obligatory. People need to be educated about green tendencies, the green chemical revolution, and the benefits of an eco-friendly environment. ■

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Indian Industry must make an effort to meet Global Standards

R S Jalan, Managing Director, Gujarat Heavy Chemicals Ltd *says, Make India has definitely helped the Soda ash industry and investments to the tune of Rs. 5000 Cr have been made in the last 4-5 years. He feels a lot will depend on how well the Government is able to action the policies announced. They must remove the hurdles, ensure timely implementation of projects, ensure cost competitiveness in the raw material prices and bring about reforms in labor and land acquisition laws.*

R S Jalan
Managing Director
Gujarat Heavy Chemicals Ltd

In the present scenario, what kind of impact will the Soda ash industry in India & globally see? How do you think the global supply chains will evolve due as the countries come together to boycott China?

If we look at the Global scenario with respect to the Soda ash industry, China is the largest Soda ash manufacturer in the World accounting for almost half the Global Capacity of around 70 Million MT. However, most of the Soda ash produced by China is consumed domestically and it exports only about 5%- 6% of its annual production. China largely services markets in the Asia Pacific region, which are not producing Soda ash themselves. Thus, China's isolation will not have a significant impact on the Global supply chain for Soda Ash.

What kind of investments is Soda ash industry likely to see across the homegrown manufacturers and from overseas in India? In your view, what would be the major challenges to be addressed?

Current domestic manufacturers are planning all investments in India, in the Soda ash industry. Tata Chemicals & Nirma have both announced plans for brown field expansions & GHCL has announced a Green field expansion of 5 Lakh Metric tonnes at a new site. In the last 4-5 years, the domestic players have made investments to the tune of Rs. 5000 Cr in the Soda ash industry. However, due to the current pandemic, some delays are expected in these projects because of the slow down. There is no known planned overseas investment.

Investors in India are looking at the Government for support on easing regulations for availability of raw materials like salt / limestone by way of fast tracking mining lease allocations as well as land for Salt Field development. Also hand holding on the very tedious pollution control norms, all Soda Ash industries are fully compliant already. Land acquisition is also a bottleneck that the Government needs to deregulate.

The ability to scale up, has been one of the major advantages for the Chinese industry to be highly productive. What are the lessons for Indian chemical manufacturers to learn?

China has been the hub of global production with robust manufacturing capabilities and a supply chain network built over the last thirty years. In India, policy reforms and ease of doing business are important factors, but the most important aspect is our ability to ramp up our manufacturing units to world-class level. We need to adopt a global outlook, best in class practices and ensure that we make ourselves globally competitive. Government policies are important, but Indian industry must make an effort to meet global standards of production and quality ensuring sustainability and encouraging innovation.

How much has the Indian chemical industry progressed towards self-sufficiency after the launch of Make in India by our Honorable Prime Minister?

Make India has definitely helped the Soda ash industry and investments to the tune of Rs 5000 Cr have been made in the last 4-5 years. Things are progressing in the right direction. However, the government still needs to focus on the ease of doing business, reforms in land acquisition laws. There has to be an increased focus on improving transport infrastructure and the speed of decision-making needs to improve considerably if we want to take advantage of this initiative.

In your view, what kind of opportunities will the whole initiative towards 'Atmanirbharta' create for the MSME sector? What support should the Government offer to accelerate the development and protection of this sector?

We believe this initiative towards 'Atmanirbharta' (self–reliance) presents India with a huge opportunity and can ensure the right impetus for domestic manufacturing. With a population close to 135 crores and the huge talent pool, a self-reliant India can be a huge opportunity for the entire nation. However, this must be implemented well. The Government needs to offer support to the industry in matters of Policy and the industry too must come forward, take up the challenge, identify opportunities and invest in the economy.

What are the paradigm shifts that the industry is likely to see & how should Indian chemical industry prepare in the near future?

The fact that the Indian population and the Government of India has acknowledged the need to be "Atmanirbhar" is a huge paradigm shift we are witnessing. This could have a very positive impact on the Indian economy. India is now looking at having more and more homegrown manufacturing facilities, which, is a huge shift from the talks about a Global supply chain until some time ago. However, post COVID, the World has come to realize that global supply chains are vulnerable and dependence on the same could be fatal. Especially for the Chemical industry, which forms the base for almost all industries and touches every human life in one way or another.

This demand for more self –reliance presents the industry with huge opportunity in the future. There is scope and willingness but how well we are able to realise its full potential is yet to be seen. A lot will depend on how well the Government is able to action the policies announced. They must remove the hurdles, ensure timely implementation of projects, ensure cost competitiveness in the raw material prices and bring about reforms in labor and land acquisition laws. Entrepreneurs too, must be ready for the long haul and be patient for the return on investments. ■

Impact of COVID-19 Pandemic on Investments in the Chemical Industry

Ajay Garg
Managing Director, Equirus Capital (P) Limited

Isaac Newton in his seminal work 'Philosophiae Naturalis Principia Mathematica' published the laws of motion, which included the treatise that given an absence of external force, all bodies tends to maintain inertia. While Newton's work was supposed to cover physical bodies, civilizations and societies tend to demonstrate the same resistance to sudden changes. COVID-19 in its geographical coverage, scale, coverage and global response is unprecedented in recent history and offers an external force that will have far reaching implications on societies in general and commerce in particular.

While the current lockdowns (or various versions of it across the globe) will significantly impact economy and chemicals industry, we foresee that governments and central banks will ensure that the recovery is rapid and impact on global GDP is transient in nature. Despite the affirmative actions, we believe that globally the crisis will lead to a renewed aversion to debt and postponing of capex and capacity additions in the medium term. However, this crisis is expected to intensify a few

global trends that were visible even prior to COVID-19. A few of them have been highlighted below:

Global markets for chemical products

The longer-term impacts will be felt in the way businesses and supply chains are structured. The complete disruption of logistics has made many countries and purchase managers realize the perils of outsourcing and over dependence on China for significant percentage of their product requirements. This will further hasten the process of de-risking supply chains in chemical industry away from China which started as a result of China strengthening its pollution norms and got further accelerated during the Sino-American trade dispute and concomitant tariffs. and has already led to businesses looking at geographical diversification. The key traits of any location to emerge as a credible competition to China includes availability of petrochemical feedstock, sizable domestic market and [ ] in addition to factors like ease of doing business.

India scores well on most of the parameters and is ideally placed to emerge as a credible alternative to China in chemicals manufacturing sector. India's share in global chemicals trade by value is ~3% with established credential across speciality chemicals segments like intermediates for APIs, agrochemicals, flavours and fragrances, dyes and pigments - segments with total value in global trade of over US$220bn. China's share in the above segments is ~3 times that of India and we foresee the gap to reduce over the next decade with companies shifting production capacities to India.

To reduce import dependency and improve exports, chemical industry in India will need an investment of ~$75bn over the next decade including an investment of $10bn over the next decade to make basic chemicals such as butadiene, ethylene, propylene and other derivatives to meet the Indian chemical industries' raw material requirements. Indian companies have tried to address this through a combination of incremental CAPEX in India and partnerships with entities outside India to secure alternative and cheaper feedstock.

Indian markets – focus on domestic manufacturing

India is the sixth largest producer of chemicals globally and third largest producer in Asia in terms of output. The country ranks third globally in the production of agro-chemicals and contributes around 16 per cent to the global dyestuff and dye intermediates production. Indian chemicals industry is a ~U$175bn industry which is expected to grow to US$300bn by 2025 at an estimated CAGR of 9%.

- **Low per capita consumption offers large untapped opportunity**

As per FICCI report on the sector, the per capita consumption of chemicals in the country is one-tenth of the world average with India being one of the low consumption countries even among developing nations. The COVID crisis is expected to cause long standing changes to personal hygiene habits across the social and economic spectrum which when combined with government initiatives like Swachh Bharat Abhiyan should help sustain strong domestic demand in the long term

- **Import substitution**

India imports ~US$50bn in chemical imports with a trade deficit of ~US$17bn. Petrochemical building blocks, intermediates and polymers form over 50 percent of India's chemical imports by value. These intermediates are vital links in the Indian chemical industry and act as feedstock for specialty chemicals, which in turn are used to produce a vast majority of consumer and technology products. This high dependence is despite the fact that India is largely self-sufficient

in Naptha, the key raw material for a large set of petrochemical building blocks and polymers.

Over the past few years, India has been pushing its chemical industry to reduce dependence on China and manufacture key raw materials in India. As per industry body 'Indian Chemical Council', to reduce import dependency and improve exports, chemical industry in India will need an investment of ~US$75bn over the next decade including an investment of US$10bn over the next decade to make basic chemicals such as butadiene, ethylene, propylene and other derivatives required for the petrochemical industry to meet the Indian chemical industries' raw material requirements. Indian companies have tried to address this through a combination of incremental capex in India and partnerships with entities outside India to secure alternative and cheaper feedstock.

While on the feedstock side, Indian petrochemical companies have already announced plans to invest over US$15bn in building incremental petrochemical capacities over the next 5 years, companies in speciality chemicals space are expanding manufacturing capabilities to take advantage of the increased demand in India as well as exports.

The sector is being supported by various GoI initiatives including the renewed focus on reviving the four 'Petroleum, Chemicals and Petrochemicals Investment Regions (PCPIR)'. The four PCPIRs in Andhra Pradesh, Gujarat, Odisha and Tamil Nadu are aimed to reduce overall capital expenditure of chemical companies by building common infrastructure of utilities, pipelines and Effluent Treatment Plants, and strategically located at ports for easier access to both domestic and global markets.

- **Focus on sustainability**

Sustainability and adherence to global best practices and environmental norms will play an increasingly role in selection of industry partners and suppliers with various stakeholders placing a premium on it. While Indian companies may need to re-evaluate their business processes and policies, their long track record in working with leading pharmaceutical and consumer companies will help them in being better placed to rise to the occasion as compared to other competitors.

All of this leads us to believe that Indian chemical sector is entering a golden period which will witness the industry witnessing rapid growth. While this will require significant capital, we do not foresee it as a challenge as are witnessing significant interest from pools of capital (debt as well as equity) to be a part of the growth story and to enable the sector's growth. ■

Impact of Digital Acceleration in Specialty Chemicals

Progresses in networks and sensors, data accessibility and processing, engineering and material technologies all embrace substantial potential for intensifying competence and efficiency in the chemical industry. Nevertheless digital transformation in chemicals also presents noteworthy opportunities to upsurge innovation in products and solutions for example; digital crowdsourcing platforms can be used for ideating on by what method to lower the carbon footprint during a product life cycle.

Dr. Pranjal K Phukan
Honorary Director (Strategy),
ICTMAE

Initial results for chemical companies comprised of substituting manual alterations to production units with distributed control systems (DCS) and the use of computer representations to predict performance in reactors. Digital technologies can nowadays guide improvements at all phases of an asset lifecycle from unit design and operations optimisation together with production and supply chain to upkeep programs. Countless tools are additionally sophisticated to meet the precise needs of chemical producers across the comprehensive blend of raw materials, technologies, production processes and markets.

The curiosity in digital tools is really fast-tracking as many companies comprehend the power such tools can deliver and see competitors keenly assuming the fresh solutions and seizing the benefits and in this competitive industry, companies cannot afford to be left behind.

Manufacturers of specialty chemicals face predominantly tough challenges owing to the intricacy of operations and the cumulative variety and number of products which their downstream customers need. Specialty chemicals necessitate greater efficiency in

innovation and new product introduction associated to commodity chemicals.

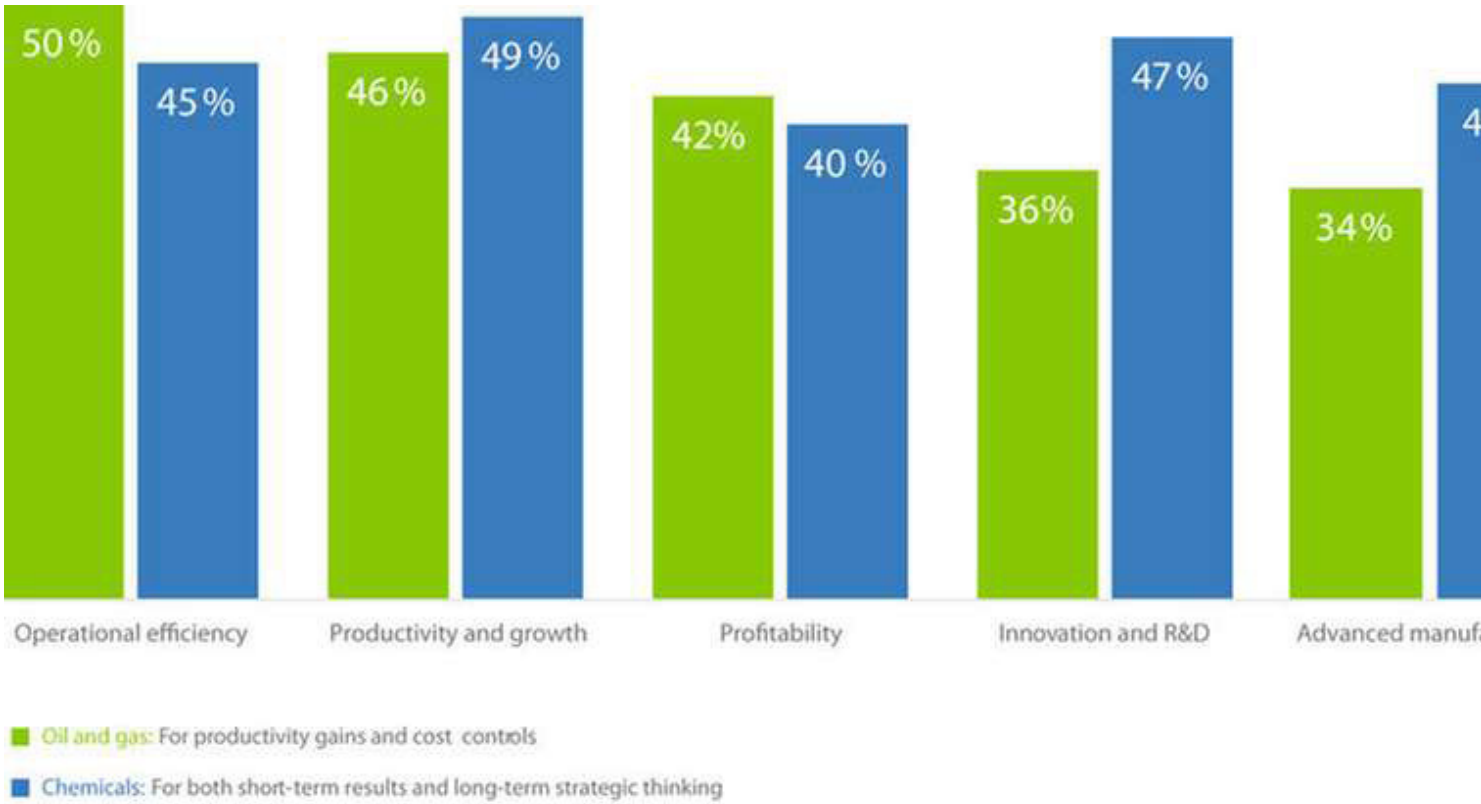
Permitting technologies to reveal concealed value

The world-wide chemicals industry has been in a maintainable up cycle for several years now and innovation,

sustainability and supply chain continue to be the key high significance strategic areas for the sector. Relating digital technologies is becoming a calculated imperative in many industries including the chemicals sector. Moreover, BASF's website states that digitalisation presents immense opportunities for us because by means of digital technologies and data they are making additional value for their customers and growing the efficiency and effectiveness of their practices.

Chemical industry's response

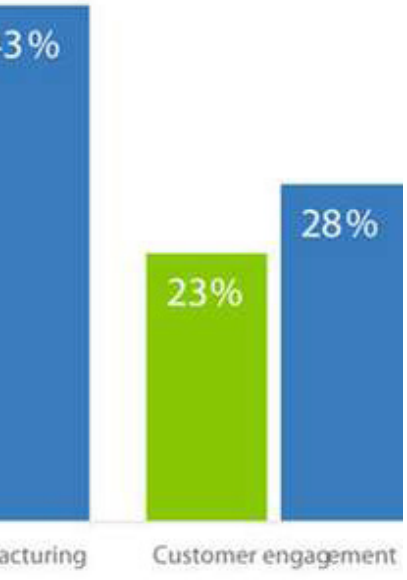
Even though various chemical companies are aggressively working to use digital



"2018 Oil, Gas, and Chemicals Industry Surv ey." Deloitte, October 2018

technologies in their business but by utmost accounts the industry is lagging. Moreover, in 2017, the Deloitte report titled Digital Transformation: Are Chemical Enterprises Ready? stated that most chemicals enterprises lack a digital roadmap or strategy wherein the authors quoted several likely reasons for the slow development from the challenge of large capital projects to the absence of confidence in and familiarity of digital technologies.

Additionally, in its 2018 update, Deloitte had reported certain progress but still regarded the chemical sector as a 5 on a scale from 1 to 10 even as 85% of executives rely on that the chemical industry is temperately to highly digitally mature. Also, Deloitte reports that chemical executives admit the value of installing digital technologies to achieve operational efficiency and output while too addressing key challenges in R&D and in complex manufacturing surroundings. These challenges are characteristically leading worries for specialty chemical companies. Chemical companies are alike to oil & gas companies in operational efficiency and productivity concerns but have larger need for innovation and advanced manufacturing.



Leaders for transformation

Foremost companies are hosting new organisational methods to digitalisation as they perceive value across their portfolios and line up their organisations to best seizure the advantages. Evonik established a digitalisation subsidiary and named a Chief Digital Officer in 2017 and has subsequently moved to invest 100 million euros in evolving and testing new digitisation technologies.

Apart from that, Wacker Chemie has also launched a new program to develop digital revolution across its supply chain. In its 2018 annual meeting, President-Rudolf Staudigl acknowledged the value thereby stating that digitalisation will help them satisfy customer needs even better. Hence, it is a subject that incorporates the entire supply chain from product development and manufacturing right through to customer service. Moreover, in 2018, Dow added Chief Digital Officer to its Chief Information Officer title to strengthen the company's stress on digital tools and CDO & CIO, Melanie Kalmar leads a team of executives, business-line presidents and functional vice presidents to develop Dow's digital policy.

In substantial asset process industries identical to chemicals and refining, leaders are accepting an asset optimisation strategy to augment the entire asset lifecycle by means of digital tools. Asset optimisation has continually been about digital technologies and it is augmented through new developments like Artificial Intelligence, Machine Learning and multivariate analytics and extra enhanced through concepts like innovation, vertical integration and asset lifecycle.

Digitalisation of value opportunities

Digital technologies can efficiently address the ensuing emerging priorities like fast-tracking innovation, optimising through the value chain and aligning with customer demands in the specialty chemicals market. Innovation permits businesses to meet customer demands even though too remaining ahead of challengers. Specialty chemical manufacturers are repeatedly considering

innovating and enhancing product performance at lesser cost frequently with fewer or alternative raw materials. Digital technologies can boost productivity and lessen mistakes by simplifying the changeover from laboratory to plant production processes.

Moreover, manual procedures, hand-written reports and paper-based systems are still common for critical activities such as recipe implementation, quality monitoring and raw material management. These out-of-the-way tools limit perceptibility into data and often delay responses to latent quality issues and regulatory requirements. However, through digitalisation companies gain awareness that permits for improvements in quality and uniformity for example, modelling tools can be used to better forecast and control behaviour in plant reactors.

As soon as evaluating the entire value chain for specialty chemicals producers, technology solutions permit monitoring, execution and control of the manufacturing process. In addition to that, planning and scheduling tools offer significant capabilities that lift responsiveness and associated profitability. Fast changing market and customer demands force recurrent fluctuations in production schedules.

Conferring to some producers, tunings of 25 to 45% each month are not scarce. Scheduling tools provide the best value when connected with manufacturing execution systems, frequently mentioned to as vertical integration so that commercial systems are harmonized with process automation.Enhanced scheduling tools benefit companies to make improved business decisions as deviations occur by integrating key limits such as storage limitations, throughput rates and variable lead times while lessening surplus inventory and off spec production. Improved scheduling competences can too boost asset utilisation and at the same time, schedulers can realize the impact of their decisions and make alterations to evade problems along the supply chain beforehand they occur. By means of targeted plant scheduling tools, the scheduler can trust on the model to notify decisions such as batch size determination, resource selection and batch sequencing and disposition. The technology permits improved asset utilisation and better-quality customer service by clarifying the profit occasions and the additional costs in less than ideal operations. The subsequent step is vertical integration which relates manufacturing systems to scheduling and these systems can contribute visibility

to storage tank levels for example, scheduling tools can choose at what time raw materials should be put in tanks and when they should be emptied. This link can too alert the scheduler if procedures are captivating longer than anticipated letting for tunings across the production plan.

Bringing in line with customer demands is critical for success in specialty chemical markets. Representations of manufacturing assets can be used to mechanize identification and assessment of an assortment of production scenarios across a variety of timeframes and these models characterize the full complexity and preferences possible including production rates, limitations, efficiencies, set-up times, sequencing and site logistics. Specialty companies comment an 8 to 12% growth in on-time order execution when these tools are applied. Meeting customer requirements includes confirming that assets function well and yield the targeted products. Foremost companies are expending multivariate tools to examine inter-related working data to classify and eradicate sources of process variability. Businesses apply this scrutiny to batch and incessant processes to safeguard more production that encounters specification.

Digital acceleration benefits

Companies have accessibility to the tools, services and solutions which specialty chemical producers need to cope their complex operations and achieve new levels of reliability and profitability. The principal step is to deliberate the primary challenge for the business and identify pertinent digital solutions for adopting such tools to set the path towards a more all-inclusive tactic to realizing the highest possible financial return over the complete asset lifecycle. Aspen Technology has been working with leading chemical manufacturers for closely 40 years fast-tracking the digital transformation of the industries by augmenting their assets to run safer, greener, longer and faster.

Three pillars of future of digitalisation

Considering above, chemical companies organizing for the future will thrive based on in what way they execute and react today in three crucial areas as follows:

- Evolution and Innovation: Interruptions in automotive, construction, agriculture and other end-use industries are making opportunities and challenges for the chemicals industry for example, while comparatively novel technologies

like additive manufacturing presently being established but not fully commercialized in many applications from engineering parts to house building might create a need for new materials, at the same time, they possibly will reduce the consumption of traditional chemicals and materials. Maximum chemical enterprises are already re-evaluating future growth policies including considering at digital value-added services to complement existing product offerings.

- Cost optimization & Performance: The succeeding stage of using digital to augment performance ought to go well beyond the plant and readily assimilate with physical assets for example, new digital technologies like block chain and prognostic analytics can be readily combined with existing Internet of Things (IoT) infrastructure to permit track-and-trace capabilities. Moreover, new process technologies like crude-oil-to-chemicals have already been installed in some refinery-scale plants.

- Circular economy & Sustainability: On the way to address regulatory limitations on single-use plastics and micro plastics, chemicals companies are working with their consumers to announce new products, capitalize in recycling technologies as well as include renewable and biodegradable materials in their growing product portfolio. Chemical manufacturers will need to bring together stakeholders for product innovation and technology commercialization with a restructure mind-set.

The way-forward

Chemical industry will need a clear picture of eagerness in the digitalization, particularly the phases necessary to establish a compliant culture that endorses suppleness and learning as with several major enterprises and digital alteration in chemicals is expected to be thought-provoking.

By way of a outline to help present a clear vision for in what way digital and exponential technologies can effect business strategy, chemical companies can realize objectives for the five key dimensions viz., user experience, talent enablement, asset consistency and performance, material system innovation and ecosystems for well preparedness for the next frontier in chemicals. ■

Look at the World as a Market and Broaden the Ambitions

If India is to succeed as a manufacturing destination, then Government investment in large-scale industrial infrastructure must always be a step ahead of industry requirements. Nirmal Shah, Vice Chairman & Managing Director, Chembond Chemicals Limited sees striking synergistic partnerships with established global companies for marketing, manufacturing, licensing with increasing frequency as the way forward.

Nirmal V Shah
VC & MD,
Chembond Chemicals Ltd.

China has been an integral part of the global supply chains including India. How do you think the global supply chains will evolve as the countries come together to boycott China?

Everyone has taken a hit due to the pandemic. Governments have been spending on healthcare and income guarantee schemes worldwide. Most companies have been operating sub-optimally and are raking up losses. Individuals have seen incomes freeze, reduce or worst still have been laid-off. With this as a backdrop, I believe that the priority for all is going to be restoring stability and getting back to profitability. China has been the sourcing basket for the world for chemicals because they have scale and they have outpriced others. So, in my opinion in the immediate term companies will have to continue sourcing from China. However as an option, companies are likely to evaluate establishing alternative manufacturing / sourcing bases. They will spend more effort at this and over few years deleverage supply chains from a single nation dependence. A general feeling is that trade wars will benefit India. I personally feel that there are opportunities that India must prepare to benefit from. But at the same time "boycotting" China is easier said than done.

How do you see the change in investments climate in India across homegrown manufacturers & from overseas companies?

Regulators should focus on building a compliance culture and its enforcement rather than resorting to ad-hoc quick fixes. Investments being directly proportional amongst other things to policy clarity and continuity, will come if entrepreneurs have confidence that their investments will not be subject to delays on account of policy changes or blanket expansion locks imposed on large industrial areas rather than on defaulting units.

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Indian entrepreneurs are increasingly sharpening their ambitions. Building manufacturing capacities to serve global markets and achieve economies of scale seems to be the undercurrent. Striking synergistic partnerships with established global companies for marketing, manufacturing, licensing, etc. is seen as a way forward with increasing frequency. Coupled with this confidence is a sense of pride associated with doing something for the country from within the comforts of our country. So, investments will pick-up in manufacturing. However, many states do not look upon chemical manufacturing favorably. This is perhaps due to blatant disrespect for environmental compliance by many companies. But if India is to succeed as a manufacturing destination, then Government investment in large-scale industrial infrastructure must always be a step ahead of industry requirements. Regulators should focus on building a compliance culture and its enforcement rather than resorting to ad-hoc quick fixes. Investments being directly proportional amongst other things to policy clarity and continuity, will come if entrepreneurs have confidence that their investments will not be subject to delays on account of policy changes or blanket expansion locks imposed on large industrial areas rather than on defaulting units.

What are the lessons for Indian manufacturers to learn from Chinese chemical manufacturers to accelerate the development of industry in India?

Indian industry should look at the world as a market and needs to now broaden its ambitions. Taking larger calculated risks, sourcing technologies and relevant talent globally and, investing in larger capacities to afford economies of scale. The integrity of entrepreneurs in assessing project viability and ensuring its success will allow raising lower cost finance and help build confidence of the financial markets in industry.

In the present scenario, although India is trying to invite investments across multiple sectors for the MNCs to make the big switch, how attractive will this be an option for the chemical & specialty chemical manufacturers?

I am not sure how this will play out. My inkling is that these investments will be sector specific where India already has a track record and relatively well-built ecosystem in place such as pharmaceuticals or where a market is already established or existing such as electronics. Investments will again be dependent on the policy and bullet-proof laws the Government enacts to boost investor confidence. Like India, many

other countries are rolling out attractive policies to invite investments into their countries. Learning from the current situation, I think that companies in the chemical industry are likely to forward or backward integrate operations and consolidate presence across geographies. This opens opportunities for Indian companies to invite investment from MNC's into India or for them to partner with MNC's to make products in India. The potential is enormous.

How much has the Indian chemical industry progressed towards self-sufficiency after the launch of Make in India by our Honorable Prime Minister? To what extent has our government addressed the issues that were restricting the growth of India's chemical industry?

I think much more was expected by the chemical industry than what has been delivered. Some financial incentives have materialized by way of new companies being formed and taking advantages in taxation. But I have not seen any defining chemical industry specific actions taken by the country. Much more can be achieved in this space because we already have a large PSU and private sector presence. Consolidation of PSU's and their expansion has been a talking point for long, but no sizeable achievements have been made yet. I believe there are still some issues holding back unrestricted growth of the industry.

In your view what kind of opportunities will the whole initiative towards achieving self-reliance create for the MSME sector?

India has had a large MSME presence. The initiatives announced to strengthen the MSME segment are laudable. It confirms that the Government also sees this segment as an employment driver, as a contributor to the economy and as a segment that can do much more than it has done so far. The government now needs to keep building sector specific infrastructure on a larger scale. We want MSME's to also think big and be able to compete internationally.

What are the paradigm shifts that the industry is likely to see & how should Indian chemical industry prepare in the foreseeable future?

A shift towards adopting greener and sustainable technologies, digital transformation, supply chain re-routing, and consolidation are going to be some of the shifts I foresee gaining pace. Indian industry will / must invest time and effort in these areas to be in the reckoning to benefit from global shifts in each of the above areas. Profits would be a corollary of being in sync with these changes. ■

Aim for Larger Share in the Global Chemical Value Chain

Parag Jhaveri
CMD, Yasho Industries

Over the last two decades, China has emerged as a leader in manufacturing products across the globe. China has invested a lot of capital to build factories with large manufacturing capacities which reduce the overall cost. Favorable government policies in terms of land acquisition and environmental norms made it easier to operate and set up operations. Hence, China produces a significant quantity of the world's commodity chemical requirements. The situation is not the same when it comes to specialty chemicals where quality and performance are important and investment in research and development is essential. Even today, American, European, Korean, Japanese and even Indian companies are leaders when it comes to specialty chemicals.

When the COVID-19 situation resulted in complete shutdown of manufacturing factories in China, the world economies realized that they were dependent on one country for the supply of key raw materials. Over the last few months, there have been talks in the media for companies to shift manufacturing out of China. However, looking at the

global situation and the dynamics of the chemical industry, this seems to be a challenging task. Any new factory will take at least 1-2 years to start and stabilize production if the project is started today. Further, for any product, there are Chinese manufacturers already existing in the market. The new factory will have to compete against these Chinese manufacturers. Though in India, the government may be able to support domestic manufacturers by implementing anti-dumping duties, competing globally still remains an issue. Chinese companies often have state support unlike Indian companies that are privately or publicly funded. While everyone wants to move away from Chinese dependence, there are very few alternative countries to choose from. India is well positioned to take advantage but there must be a sincere effort by the government to offer land and commitment to long term economic incentives. In the short to medium term, Indian and non-Chinese manufacturers will be able to capture market share where customers are looking to diversify raw material sourcing, ensuring consistent supply and looking at an alternative non-Chinese source.

Opportunities for Indian Manufacturers

India contributes only 3-4% of the global chemical output. Even though Covid-19 has resulted in short term economic disruptions, India's economic outlook remains positive in the medium to long term. The chemical industry in India has consistently created growth for investors and shareholders.

There are several opportunities for specialty chemicals in India.

- As India grows, the consumption of specialty chemicals is expected to increase due to increase in demand of end use industries like agriculture, FMCG, infrastructure, automobiles, electronics and healthcare.
- India imports a significant number of chemicals. Developing products

Over the last few months, there have been talks in the media for companies to shift manufacturing out of China. However, looking at the global situation and the dynamics of the chemical industry, this seems to be a challenging task. Any new factory will take at least 1-2 years to start and stabilize production if the project is started today. Further, for any product, there are Chinese manufacturers already existing in the market.

that substitute import will be a step towards reducing import dependence.

- Indian companies have an opportunity to ramp up exports and obtain a larger share in the global chemical value chain.

To match global competitive levels, Indian companies need to invest in large chemical plants where they can take advantage of economies of scale and be able to compete with Chinese plants. The government at the central and state levels need to work together to implement supportive policy measures and offer cheap land. Specialty chemical companies need to hire skilled personal and invest in R&D activities to stay competitive and offer innovative and quality products.

Anticipated Growth

The specialty chemical products find application in a very wide range of applications wherein in some industries Yasho Industries is a market leaders and has long term global contracts. Jhaveri anticipates significant growth in the rubber, specialty chemicals and lubricant additives businesses. He says, "Even though the rubber industry is facing a downturn due to the Covid-19 situation, we expect demand to pick up by December 2020. Further we compete globally against the Chinese & Europeans and expect to have a deeper market penetration after our recent capacity expansion. Our lubricant additives business has been growing steadily since the last 2-3 years and we expect it to be a major contributor to revenue and profit in the next 2 years."

Up-gradation and Expansion

Yasho successfully completed an expansion at our Unit 2 manufacturing facilities adding about 2500 tonnes per annum of output and in March 2020 the company commissioned Unit 3 facilities for manufacturing specialty chemicals. We continuously invest in our R&D activities to develop new products and improve our processes to remain competitive. Further optimization of plant activities has helped Yasho improve the profit margin over the years. Being a specialty chemical manufacturer, their plants are designed to be multipurpose plants that enables the company to stay agile and respond quickly to the changing market requirements. Complete automation of such processes is not feasible, especially in already existing plants which were not designed keeping automation in mind.

Jhaveri credits the progress of Yasho Industries to the strong focus on R&D activities to develop new products that has continued to drive the growth. While the company does plan to expand capacity, but will take the decision in Q4 after reviewing the economic and market situation. ■

Safety by Design

As per the National Disaster Management Authority (NDMA), during last decade, 130 significant chemical accidents reported across the country, which resulted in 259 deaths and 563 injured people. Author suggests, many of such accidents can be avoided by performing process safety risk assessment of various parameters of using Reaction Calorimeter

Chemical accidents are a serious concern for India. In 1984, India witnessed one of the world's worst chemical disasters, the Bhopal gas tragedy. Thousands of people died due to accidental leakage of nearly 42 tons of toxic gas, in the intervening night of 2-3 December 1984. Besides the deaths, the accident led to physical disabilities in residents of the area and thousands of children born to parents, who had been exposed to the gas, in subsequent years suffered from birth defects.

But Bhopal was not the last accident. India has witnessed a series of chemical accidents even after Bhopal. More recently in Vishakhapatnam area at polymer manufacturing plant in which many residents had to be hospitalized due to breathing problem.

As per the National Disaster Management

Image 1. Mettler Toledo RC1mx calorimeter

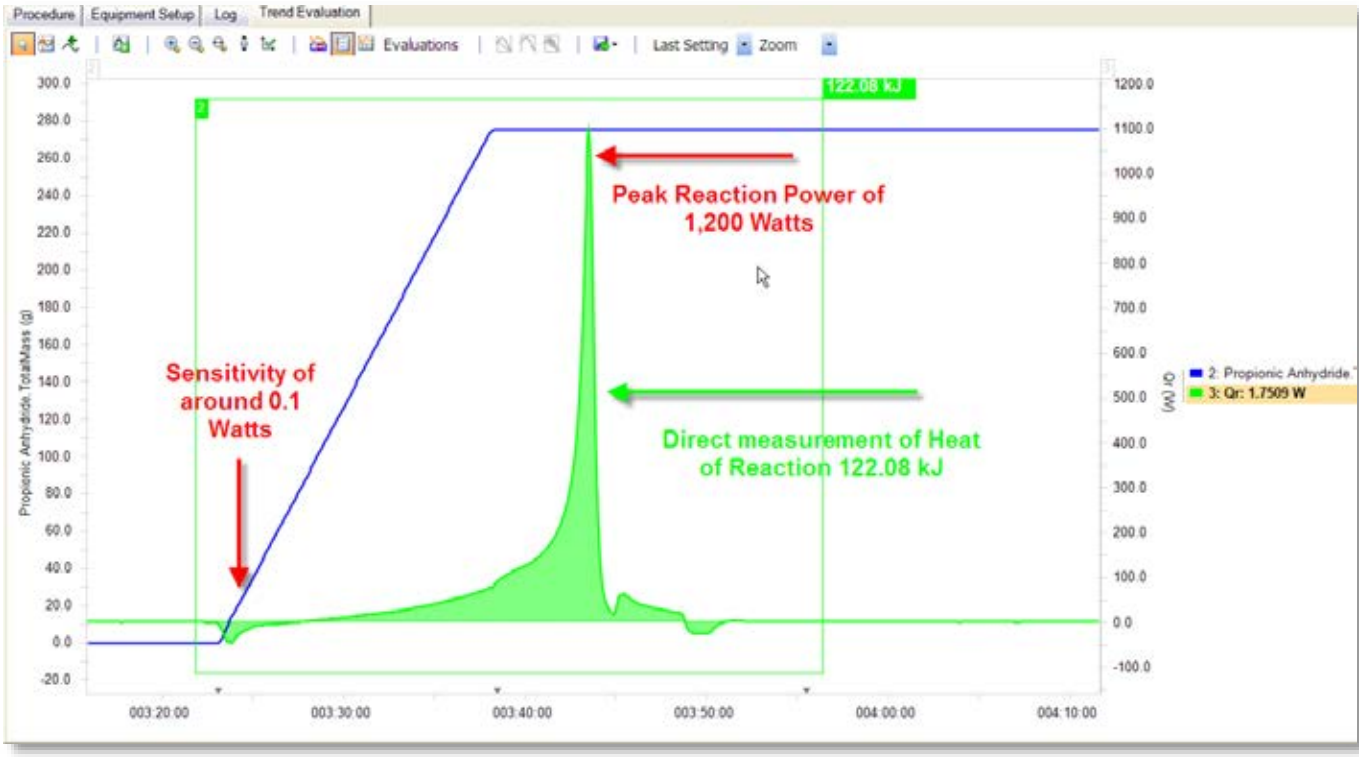

Image 2. Heat flow graph obtained using RC1mx of critical chemical process

Authority (NDMA), during last decade, 130 significant chemical accidents reported across the country, which resulted in 259 deaths and 563 injured people.

In May 2016, a major blast occurred at a chemical plant in Dombivli (Maharashtra), around 41km from Mumbai. In this incident, four persons died and around 85 were injured. Many of such accidents can be avoided by performing process safety risk assessment of the process using Reaction Calorimeter RC1.

Many chemical processes are exothermic and release a defined amount of energy. If the energy released during the chemical process cannot be removed instantaneously, the process temperature rises. Even those processes which are intended to run isothermally will show a small deviation from the target temperature, which may have important implications on reaction kinetics and safety of the process. In order to avoid such incidents, understanding critical process safety parameters becomes crucial.

Reaction Calorimetry can tell us about when the reaction starts and ends from thermal prospective. It also provides valuable information on how much energy is being released and when. With the

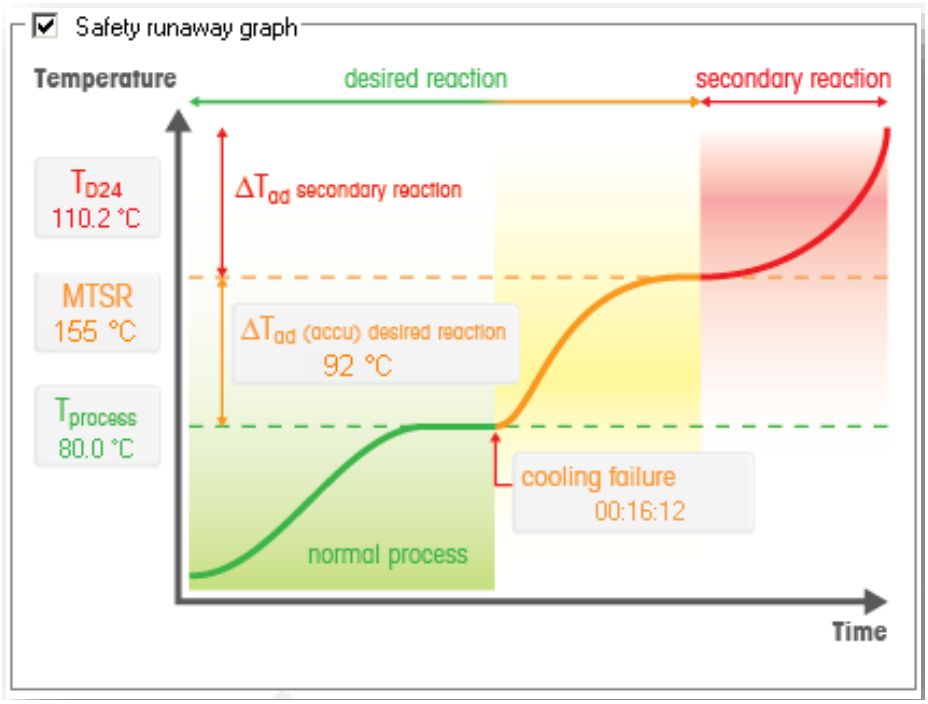

Image 3. Safety runaway graph obtained using RC1

help of modern calorimetry, one can derive reaction kinetics, critical process parameters such as effect of dosing and mixing. Additionally from accurate calorimetric measurements, we can also derive scale-up parameters such as enthalpy per kilogram and requirement of cooling potential for the plant. Safety parameters such as adiabatic temperature rise and MTSR are very important for defining the process criticality.

RC1 is well equipped with the high performance thermostat. It has in-built electrical heater to heat the oil and it has a separate pre-cooled oil cabinet. In case of exothermic reactions, pre-cooled oil can be injected automatically to the jacket to maintain the desired reaction temperature and possible runaway reaction can be avoided during the safety studies of unknown reactions. Due to this unique feature to control temperature accurately RC1 thermostat is also known as golden standard calorimeter.

Following 6 questions help to develop the runaway scenario and provide guidance for the determination of the data required for the risk assessment:

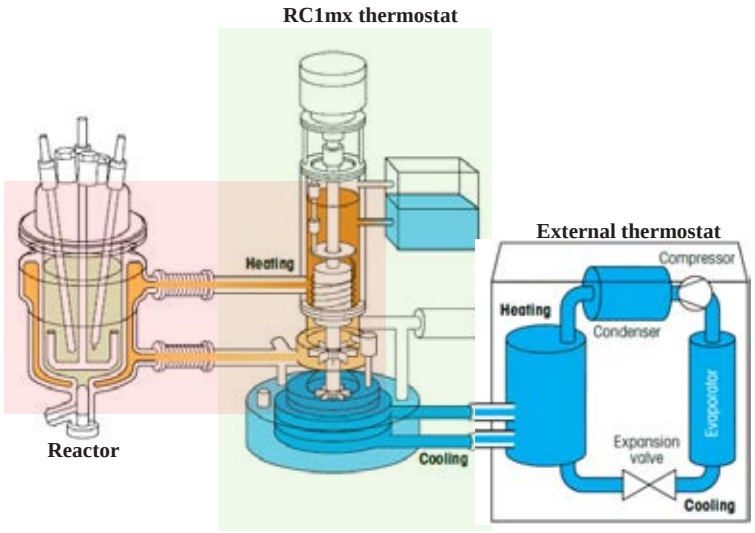

Image 4. High performance thermostat of RC1

1. Can the process temperature be controlled by the cooling system?
2. What temperature can be attained after runaway of the desired reaction?
3. What temperature can be attained after the runaway of the secondary reaction?
4. At which moment does the cooling failure have the worst consequences?
5. How fast is the runaway of the desired reaction?
6. How fast is the runaway of the decomposition starting at MTSR?

One needs to find out the answers to the above questions prior to the first plant scale up and move towards sustainable production. By implementing the culture of safety, an organization can minimize number of incidents, which will result in an increasing its profitability and reputation. ■

Mettler Toledo

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Why baseline ultrasonic intelligent pigging is critical for pipelines

Pipelines operate in some of the harshest environments on earth, and hydrocarbon production in this environment incurs high costs and presents complex technical challenges. Many of these challenges can be found in offshore pipeline inspection, which demands high accuracy, fast turnaround, reliability, data quality, and first-run success. Inline inspection providers must be able to meet all of these demands, so operators are able to make fully informed decisions on future interventions. With highly accurate and fast results, inspection intervals can be extended, required repairs can be performed more efficiently, and the requirement for costly verifications can be reduced.

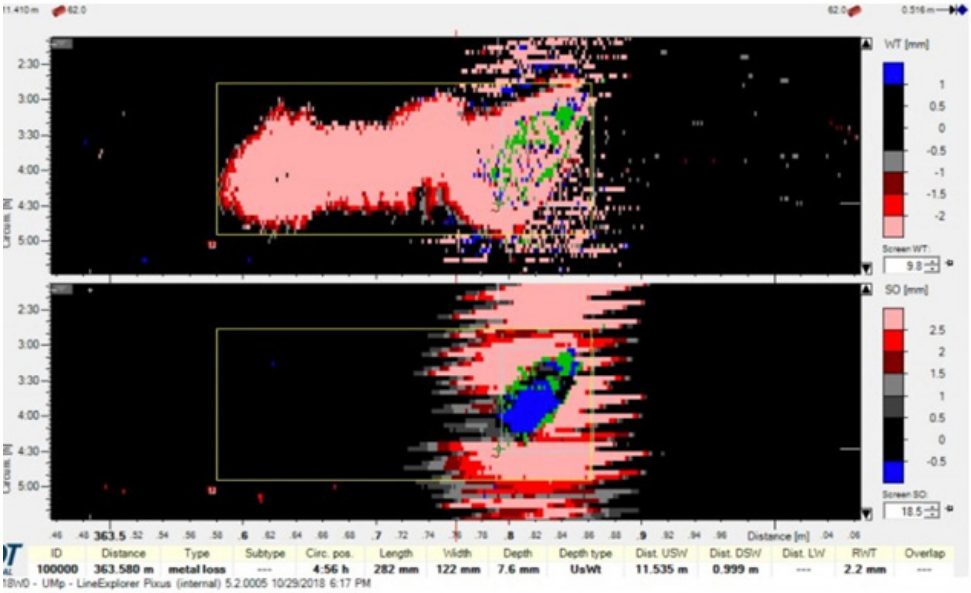

Figure-1: Top - How the defect appears on wall thickness (UM) Bottom - How the defect appears on geometric data (UG)

This article describes the case study from a job in Mexico.

Potential economic value

The six (6) new fields targeted by Pemex (Petroleos Mexicanos – Mexico's National State Petroleum Company) have the potential to increase domestic crude oil production to 210 000 bpd by the end of 2020. This may return the operator's production level to 2 million bpd, starting in the year 2021. This is significant,


Figure-2: Physical appearance of the anomaly on verification

as Mexico's crude oil production had decreased to 1.8 million bpd in 2018. Part of the operator's strategy for the development of these Gulf of Mexico reserves is construction of new platforms and pipelines that will produce, gather, and transport the product. Many of these pipelines will transport high-temperature (over 50˚C), multi-phase (water-oil-gas) product or will be connected to high-flow wells. It is not possible to restrict or limit production from these high-flow wells without incurring the potentially large economic costs of lost production. For these pipelines in particular, the pre-commissioning stage – immediately after pipeline construction is completed, and before the line begins flowing production – is the ideal point for diagnosis and integrity assurance.

The pipeline for inspection

The pipeline requiring inspection was the "Manik-A" Production Platform to "Ixtal-B" Production Platform section. This line has an 8" nominal diameter and is 7.3 km in length. The wall thickness is 9.52 mm (predominant) and 14.28 mm (heavy wall) in the riser and above-water, deck facilities section, with a steel grade of X-52. Potential threats included manufacturing defects (e.g. laminations, inclusions, seam-weld lack of fusion), gouges, and dents. After evaluating available methods to assess the condition of the pipelines, the operator selected NDT Global's trio of Ultrasonic solutions for these baseline inspections. Accuracy was essential, because these inspections established the foundation of an enhanced pipeline integrity programme.

Specific inspection technologies

The EVO Series 1.0 UMp compression-wave robot is used for metal loss inspection; mill anomalies such as

laminations and inclusions; and quantitative wall-thickness measurement, with high resolution for pitting detection

and sizing. Inline inspection with this robot is designed to cause no loss or reduction of throughput, which eliminates a potentially high cost associated with other methods. Inspection speed is also up to four times faster than other methods, and axial resolution is up to four times greater.

The EVO Series 1.0 UC shear-wave robot is engineered specifically for high-precision inspection of axial cracks in the pipe body and long seam welds, including stress corrosion cracking and lack of fusion. The robot provides absolute crack sizing for the full range of crack depths, and does not reduce flowrate.

The EVO Atlas UG+INS is a geometry-specific robot that can be combined with the other robots for combined inspections, to increase inspection efficiency. Multiple data sets can be gathered in a single inspection, without time-consuming calibration. Combined inspections enhance identification of combined defects, as the data is fully aligned. Data analysis uses this amalgamated data with improved identification of corrosion associated with dents. The detection, identification, and sizing capabilities of Atlas UG include dents, ovalities, buckles, wrinkles, off-takes, roof topping and out-of-roundness, and pipe expansion.

Additional challenges

The operator wanted to fast-track the preparation stage of the project. This stage included technical data gathering and reviewal, ILI robot drawing request and release, parts disposal, assembly, and mobilisation. Other challenges included performing ILI robot refurbishment and

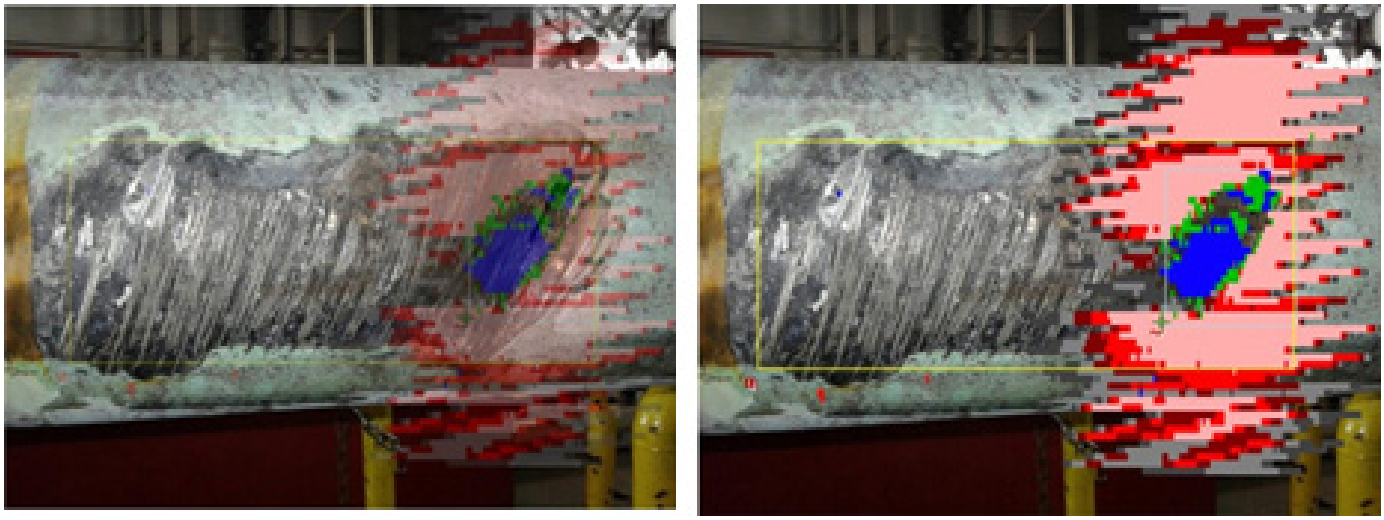

Figure-3: Wall thickness and geometric software image overlaps actual defect image. The inspection data is highly correlated with the damage

modification onboard the work ship. Upon retrieving the robot from the receiving platform, the robot operator disassembled the ultrasonic modules to replace the spare parts, changed the sensor carrier from UMp to UG, and added the INS module. Because all work was performed on the work ship, and the necessary resources had to be onboard as well, less time was required for reconfiguration and preparation. The ability to reconfigure the robot was critical to meeting this tight schedule. NDT Global was able to perform the inspection using two robots, in three runs. Since all three robots could not be provided on such short notice, the UMp robot was modified to UG+INS specifications for that inspection.

Figure-4: UMp sensor carrier during the loading procedure

Additionally, data management was included for an agile run validation and analysis. This function required assuring data transmission, resources to expedite data review and preparation, and adjusting the process for immediate reporting of critical findings. Furthermore, accurate data set correlation was essential, because multiple inspection solutions were providing data. The use of high-resolution ultrasonic geometry is designed to ensure complete coverage of the pipe wall. This coverage is maintained in bends with no loss of data. The absence of mechanical calipers ensures that there is no risk of damage to the robot, and allows the flexibility to perform bidirectional inspections.

Major anomaly detected

A critical reason why the operator chose NDT Global was because of a very tight schedule, with short notice to mobilise and the confidence that this company could provide results. In the pre-commissioning inspection, NDT Global

detected a major anomaly during the run validation. This was an interesting feature that combined both metal loss and a dent, which indicated gouge-type damage.

In order to conform to the operator's schedule, the scope of work specified a run validation in less than 24 hours, which included reviewing the run data and grading the information quality. NDT Global then immediately reported the findings so that the operator was informed in advance and could plan all necessary actions. The feature was detected under the seabed at 70 m depth. After the critical anomaly was first reported, the pipeline failed to pass the hydrotest. As a result of the quick, initial analysis and report – less than 24 hours after the retrieval of the robot – the operator was made aware as to why there was a loss of pressure. The most effective robots are only as good as the analysis of the data they produce. This was a factor in the operator's choice of inspection technologies. NDT Global data analysis personnel are trained according to the latest version of ANSI/ASNT ILI-PQ-2010 In-Line Inspection Personnel Qualification and Certification Standard. The analysis team had 580 years of combined data analysis experience.

An ultrasonic baseline inspection for offshore pipelines provides operators with the ability to better understand the current condition of a pipeline, to help simplify root-cause analysis later in the lifecycle, and to be able to cost-effectively assess any leaks generated during the construction process. For example, the daily costs of a construction vessel trying to locate a leak are approximately US$110 000, with diving costs as an additional expense. The operator was also able to start flowing product through the line, and earning revenue, much sooner. ■

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Downstream Separation of Fusel Oil: Mini Review

If fusel oil are allowed to recycle in plant then they hamper the fermenter completely and cease further process. Removing these components completely is accomplished by energy demanding methods like distillation, however processing of this mixture to obtain pure form of alcohols is a challenging task due to presence of azeotrope in it. Authors discuss alternative methods for separation or reutilization in this article.

Increasing trend in sustainable development shifted the manufacturing processes to the biological path of synthesis. Fermentation processes are most widely preferred method of synthesis for various chemical commodities. Alcohol fermentation processes produce a mixture of C2-C5 hydrocarbons as byproduct and is termed as fusel oil. It is mainly composed of high percentage of iso-amyl alcohol, water, iso-butanol and low percentages of short chain alcohols (C3-C5) and may also contain aldehydes, ketones, fatty acids and esters in very low quantity

(Patil et al., 2002 and Bayrock, 2012). This mixture of components together forms highly viscous dark color liquid difficult to separate by usual physical operations. Since, it is a byproduct of fermentation process, the quality and quantity of fusel

oil generated depends on the type of feedstock used, method of preparation, operating conditions and the environment under which fermentation proceeds. Terms such as fusel oil, fousel oil, finkel, faints and higher alcohols all refer to the high-molecular weight compounds that are obtained by distilling fermented carbohydrates (Garcia, 2008). General appearance of fusel oil is dark green in color with acrid smell. It has a high boiling point between 130 - 132 °C and must be removed from the low volatility fractions during rectification (Mayer et al., 2015). This mixture has an oily consistency and potent odor in concentrated amounts (Bayrock, 2012).

According to the Indian standard specification 0.05 to 0.2 percent of fusel oil is produced in ethanol fermentation process (Rao et al., 1965). In a commercial plant, typical yield of fusel oil estimated may vary between 1L - 11 L/1000 L of alcohol produced (absolute basis). Current industrial scenario has increased biofuel demand and biological route of synthesis of many chemicals and hence fermentation processes have thereby increased producing extent of fusel oil (Pedroza et al., 2015). It is reported (Bayrock, 2012), that 100 MMgy ethanol plant produces nearly 40,000 gallons of fusel oil per year. These alcohols in pure form are valuable raw material for various products ex. biosolvent, extractant, flavor, fragrances, pharmaceuticals and plasticizers (Montoya et al., 2016). Separation of these heavy mixtures from the product stream is essential as they pose a significant risk to ethanol yield. If not properly managed, they can become a part of the process water and recycle to the front end of the plant. It is noticed that fusel compounds are 10 to 15 times more toxic to yeast than ethanol and hence they are safely removed by adjusting the pressure, flow and operating temperature in the rectifier column (Bayrock, 2012). If fusel oil are allowed to recycle in plant then they hamper the fermenter completely and cease further process. Removing these components completely is accomplished by energy demanding methods like distillation, however processing of this mixture to obtain pure form of alcohols is a challenging task due to presence of azeotrope in it.

Source of Fusel and Composition

Fusel oil composition varies according to the fermentation process used and hence quality of fusel oil depends on the substrate used, nitrogenous substances added and the conditions of fermentation and distillation process (Guvenc et al., 2007). Some of the sources of fusel

oil are beer (O'Donovan and Novellie, 1966), brandy (Ebeler et al., 2000), wine (Tang et al, 2017), beet molasses, cane molasses, corn and barley(Hirose et al, 1962) and other sucrose containing substances that undergo fermentation to produce alcohols. Some of the substrates produce either one of the alcohol in excess and others as minor components. Examples of such substrates are listed in Table 1. Since bioethanol plant are majorly practiced, sugar cane is the major source used for its fermentation and due to this fusel oil having high percentage of amyl alcohol is obtained as a byproduct. Typical composition of fusel oil obtained from ethanol fermentation plant is extracted from Ferreira et al., (2013) and represented in form of Figure 1.

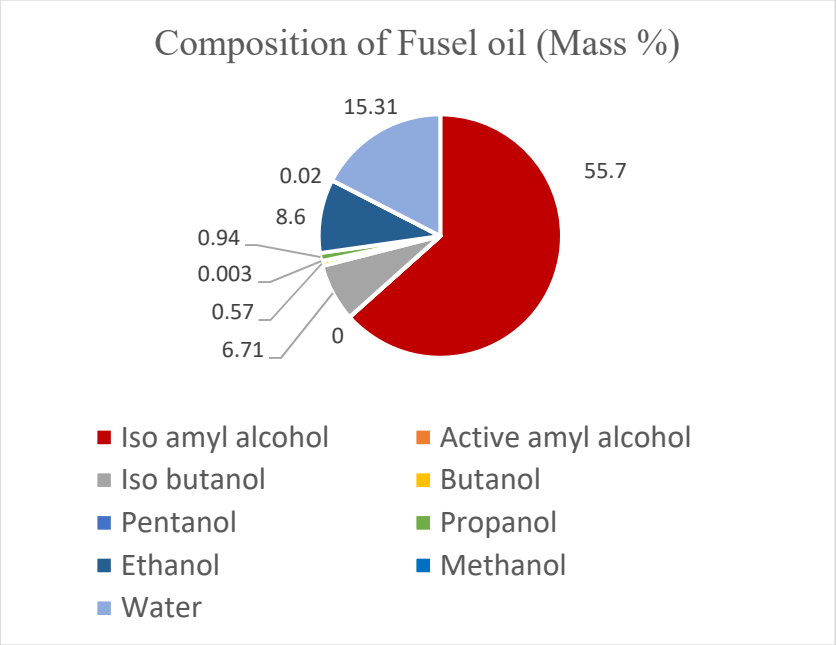

Figure 1. Typical composition of fusel oil from ethanol fermentation.

Origin of fusel alcohol	Alcohol present in excess
Grapes	Butyl alcohol
Potatoes	Iso-amyl alcohol
Grains	Iso-amyl alcohol
Sugar Cane	Iso-amyl alcohol
Molasses	Iso and active amyl alcohol
Corn	Iso and Active amyl alcohol
Barley	Iso and Active amyl alcohol

Table 1: Excess alcohol in some substrates

Potential uses of Fusel

This byproduct is identified as a potential resource in many applications (Simsek and Ozdalyan 2018, Bayrock, 2012, Brau, 1956, and Azania et al., 2011) and some of the potential uses are listed below:

- It is blended with traditional fuels and used in engines due to its high octane value and low production of exhaust emissions. It is also used as an alternative fuel to generate power in factories.
- Used as general solvents for alkaloids, camphor, fats, iodine, phosphorous, resins, sulphur and others. Since it is miscible with ethyl alcohol, ether and essential oils it is used as a solvent for fats, essential oil and waxes, rubber,

textile, paints, paper, glass, leather and metal fabricating industries.

- In synthesis of amyl acetate, amyl butyrate, amyl formate, amyl oleate, amyl oxalate, amyl phthalate, amyl propionate, amyl tartrate, and pharmaceutical chemicals such as amyl nitrate, amyl valerate, amyl formate and amyl barbital.
- In the perfume industry, amyl benzoate and amyl salicylate are formed from refined fusel oil.
- In the manufacture of cellulose products, fusel alcohols are used as ingredients of solvent mixtures for synthesis of cellulose acetate, nitrocellulose and cellulose esters and ethers.
- It is used in the beverage industry for the production of flavoring syrups and extracts. It is also used as gloss imparter and promoter of good flowing properties in dopes, lacquers, enamels, paints and varnishes
- Some other industries where it is valuable are the cosmetic, coating in electrical industries and ceramic industries.
- In agriculture as herbicide for weed management and eradication of sugar cane plants.

Thermodynamic Study of components

Thermodynamic study of fusel oil from ethanol plant reveals presence of multi azeotropes in mixture due to ample quantity of water in down streams. Removal of fusel oil from the product mixture was usually achieved by adding water to the mixture, so as to gain advantage of phase separation and separate product ethanol from byproduct (fusel oil), however, this led to excess amount of water in product streams thereby increasing operational cost for ethanol - water separation. Second phase

Component	Boiling Point (°C)	Azeotrope with water	Boiling Point (°C)
n-amyl alcohol	138	n-amyl alcohol + water	95.8
Iso-amyl alcohol	132	Iso-amyl alcohol +water	95.2
n-butanol	117	n-butanol + water	92.4
Iso-butanol	108	Iso-butanol +water	89.8
n-propanol	97	n-propanol + water	87.7
Iso propanol	82.5	Iso propanol + water	80.4
Ethanol	78.3	Ethanol + water	78.1

Table 2: Boiling points of fusel components

rich in fusel oil was a complex mixture, due to azeotropes formation of phase components. Table 2 exhibits details of boiling points of pure components and azeotropes present in fusel oil for C2-C5 alcohols.

It is observed from composition of Figure 1 that, iso-amyl alcohol is major content in fusel oil and hence methods to separate it from fusel were attempted. Literature witnesses use of distillation or reactive distillation as the separation tool for fusel alcohol separation and are discussed in next section.

Method of Separation used

- **Distillation:** It is a well-established technology for separating alcohols based on relative volatility of the components. Bench column is operated under total reflux conditions to obtain maximum concentration in distillate. The sample is loaded to the reboiler and vapours are condensed and collected at stipulated time period. Feed is supplied on hourly basis to maintain the uniformity in flow rates of distillate and bottom products. Major components are collected in cuts to obtain pure separation at specific boiling temperature. Since amount of amyl alcohol is maximum in fusel alcohol, it is distilled at 132 o C until all amyl alcohol is removed from fusel (Hirose et al., 1962 and Mayer et al., 2015). In a Brazilian ethanol production plant, Ferreira et al., (2013) proved by simulation studies that a mixture of iso-amyl alcohol and n active amyl alcohol are obtained in distillate and it is difficult to separate these isomers further by continuous distillation operation. Recently (Pedroza et al., 2015) divided wall column (DWC), the most integrated technology was applied for separation studies of fusel oil. This study reflected total annual cost reduction by 73% with use of this thermally coupled column instead of sequence of distillation columns. Earlier study (Schicktanz et al., 1939) reflected use of azeotropic distillation to separate these alcohol mixtures. Montoya et al., (2011) reported 3 step procedures for separation of iso -amyl alcohol from fusel oil. First step is of acid neutralization, second step is distilling for separating heavy components from the mixture and last step is of stripping, for separation of iso amyl alcohol from aqueous phase. Simulation study (Sulaiman and Gamelseed, 2010) revealed separation of alcohols is possible by proper design of a distillation column.

Continuous efforts are made to isolate isoamyl alcohol in concentrated form with use of integrated technologies. Although method of distilling to achieve pure alcohols is successful to some extent, yet,

it increased operation cost of the whole process making separation to be cost intensive.

- **Reactive Distillation :** This is a proven integrated technology to carry reaction and separation in one unit so as to reduce energy and total operating cost of process. Many esterification reactions are studied with aid of this technology (Sharma and Mahajani, 2003). Reactive distillation (RD) brings advantage of esterifying the alcohols present in mixture in reactive zone and simultaneously separates them in same column. Study of fusel oil esterification reaction was systematically attempted by Patidar and Mahajani, 2012 and 2013. Experimental kinetic data for acetic acid and fusel oil as reactants with Amberlyst 15 as a catalyst was generated. Mixture of four components of higher percentage viz ethanol, n-propyl alcohol, iso-butyl alcohol and iso-amyl alcohol were considered as fusel oil and further investigation were done in reactive distillation studies. Validated simulator was used to obtain the specified product purity with minimum energy consumption. This study reflected RD can be one of the process alternatives for complete utilization of spent fusel oil to valuable product esters. Table 3 depicts some of important findings of fusel oil simulation by distillation and reactive distillation.

Fusel oil content	Observation	Remark	Ref
Bio ethanol distillery	Industrial distillation process was evaluated for the separation of isoamyl alcohol by simulation.	99.4% amyl alcohol separation achieved.	Ferreira et al., 2013
Sugar cane base distillery.	Simulation study of DWC was done to separate alcohols.	20-30 % energy reduction was observed in comparison to conventional column	Montoya et al., 2011
Sugar mills	DWC simulation was done to minimize cost and obtain pure separation of alcohols.	High purity isoamyl alcohol can be produced with minimum cost. 20% energy savings are obtained as compared to conventional column	Pedroza et al., 2015
Fusel oil synthetically prepared	Reactive distillation studies for formation of esters from fusel oil and separation. Validated simulator was used for study	Feasible RD process for separation of esters in pure form is developed.	Patidar and Mahajani, 2013

Table 3: Fusel alcohol separation by distillation and reactive distillation

- **Enzyme esterification:**

Esterification of alcohols is a good option to convert these components into valuable acetates of higher demand in process industry. Conversion of selective alcohol to its acetate is only possible through enzyme esterification. It is noteworthy that, in some enzyme studies (Yilmaztekin et al., 2009), yeast was found to convert higher alcohols into the corresponding acetates. Lipase-catalyzed (C. antarctica lipase) synthesis of isoamyl acetate was successfully done in absence of organic solvents. Enzyme Novozym 435 a biocatalyst was used to study esterification of isoamyl alcohol with acetic acid. Experimental findings revealed conversion enhanced by 75% as compared to conventional esterification reaction (Guvenc et al., 2007). Comparative study of fusel esterification reaction with addition of enzyme and without adding any catalyst was reported by Kucuk and Ceylan 1998. Conversion of reaction in without catalyst was found to be very low as compared to enzyme catalysed reaction.

- **Extraction :** Recently patent was filed (Berglund A. and Rossman K., 2014), where in isoamyl alcohol, iso amyl acetate or mixture where selected as an extractant to separate ethanol water mixture from fusel alcohol. Phase separation occurs, where, ethanol and water are separated as one phase and other phase rich in alcoholic mixtures C2-C5. Alcohol rich phase is subjected to reactive distillation where in isoamyl alcohol is reacted with acetic acid to produce isoamyl acetate. Thus it is combination of two operations extraction and reactive distillation to recover isoamyl alcohol in acetate form.

Analysis of literature

Literature findings on fusel oil revealed use of extraction, distillation and reactive distillation methods for isolating isoamyl alcohol in pure or converted form. Selective separation of isoamyl alcohol needs to be addressed with minimum energy consuming methods. Limited literature is available on exposure of other methods for isolating these components in pure form. Although literature on composition of fusel oil of various substrates are continuingly discussed, advanced methods for recovery of alcohols is still potential topic for research. Some other methods like fusel esterification with efficient catalyst at room temperature and then separation of acetates, application of reactive extraction method and clubbing membrane separation for selective component removal are scarcely discussed and needs more attention.

Conclusion

Recovery of chemicals from fusel oil is vital as they can be used as raw material for other processing industries. Efforts are to be made to recover these chemical in more efficient way. Down streaming processes of ethanol fermentation containing maximum percentage of isoamyl alcohol is separated by application of distillation, reactive distillation and extraction method. It is noticed that reactive extraction method, esterification and membrane separation are essential to be addressed for recovery of these chemicals in future research. ■

Authors

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Student Outreach Program 2021

Develop Future Leaders

Dr. Raghunath Mashelkar

Chemtech SOP hosted its first **Webinar on 19th June 2020.** The first speaker was **Dr. Raghunath Mashelkar** He interacted with the students for an hour and answered their questions on what the world would be like for chemical engineers post COVID - 19 Pandemic.

Next Generation Gas Analyzers

OmniStar and ThermoStar GSD 350 are compact, portable benchtop analyzers for analyzing gases at atmospheric pressure. They are particularly used for applications in chemical processes, in the semiconductor industry, metallurgy, fermentation, catalysis, freeze-drying and environmental analysis. The gas inlet is fitted with a heated capillary for use at up to 350°C. This prevents vapors from condensing during process gas analysis. Thanks to the two-stage inlet system, an almost segregation-free gas supply is possible.

The ThermoStar solution was specially developed for coupling with thermo balances. The inlet system with a quartz capillary and a platinum orifice ensures that even the smallest concentrations can be analyzed. The OmniStar was developed for a wide range of applications and uses a stainless steel capillary as well as a valve which can interrupt the sample gas stream. Unlike other analytical methods such as FTIR or GC-FID, the two new devices allow simultaneous detection of all gases within the mass range.

For details contact:
Pfeiffer Vacuum
Website: www.pfeiffer-vacuum.com

Smart Technology for Dust Extraction

Dustcontrol UK has entered a new era of smart technology with the launch of two comprehensive control systems that are set to cover up to 90 per cent of its stationary units worldwide. Both high on energy-saving and environmentally friendly, the new Smart Panel and Base Panel will be a gamechanger in the way its stationary machines are operated, offering a high degree of functionality and automation as standard. The Base Panel is a standardised and configurable product with a clear and simple definition of functions and built-in frequency drive. It has been developed as a compact and efficient control system suitable for Dustcontrol UK's central vacuum systems.

For details contact:
Dust Control UK
Website: www.dustcontrol.co.uk

Easy Access to SOx Scrubber Advantages

The new PureSOx Express is an open-loop PureSOx system, but one delivered as a fully enclosed module. Adapted for a simple and cost-efficient fit on smaller vessels, it reduces the investment cost, engineering time and physical work of installing a SOx scrubber. PureSOx Express uses the proven PureSOx technology that's already used on hundreds of vessels . But it can be lifted on board and connected without a specialized scrubber team, which means less work at the shipyard and an installation time of just 10–14 days. Not only is the initial investment lower, the vessel can return more quickly to its money-making operations. Prefabricated and preconfigured, PureSOx Express is designed for up to 75 tonnes of exhaust gas per hour and engine power up to 10 MW. This makes it a one-size-fits-all solution for many vessels of 40,000–65,000 DWT, which typically include bulkers and product tankers. The scrubber is also hybrid-ready, with connections present for a later conversion to a hybrid system. This makes the module as future-proof as it is cost-efficient.

For details contact:
Alfa Laval
Website: www.alfalaval.com

R K Chaturvedi assumes charge as Secretary, DCPC

R K Chaturvedi (IAS), Secretary, DCPC

New Delhi, India - R K Chaturvedi, a 1987-batch IAS officer of Madhya Pradesh cadre, has assumed charge today as Secretary in the Department of Chemicals and Petrochemicals, Ministry of Chemicals and Fertilizers, Government of India. Before being appointed as Secretary, he was serving as an Additional Secretary and Financial Advisor in the Ministry of Culture and also worked as the Chairman of CBSE and as DG in the National Skill Development Authority-NSDA. He has replaced P. Raghavendra Rao who superannuated on 31st May, 2020.

Cabinet Minister takes stock of progress of Talcher Fertilizers Ltd

New Delhi, India - Cabinet Minister of Chemicals and Fertilisers DV Sadananda Gowda took stock of progress of Talcher Fertilisers Limited (TFL). During a meeting with S.N. Yadav, MD and S. Gawade, Director Operations of Talcher Fertilisers Ltd. The company is setting up urea unit of 12.7 Lakh MT per annum capacity at Talcher, Odisha. It is a Joint Venture Company (JVC) promoted by GAIL, CIL, RCF and FCIL. When completed it will be first of its kind in India to employ coal gasification technology for production of urea. The estimated cost of the project is around INR 13,270 crore. The successful completion of the project will reduce India's dependency on imported urea, and is expected to create hundreds of direct and indirect employments.

During the meeting the Yadav briefed about status of progress of the project and various challenges being faced during execution of the project due to COVID-19 crisis. He said that work has started since May and has gathered pace. However, due to issues such as travel restrictions and shortage of laborers the project has got delayed by about six months as on the date of discussion. He assured that the project will be commissioned

Caption- D V S Gowda, Cabinet Minister Ministry of Chemicals & Fertilizers with S N Yadav , MD , TFL

at the stipulated deadline. Minister said that the COVID situation may have delayed the execution of the project at present, we must, however be prepared to compensate current delay by faster execution in future so that the project is commissioned by deadline of September 2023. When commissioned TFL along with other four revival projects at Ramagundam, Gorakhpur, Barauni and Sindri will be able to realise the vision of Prime Minister to achieve self-sufficiency in urea production.

Mansukh Mandviya, MoS, Ministry of Chemicals & Fertilizers

Mandaviya Reviews Revival progress of 5 Fertilizers Plants

New Delhi , India - Union Minister of State for Chemicals and Fertilizers Mansukh Mandaviya held a review meeting with officers of Department of Fertilizers on the progress of revival of 5 Fertilizers plants through video conference . These include Hindustan Urvarak Rasayan Limited (HURL) : Gorakhpur, Barauni and Sindri); Ramagundam Fertilizers and Chemicals Limited (RFCL) and Talcher Fertilizers Limited (TFL). Senior officers from RFCL, HURL and TFL looking after revival of these 5 fertilizers plants attended the meeting. While reviewing the physical and financial progress of all the above fertilizer plants, the Minister directed that the concerned authority may take all possible step for early completion of the projects. He was informed that the Ramagundam Fertilizers and Chemicals Limited (RFCL) has already achieved 99.53 % of physical progress and there has been some delay in completion of small component of physical work due to COVID-19. It is expected that urea production will commence by the end of September, 2020. Similarly, the Minister was told that Gorakhpur, Sindri, Barauni fertilizer plants have achieved 77%, 70% and 69% of physical progress respectively. It is expected that Gorakhpur, Barauni and Sindri plants will be completed before May 2021. He was also informed that the currently Pre-project activities are in progress in the Talcher Fertilizer Plants in Odisha. He was also told that these projects are being pursued vigorously despite challenges posed by Covid-19 causing some delays. Government of India had announced New Investment Policy (NIP), 2012 to facilitate fresh investment in urea sector and to make India self-sufficient in the urea sector. Under NIP, 2012, GOI is reviving the above referred 5 closed fertilizer plants of Fertilizer Corporation of India Ltd (FCIL) and Hindustan Fertilizer Corporation Ltd. (HFCL). The five Public Sector Units under revival are Ramagundam Fertilizers and Chemicals Limited (RFCL), Talcher Fertilizers Limited (TFL), Hindustan Urvarak & Rasayan Limited (Gorakhpur, Barauni and Sindri).

Rashtriya Chemicals and Fertilizers Ltd. (RCF) tripled its standalone profit after tax

Mumbai, India - Despite the current COVID19 situation Rashtriya Chemicals and Fertilizers Ltd- RCF a PSU Under the Department of Fertilizers government of India has been

S.C. Mudgerikar, CMD RCF

successful in keeping its operations running and has crossed Rs. 100 Crores in sales of its Industrial Products in the first two months of the current Financial year 2020-21. Major Products are : Ammonia as refrigerant for nitriding of steel, rocket fuel, pharmaceuticals, Ammonium Nitrate- in explosives for coal mining etc. Ammonium Bi-Carbonate- for bakery products, tanneries , Methyl Amines- in pesticides, dyestuff, pharmaceuticals. Concentrated Nitric Acid: in explosives, pharmaceuticals. Dilute Nitric Acid in jewellry, propellant , Argon for arc welding , Formic Acid in rubber, leather, Di-Methyl Formamide - as solvent for fibres, spandex, polyamides, Di-Methyl Acetamide - as solvent for polyester film, acrylic fibres and Sodium Nitrate : in propellants, explosives.

RCF's Profit after Tax for FY 2019-20 rises 49 % over FY 2018-19. Profit after tax for financial year ended 31st March 2020 surged to Rs.208.15 crores from Rs 139.17 core in previous year. Annual revenue from operations jumped 9 % year-on-year (y-o-y) to Rs. 9698 crores, which is the highest ever since inception. Annual EBIDTA before exceptional items grew 36 % y-o-y to Rs. 711.96 crores. Despite various challenges being faced by the Company, the financial performance for the current year has been better as compared to previous year.

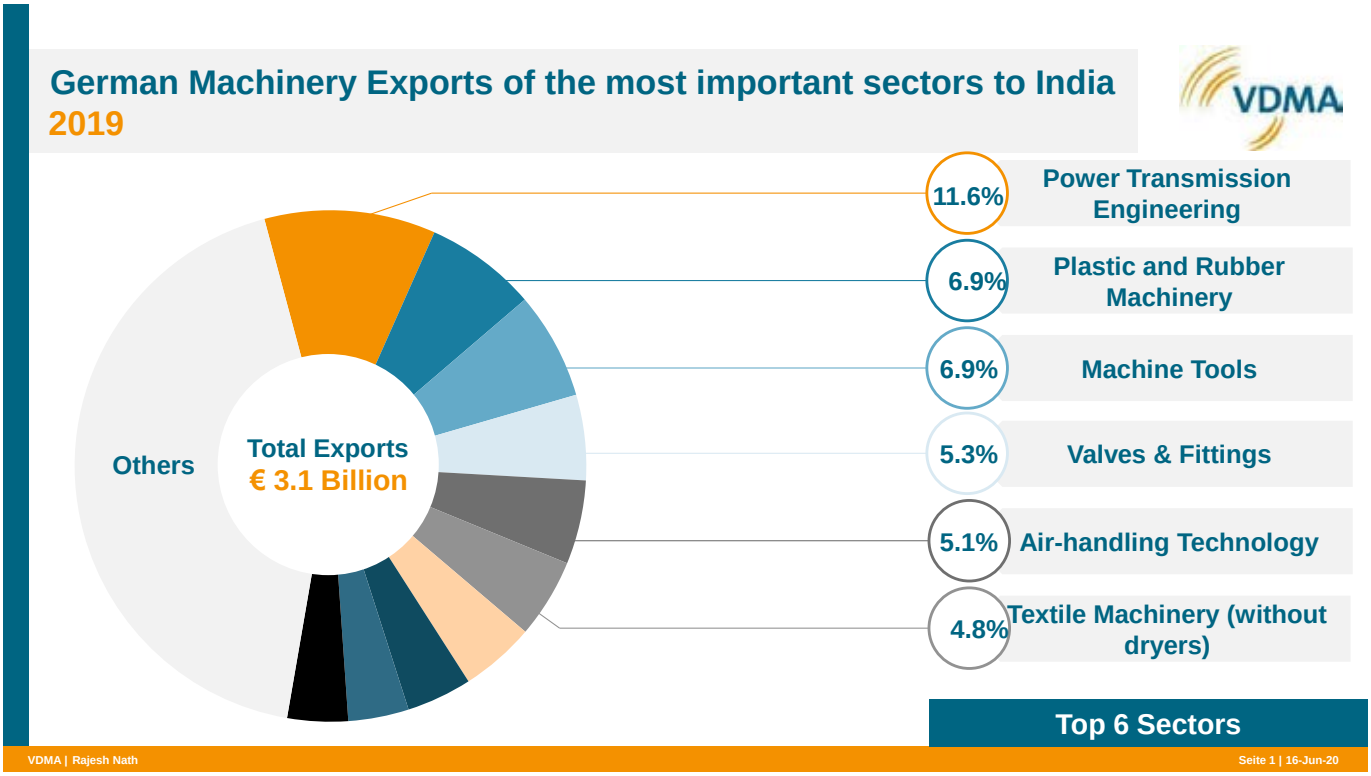
S.C. Mudgerikar, CMD RCF, has stated that during the FY 2019-20 the overall sale of manufactured & traded fertilizers increased by 7% over previous year. Company's Complex Fertilizer-Suphala sale increased by more than 15% over previous year. RCF launched two new products during FY 2019-20 viz. Organic Growth Stimulant & Water Soluble Silicon Fertilizer. RCF commissioned 15 million litre per day capacity Sewage Treatment Plant during FY 2019-20. RCF also got recognized as a State Trading Enterprise for import of Urea on government account & imported 16 lakh MT of Urea.

VDMA analyzes impact of Covid-19 on German Mechanical Engineering Industry in India

Germany is the 7th largest foreign direct investor in India. German FDI into India during 2018-19 was to the tune of $ 886 mn. Germany's cumulative FDI in India from April 2000 to June 2019 amounted to $ 11.9 bn. India is the 6th largest recipient of FDI from Germany. Top sectors attracting FDI inflows from Germany were Automobile industry (37.22%) Services sector (29.34%), Trading (4.87%), Electrical equipment (4.10%), Drugs and Pharmaceuticals (3.27%). These top five sectors accounted for about 78.8% of total inflows from Germany during the last fiscal.

Germany is India's largest trading partner in Europe. The trade volume between India and Germany, during 1st half of 2019, showed an increase of 7.69%. India ranks 15th globally, in the list of top 50 destinations for the German Mechanical Engineering exports. In 2019, the total import of machinery from Germany reached a volume of € 3.07 billion. This was a drop by 8.6% compared with the same period of time in the previous year.

Among the machinery sectors, major demand of German equipment was for Power Transmission (11.6%), Plastics and Rubber



Machinery (6.9%), Machine Tools (6.9%), Valves & Fittings (5.3%) and Air Handling Technology (5.1%). There are other sectors like Construction Equipment & Building Material Machinery, fluid power equipments, Textile Machinery and food processing & packaging, which are growing steadily in India.

Out of the total export of German Mechanical Engineering to Asia of € 41 billion, India is the second largest sales market in Asia for the German engineering industry, with a share of 7.5%, after China (45.8%). In 2019, India imported machinery of the value € 24 bn globally. Germany is the 2nd most important supplier to India globally, share of around 15%.

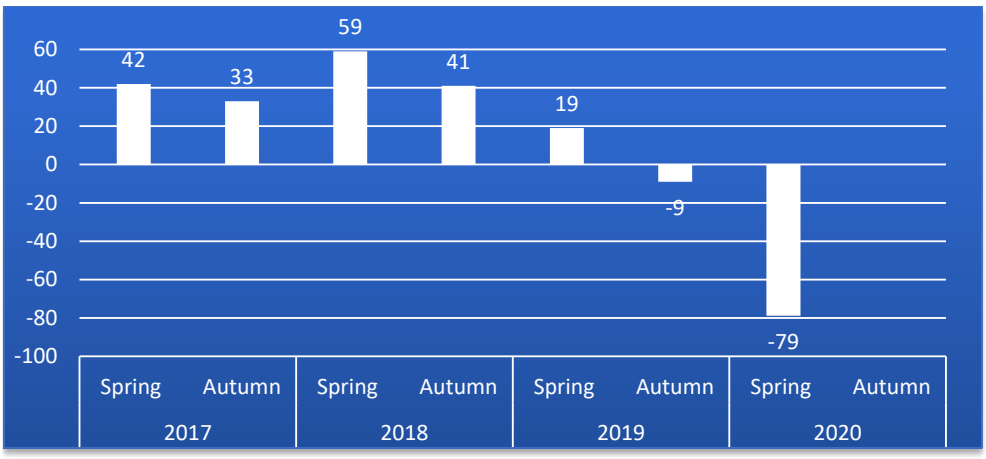
In 2019, India exported Machineries worth of € 756.2 Million to Germany, and showcased a growth of 3.2% over the previous year. The top sectors which experienced the highest demand were Power Transmission, Precision Tools, Valves & Fittings, Compressors and Pumps

VDMA India conducts the VDMA Business Climate Survey twice every year, in spring and again in autumn. This survey is an integral part of our association's activities here in India. And we regard this joint initiative between the association and our members as an additional compass playing a major role in future decision making. Our members are the solid ground of our association. And we express our earnest gratitude for the support and trust placed in us over the years.

COVID-19 has had a major impact on businesses this year and despite the prevailing uncertainty our members were able to share their forecast for the next 6 months. 205 participants from more than 160 organizations across different sectors of the mechanical engineering industry shared their evaluations regarding their company's business and the situation of their most important customer industries.

Mechanical engineering companies in India are much more pessimistic than they were six months ago. This is shown by the results of the current VDMA business climate survey. 2019 was not necessarily the best year for the

mechanical engineering sector in India. Many companies were hoping for a better year in 2020, but the corona pandemic shattered all such hopes.



Diffusion index of current business situation

The diffusion index of the current business situation stands currently at minus 79 percentage points. The index is calculated by subtracting the share of companies reporting a good business situation minus the share of companies reporting a bad business situation.

80% of the respondents assess their current business situation as bad while only 1% felt that their current business situation is good. In autumn 2019, the share was significantly lower (29%). Moreover, the current survey results are the weakest since the start of the survey in 2017. The same applies to the development of the capacity utilization where 75% of the companies report a below normal level. The current level of capacity utilization of their company was seen as "normal" by 54%, whereas 10% are operating at high and 36% at low rates of utilization.

The economic outlook is concerning where 45% of the respondents expect their situation to worsen during the next six months while 25% expect an improving situation. The world has been put in a Great Lockdown and the magnitude and speed of collapse in activity that has followed is unlike anything experienced in our lifetimes. The road to recovery will be slow given the many adverse factors that continue to exert downward pressure on the economy (e.g. lack of orders, labor and raw material shortages, travel restrictions and logistical issues). Companies are forecasting average revenue to decline by 2% compared to 2019.

The restrictions on trade and business due to corona pandemic are the major reason of the slowdown. This could continue to weigh on the Indian economic prospects and business activities of the real economy unless well strategized Government intervention takes place. Industries are hoping for stimulus and other measures announced by the Government to play their role in boosting the economy. What also ails the economy is lack of demand. And the one factor to revive the economy instantly would be "consumption". Thus it is extremely critical to stimulate demand and drive consumption.

Siemens introduces workplace distancing solution for 'Next Normal' manufacturing

Nuremberg, Germany - Using proven software and hardware, Siemens has developed a unique workplace distancing solution that helps manufacturers to simulate and manage employee exposure risks while enabling productivity throughout their facilities. Combination of Siemens' SIMATIC Real Time Locating Systems and Xcelerator portfolio will enable customers

to manufacture with confidence and future-proof their operations.

Manufacturers are facing new challenges as they look to restart or maintain operations during the ongoing COVID-19 pandemic. As preparations are made for the "next normal", manufacturers must consider additional dimensions of employee safety, including the establishment of production environments and workflows that address physical distancing requirements. Combining proven hardware and software, Siemens has created a new solution that enables companies to quickly and efficiently model how employees interact with each other, the production line and plant design. The new solution also enables organizations to build an end-to-end digital twin, in order to simulate worker safety, iterate on and optimize workspace layouts and validate safety and efficiency measures to help future-proof production lines.

With Siemens' SIMATIC Real Time Locating Systems (RTLS), companies can continuously measure distances between workers, provide real time visual feedback to employees regarding their spacing from others and create a log of all movements and interactions over time. In this way the Siemens' SIMATIC RTLS continuously facilitates safe distancing while providing numerous additional benefits.

Combining Siemens' SIMATIC RTLS with a digital twin of the actual manufacturing environment permits companies to model and simulate how employees interact with the equipment and each other, enabling them to iterate and optimize safety and productivity in the short term, and validate a redesign of the entire operation before more costly physical changes are made.

"We are helping our customers create a safe work environment, which is extremely important as they look to produce efficiently and reliably under unprecedented circumstances," said Tony Hemmelgarn, President and CEO of Siemens Digital Industries Software. "The combination of real time distancing management and digital simulations will help companies maintain safe work environments today and make educated decisions about ongoing and long-term optimization."

In order to implement this solution, Siemens' SIMATIC RTLS transponders are embedded in badges which are worn as personal protective equipment by all employees. RTLS receivers placed throughout the operation can then continuously track and record workforce movement. When two employees are in a risk scenario (e.g., less than six feet apart), their badges will display a warning, alerting them to the situation. The data collected over time can be analyzed to identify "hot spots" where risk scenarios occur frequently. Such situations become easily actionable

via the digital twin, which is provided by Siemens' Tecnomatix® Process Simulate and Plant Simulation software. Utilizing the collected data, new manufacturing layouts or workflows can be simulated until one is determined to provide the desired outcomes, which can then be implemented in the physical operation.

Beyond this, manufacturers can add traceability to the solution through Siemens' on-premise solutions or an application such as Siemens' Trusted Traceability Application on MindSphere®, the cloud-based, open IoT operating system from Siemens, which helps enable rapid, comprehensive contact analysis in the unfortunate event of an actual workplace illness. All movement and contact with the affected employee can be visualized, enabling rapid notification of those who came into close contact and selective (rather than site-wide) deep cleaning of exposed physical environments.

"Siemens is providing a powerful, rapidly deployable solution that helps manufacturers take control of their operations and achieve better safety, productivity and cost outcomes today and in the post-Covid era," said Raj Batra, President of Digital Industries for Siemens USA. "Our solution consists of proven technologies that can begin delivering results for most manufacturers in one to two weeks."

Covestro CEO leads European plastics association

European Union - Covestro CEO Dr. Markus Steilemann is the new President of PlasticsEurope, the association of plastics manufacturers in Europe. The 50-year-old manager was appointed to the position on Wednesday for three years. He succeeds Javier Constante of Dow Chemical, who

Dr. Markus Steilemann, CEO , Covestro

oversaw a fundamental reorganization of PlasticsEurope. Mr. Steilemann wants to focus the work of the association even more on promoting sustainabilty and in particular the circular economy. "Given the many global challenges, plastics are vital to create a truly sustainable future and to make the circular economy the new guiding principle," said Steilemann. "In this context, it is important to use endof-life materials and waste as a resource for new products. Under no circumstances should they continue to enter the environment uncontrolled. In addition, plastics as particularly sustainable material must be used in as many areas as possible. This is how our industry can and will help Europe move towards sustainability."

In addition to his new position at PlasticsEurope, Steilemann has also recently been elected as vice-president of the German Association of Chemical Industries (VCI). He is also a member of the European Chemical Industry Council (Cefic) and Chairman of SusChem, the European Technology Platform for Sustainable Chemistry. PlasticsEurope, with centers in Brussels, Frankfurt, London, Madrid, Milan and Paris, represents around hundred companies that produce more than 90% of polymers in the 27 EU member states, as well as Norway, Switzerland, Turkey and UK.

Clariant introduces new pigment dispersions for industrial coatings bases

Charlotte, USA – Constant color adjustments to industrial paint formulas are history! Clariant launches a new line of pigment dispersions engineered for exact color matching, reducing the time and costs related to batch-to-batch reformulations. This novel approach answers a direct need of formulators who work on industrial, automotive, maintenance and other demanding protective coatings. New Hostatint SI pigment dispersions address one of the top challenges for North American manufacturers of solvent-based paints and coatings, the majority of which are used in industrial applications.

Dr. Romesh Kumar, Senior Technical Sales Manager, North America, comments: "Through discussions with customers, we saw a real need in this region's extensive industrial coatings market for pigment dispersions that can deliver consistent color eliminating or minimizing formulation adjustments between batches. Hostatint SI's unmatched, broad compatibility will provide welcome relief from this headache, and it's easy to make the switch. No reworking means great news for optimizing manufacturing time and costs, and maximizing color performance too."

Hostatint SI pigment dispersions are the first "drop-in ready" solution for alleviating problems frequently caused by a dispersion's incompatibility with the diversity of industrial coatings bases, namely inconsistent tinting and finished product color float or post application color rub-up.

Their unmatched compatibility with the broadest range of base chemistries and high quality Clariant pigments make for a less complex tinting process. This results in easier batch-to-batch consistency in the finished coating product and less potential issues for the end user. Color performance and shade consistency are also boosted thanks to best-in-class, tighter tint strength and color shade.

With its market innovation, Clariant has applied almost a century of industry knowledge as one of the first producers of pigment dispersions to achieve a stable, widely-applicable coloration solution that helps manufacturers to focus on their priorities – making highly durable color-matched coatings. The pigment dispersions are suitable for producing or tinting RAL shades, OSHA safety shades, and industrial point-of sale standard shades in a wide variety of coatings systems.

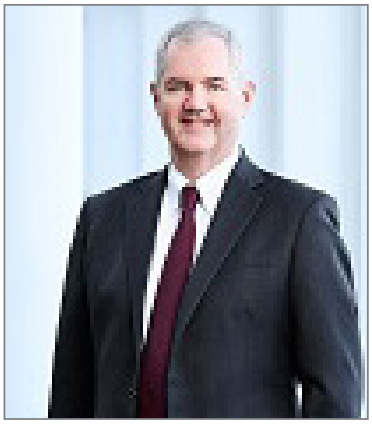
BASF partners with Zhengming to develop PU insulation panels in China

Shanghai, China – BASF has signed a strategic cooperation agreement with Shanghai Zhengming Modern Logistics Co., Ltd. (Zhengming) to develop insulating polyurethane (PU) sandwich panels, for use in the construction of refrigerated storages for the cold chain industry in China. Under the agreement, BASF will support information and technology exchange as well as market development while Zhengming will designate BASF as its PU supplier for all joint cold storage projects. The two parties will also explore joint marketing and promotion opportunities for PU sandwich panels.

"China's cold chain industry has been developing rapidly, driven by increasing living standards and food safety requirements," said Huang Zhengming, CEO, Zhengming. "Owing to the superior fire performance and thermal

insulation of BASF's Elastopir solution, we will be able to bring even fresher food to the consumers through high-quality refrigerated transport and cold storage facilities." BASF's Elastopir is used in the core of insulated sandwich panels. In addition to being energy-efficient and safe, Elastopir also offers customers a more sustainable solution as fewer flame retardants and no bromine are needed for production. "We have typically collaborated with various partners along the cold chain, such as panel producers, to develop PU sandwich panels. This new collaboration marks a significant milestone for BASF, as we are collaborating directly with a cold storage owner," said Desmond Long, Vice President, Business Management, Performance Materials Greater China, BASF. "We would like to thank Zhengming for this exciting opportunity and look forward to enhancing the cold chain supply in China together."

INEOS Styrolution announces change in leadership



Kevin McQuade, Chairman, INEOS Styrolution

Frankfurt , Germany - Kevin McQuade, who has led the company as Chief Executive Officer since January 1, 2015 has been appointed as Chairman of INEOS Styrolution. Steve Harrington, currently President Global Styrene Monomer and Asia-Pacific for INEOS Styrolution, has been appointed as CEO reporting to McQuade.

McQuade began his career in 1980 at Mobil Chemical Company, where he held various technical, production and commercial positions before moving to BASF in 1992 and becoming Business Director for the Styrenics division. Harrington has a 30-year career in the chemical industry, the last 19 years working for INEOS in commercial and senior management roles. He also has prior experience with ICI and Unilever. He holds a degree in chemistry from Hull University in England.

SDK Subsidiary, Hitachi Chemical changes name

Tokyo, Japan - Showa Denko announces that Hitachi Chemical Company, Ltd. (Hitachi Chemical), a consolidated subsidiary of SDK, has resolved at the annual general shareholders' meeting held on June 23, 2020 to change its firm name into Showa Denko Materials Co., Ltd. on October 1, 2020. Details of the decision are as follows. The new firm name "Showa Denko Materials Co., Ltd." represents Hitachi Chemical's determination of opening its new chapter as a consolidated subsidiary of SDK, and now SDK and Hitachi Chemical share the idea of offering their customers and society optimum solutions by combining Showa Denko Group's wide-ranging material technology with Hitachi Chemical Group's material design technology utilizing characteristics of raw materials, ability to evaluate functions, and ability to design functions leading to process technology, including module segmentation. The scope of business for Showa Denko Materials Co., Ltd. will include manufacturing, processing & sales of functional materials and advanced components & systems. The company has appointed Hisashi Maruyama as the President, CEO and Representative Director.

Showa Denko K.K. is a major manufacturer of chemical products serving from heavy industry to computers and electronics. The Petrochemicals Sector provides cracker products such as ethylene and propylene, the Chemicals Sector provides industrial, high-performance and high-purity gases and chemicals for semiconductors and other industries, the Inorganics Sector provides ceramic products, such as alumina, abrasives, refractory/graphite electrodes and fine carbon products. The Aluminum Sector provides aluminum materials and high-value-added fabricated aluminum, the Electronics Sector provides HD media, compound semiconductors such as ultra-high bright LEDs, and rare earth magnetic alloys, and the Advanced Battery Materials Department (ABM) provides lithium-ion battery components. The new name will come into effect from October 1, 2020.

Thermax Group revenue drops 4% for the fiscal

Pune , India - Thermax Group posted consolidated revenue of Rs. 5,731 crore compared to Rs. 5,973 crore in the previous year, down 4%. Profit after tax for the year was Rs. 212 crore (Rs. 325 crore). Consolidated earnings per Rs. 2/- share were Rs. 18.87 compared to Rs. 28.90 in 2018-19. Order booking for the year, at the consolidated level, was at Rs. 5,498 crore (Rs. 5,633 crore), down 2.4%. The overall slowdown in investment globally further disrupted by the onset of the Covid-19 pandemic towards the end of the fiscal had an impact on the group's financial performance on all the parameters. Thermax Group had an order balance of Rs. 5,238 crore (Rs. 5,370 crore), down 2.5%.

On a standalone basis, from continuing operations, Thermax posted an operating revenue of Rs. 3,215 crore as compared to Rs. 3,541 crore in the previous fiscal, down 9%. Profit after tax for the year was the same as last year's Rs. 161 crore. The profit is after considering Rs. 15 crore (Rs.48 crore) of an exceptional item of expenditure on account of impairment loss on the company's investments in JVs and subsidiaries. For 2019-20, Thermax Limited registered an order intake of Rs. 4,058 crore (Rs. 3,325 crore) and an order backlog of Rs. 3,569 crore (Rs. 2,741 crore). For the fourth quarter of FY 2019-20, Thermax posted consolidated operating revenue of Rs. 1,323 crore, down 36.2% as compared to Rs. 2,074 crore in the corresponding quarter, last year. Profit after tax stood at Rs. 39 crore as compared to Rs. 127 crore. The enforcement of lockdown by the Indian government, beginning March end, to contain the spread of Covid-19 disrupted business activities, both for Thermax and its customers, leading to an impact on the revenue and profitability. To prevent health risks to its employees, the company shut down all its manufacturing facilities in India and implemented work from home. The company's international facilities continued operations, albeit at a scaled down pace. Chemical facilities, classified as essential services, resumed production in early April, followed by the progressive reopening of all the other facilities by the end of May 2020 in adherence to Government guidelines.

Promising Results from Innovative Asphalt Research Project

Washington D.C., USA —The Plastics Industry Association (PLASTICS) has released promising results from its New End Market Opportunities (NEMO) for Film Asphalt Project in partnership with the National Center for Asphalt Technology (NCAT). Extensive testing shows that a new asphalt formulation using recycled polyethylene (rPE) film recovered from retail

locations could achieve many of the same benefits of traditional polymer-modified asphalt formulations, including improved performance, decreased cost, and increased lifespan of asphalt. The new formulation represents a sizable end-market opportunity for recycled mixed films. PLASTICS partnered with NCAT to conduct a battery of tests using federal and state transportation standards, a necessary step before large-scale implementation across the U.S. Research shows that even in small amounts, rPE could improve properties such as stiffness and resistance, without cracking due to low temperature or fatigue. With the right blend of rPE and a reactive co-polymer additive, new asphalt formulations match the effectiveness of traditional styrene-butadiene-styrene block copolymer (SBS) at less cost.

"As a leading institute for asphalt research, NCAT was well equipped to work with our plastics industry partners to develop new formulations that can use recycled plastics," said NCAT's Assistant Research Professor, Fan Yin. "This not only creates a new and important end market opportunity but lays important groundwork for further testing around improving the lifespan and performance of roadways using recycled feedstocks – creating an environmental win-win for the asphalt industry." Based on successful lab-scale research on the latest rPE formula, PLASTICS is now working with several companies to use it on privately-funded roadways and parking lots. Asphalt research with NCAT is just one component of PLASTICS' larger New End Market Opportunities (NEMO) project, an effort across the entire plastics supply chain to develop new end markets for post-consumer recycled plastic. Across the globe, attention is focusing on recycled plastics in road projects.

Tony Radoszewski, President & CEO , Plastics Industry Association said that the entire plastics industry is working to demonstrate the application of recycled material and the research will be publicly available in an open source format.

Akzo Nobel introduces new range of corrosion protection coatings

Mumbai, India - Corrosion protection just got easier following the launch of a range of high-performance primers from AkzoNobel's Powder Coatings business. The company's new Interpon Redox range offers customers a one-stop-shop that provides the simplest route to maximum corrosion protection. Four innovative systems were developed to cover a variety of substrates, surfaces, and environments – from swimming pools to chemical plants and high humidity to highly corrosive areas.

The portfolio consists of Interpon Redox Active, a robust primer system with a wide curing window and excellent edge protection, Interpon Redox Plus for durable protection for a wide variety of substrates and pretreatment methods , Interpon Redox PZ , high performing powder primer for corrosion protection over blasted steel and Interpon Redox Triplex an extremely protective three-layer system for highly corrosive environments.

"Interpon Redox is all about bringing simplicity to corrosion protection," explains Daniela Vlad, Managing Director of AkzoNobel's Powder Coatings business. "Selecting the right primer for the right level of corrosion can be a lot more complex than people may think. So, our Interpon Redox systems have been developed with characteristics that address all the variables, making it much easier for customers to pick the perfect coating system."

Long-term performance is paramount for specifiers, who rely on finding the right corrosion protection system for their steel products. However, the process of selecting the right system is influenced by numerous factors, such as the material used and the environment it's exposed to. Interpon Redox helps to simplify this often-complicated decision-making process and offers customers the best possible corrosion protection, in all conditions. "We take great pride in making sure that our customers have absolute confidence in the superior quality of our products and the best-in-class service and support we provide," continues Vlad. "Interpon Redox is the latest example of our long-standing insight into customer needs and industry trends and highlights why we're widely regarded as being the reference in powder coatings." Powder coatings offer inherent sustainability benefits, such as no VOCs, reduced energy use, and less waste.

ELGi Compressors Deliver Energy Efficiency Gains

Coimbatore, India - ELGi Equipments, one of the world's leading air compressor manufacturers, with over 2 million installations across 120 countries continues to expand its footprint in European market. ELGi Compressors Europe, a subsidiary of ELGi Equipments Limited, completed an upgrade of the compressed air system at the Rubber Resources' BV manufacturing site in Maastricht, The Netherlands. Following the modernization project, Rubber Resources – a major player in rubber re-manufacturing in Europe – experienced increased efficiency and lower energy consumption which contributed to lowering their carbon footprint.

Chantal Bulten, General Manager at Rubber Resources, said "Rubber Resources specialises in the recycling of rubber waste, mainly butyl inner tubes and the treads of heavy vehicle tyres, into a product that can be used again in the production of consumer goods and products for commercial markets. Our mission is the sustainable re-use of rubber thus it is our priority to make our processes, especially our compressed air, as energy efficient as possible. It was therefore an easy decision to replace the existing 180kW compressor with a 110kW Variable Speed ELGi EG Premium Series unit, which resulted in us achieving class leading energy efficiency, reliability, and low maintenance costs with a support network and expertise to match. In addition, ELGi managed to install and commission the installation within 3 weeks after we placed the order as per the contractual agreement." Chris Ringlstetter, President at ELGi Europe, said "At ELGi, we realise that energy efficiency is more than a buzzword – it is an operational and socio-economic imperative as well as being market and industry specific. Compressed air in Europe accounts for approximately 10 percent of Europe's total energy output. Energy savings compliance norms for companies in The Netherlands are quite stringent. ELGi's EG Series with its built in variable frequency drive, and the lowest power consumption in its class, has proven instrumental in reducing

the total energy consumption of Rubber Resources' 24/7 manufacturing operations."

Over the last 60 years, ELGi has developed world class products with best-in-class lifecycle costs, resulting in higher uptime for the customer. The EG Series of oil-lubricated compressors provides customers with high-quality compressed air in the harshest environmental conditions, all while ensuring minimal downtime. One of the key attributes of the EG Series is that it incorporates the state-of-the-art technology of ELGi's oil-injected screw element providing a long and trouble-free life at one of the lowest operating cost. The entire EG Series package houses the ELGi designed screw element with ELGi's unique nV rotor profile which is highly efficient and much slower running versus most other units on the market. The in-built ELGi CONSERVE Variable Frequency Drives (VFD) matches compressor output with demand by varying motor speed – reducing power consumption in line with the reduction in demand. Compared to a compressor without a VFD, over a ten-year operating period, an EG Series can have a 34 percent reduction in energy costs.

Grundfos proceeds to acquire Eurowater

Bjerringbro, Denmark - Grundfos has entered into an agreement to acquire Eurowater. This marks an important milestone in the company's ongoing efforts to pioneer solutions to tackle global water challenges.

Grundfos has entered into an agreement to acquire Eurowater, and thereby significantly strengthening its value proposition within the water treatment business. The acquisition aligns closely with Grundfos' strategy to strengthen its innovation leadership within water technology, and supports the company's purpose to pioneer solutions to the world's water and climate challenges and improve the quality of life for people. "Eurowater brings a broad portfolio of solutions and a deep understanding of water treatment applications and end-users. This will enable us to strengthen our value proposition to customers. When complete, this acquisition will further advance us in our important work to address water challenges on a global scale," says Ulrik Gernow, Group Executive Vice President, CMO, at Grundfos and continues: "Eurowater is an outstanding company and we are truly impressed by its organization and the people we have met".

The Eurowater and Grundfos businesses share many similarities, including a sharp focus on innovation and offering high-quality products and value-added services to customers. Culturally, the two organisations match well, both being purpose-driven and highly customer-centric.

"A better buyer does not exist! It is with peace of mind that we leave ownership of our life's work to Grundfos. We took over the company 17 years ago from the Scherfig family, who has owned the company since its foundation in 1936. With the global reach and presence of Grundfos and our extensive experience in producing first class products, we see great opportunities to boost the development of innovative and water efficient solutions to the benefit of our many customers," says Torben Buhl, Managing Director for Eurowater. Headquartered in Denmark, Eurowater serves primarily the European markets with a range of water treatment offerings, with a focus on customers in the industrial and municipal sectors. The transaction is subject to regulatory approvals and is expected to be closed during autumn 2020.

Bungartz receives 2nd largest order in company's history

Düsseldorf, Germany- With a major order for 24 MPCV magnetic drive pumps Bungartz continues its success with intrinsically safe pumps. "In these difficult times for many companies, this order is also a positive signal for the economic development in the country", the managing director Dipl.-Ing. Frank Bungartz is pleased to say. For the new construction of a plant with a planned output of 160,000 tons of titanium tetrachloride (TiC14), highest safety and reliability is required. The medium, which is difficult to pump, forms dangerous hydrochloric acid vapours when it comes into contact with air humidity. For about 10 years BUNGARTZ has been using the magnetically coupled pumps type MPCV for this medium. The vertical pump, in which the pump bearings and magnetic coupling work independently of the hydraulics and thus of the pumped fluid by pure physics, is safe to run dry, requires very little maintenance and is safe against operating errors. With an NPSH of almost 0m it runs cavitation-free and without requiring a minimum volume flow. The future minimum monitoring effort of the pumps and the exceptional service life of the bearings also contributed to the selection. The bearings have been proven to be in continuous operation for more than 5 years.

Kraton joins TfS for sustainable supply chains

Brussels (Belgium), Houston, TX (USA) - Kraton's arrival brings the total TfS membership to 26 multinational chemical companies, jointly representing €424 billion in global turnover (total revenue) and €282 billion in global spend. The membership increase will put TfS in a stronger position to drive sustainability through global chemical supply chains.

TfS President Bertrand Conquéret comments, "I am very proud that since the beginning of 2020, Kraton is the fourth company that decided to become a member of the TfS Community. This underlines that, despite the challenging times, the chemical industry is more than ever committed to putting sustainability at the heart of its business operations and procurement strategies. The arrival of Kraton will make the TfS initiative stronger and will enable it to expand its reach and impact; putting TfS into a pole position to grow into this truly global initiative and make tangible impacts to improve sustainability in the chemical supply chains."

Together with Kraton, the TfS initiative will continue to foster and drive sustainability practices and processes along the chemical industry's supplying companies. This will benefit the sustainability performance of all TfS member companies' business operations, as well as their many suppliers. "Kraton is proud to join Together for Sustainability" says Suzanne Pesgens, Vice President, Chief Procurement Officer Kraton, "As a leading global supplier of styrenic block copolymers and pine chemicals, we aspire to make a Positive Difference. Kraton's alignment with TfS enables us to more effectively collaborate across the industry – from our suppliers to our customers – to accelerate environmental and social improvements." ■

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