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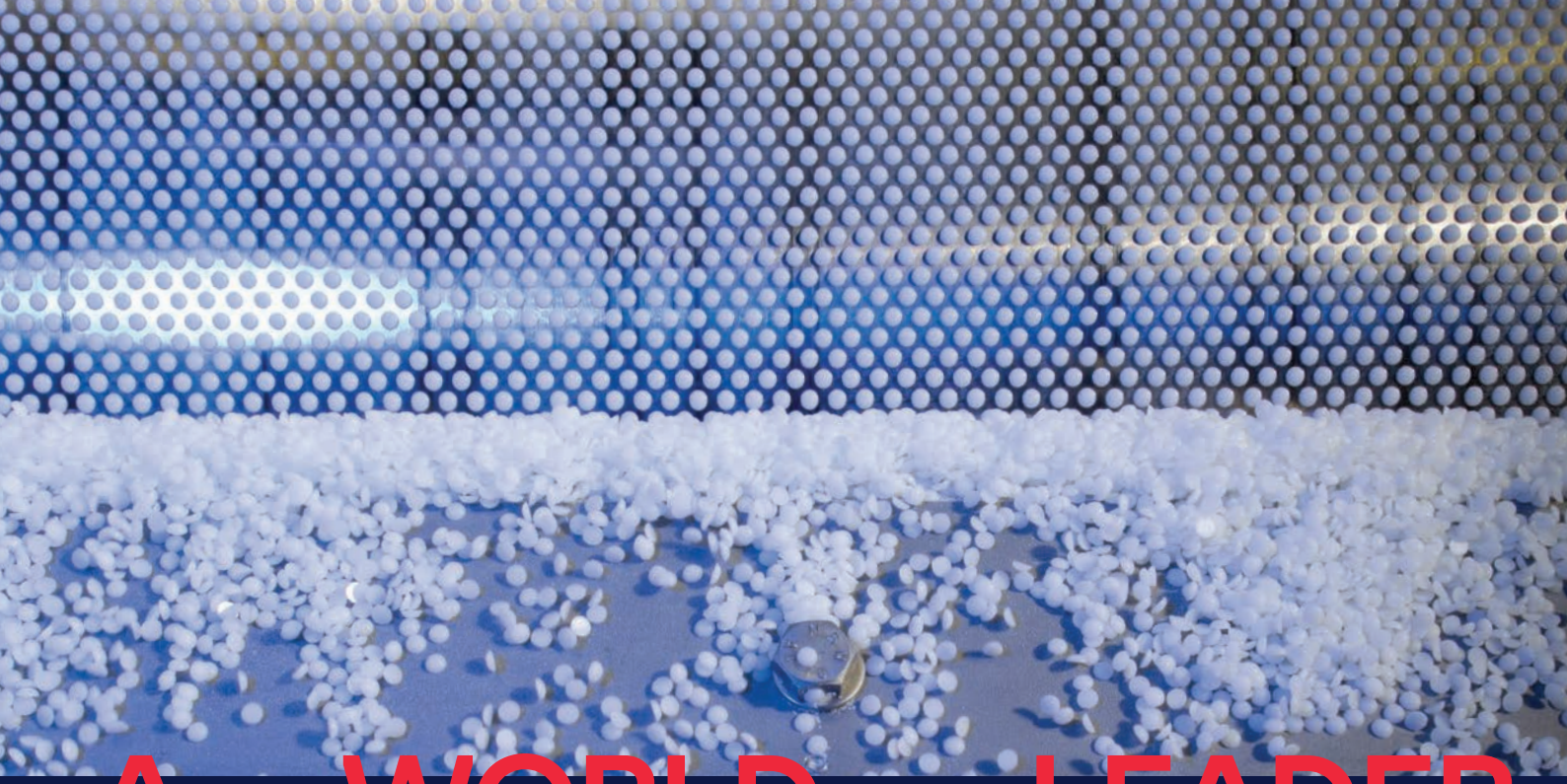

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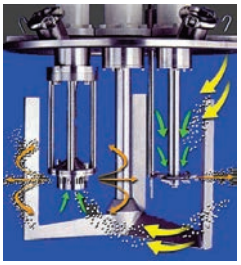

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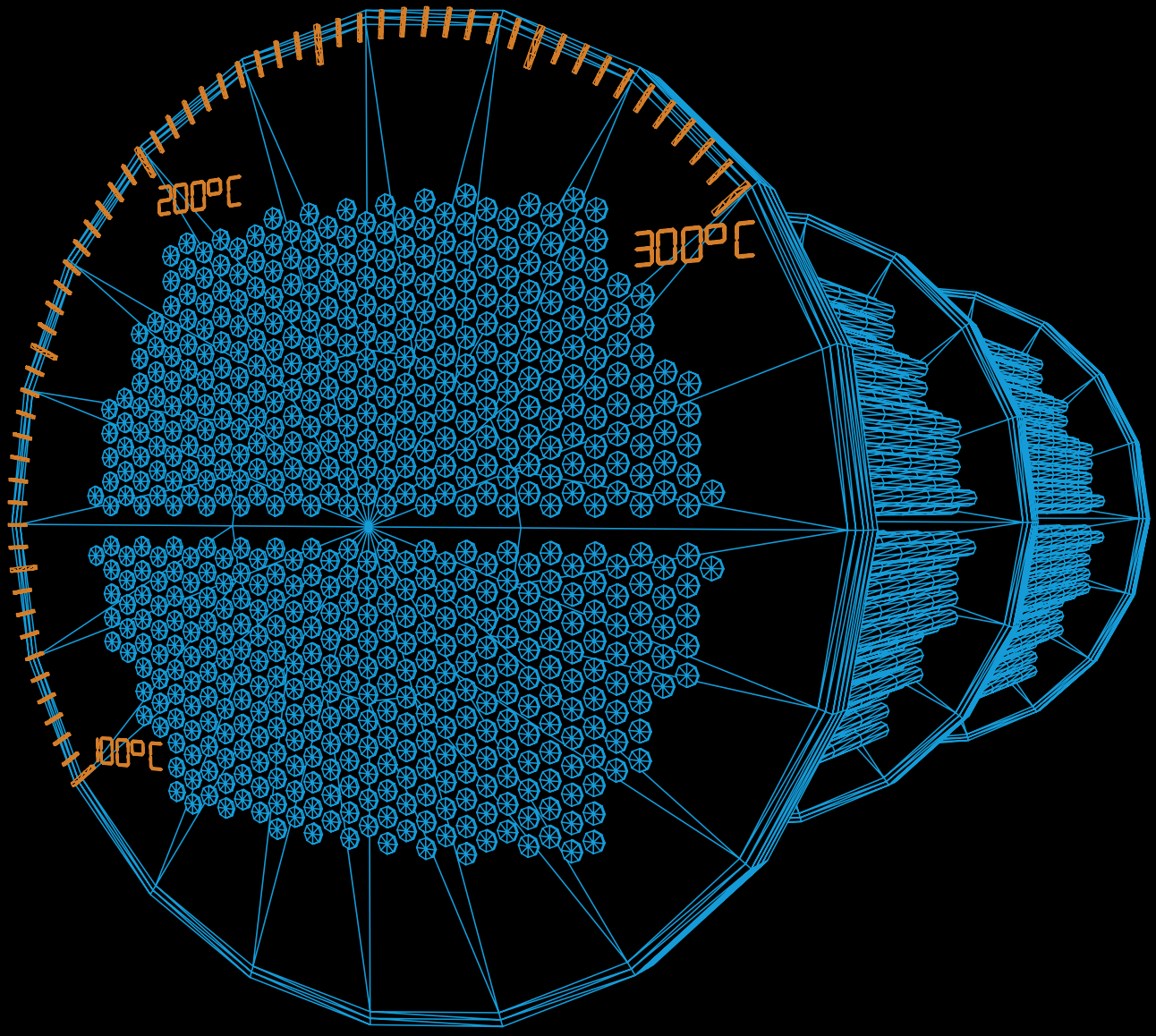

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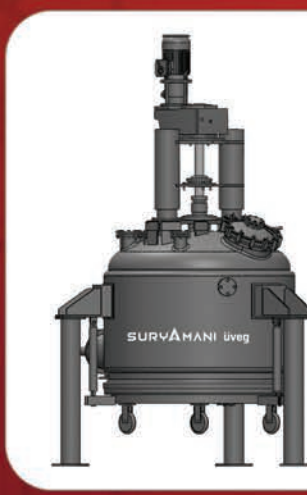

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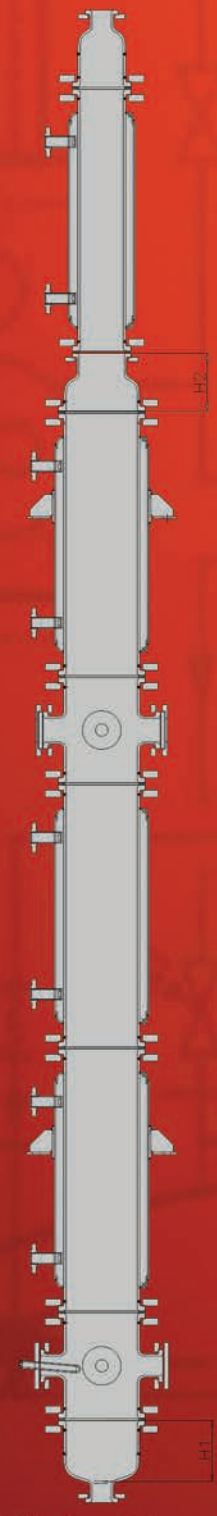

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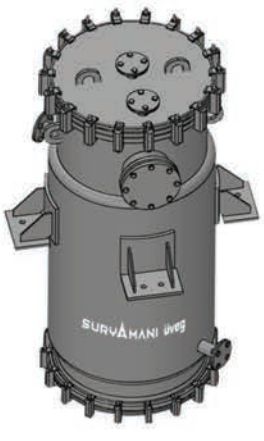
Storage & Condensate Receiving	Storage Tanks Vertical Horizontal



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ONGC promotes Atmanirbhar Bharat, changes procurement policy

New Delhi, India - During a webinar on Vendor Development for E&P Sector requirements – Vision of Aatmanirbhar Bharat, ONGC Directors and key executives showcased how ONGC is pursuing localization of equipment and tools at every location and exhorted Indian vendors to come up in fields where currently India is mostly dependent on import. This vision is in line with the nation's goals of achieving self-reliance across important sectors critical to the economic development of the country.

Encouraging vendor to focus more on localization, O P Singh, Director (T&FS) said, "Indian industry has the ability to locally manufacture items which are currently imported. ONGC will continue to play enabler in this localization, so that vision of self-reliant India is fulfilled."

Anurag Sharma, Director (Onshore) stated that India is the third largest importer of oil and gas and with time E&P efforts will go up. He highlighted that ONGC is pioneer in localization with indigenous efforts. "The Maharatna has played an important role in promoting Indigenization. We have achieved around 60 percent of indigenization but we want to become fully self-reliant. Various policies and measures like OaPL, DSF, small field, and national seismic program have been taken by the MoPNG Ministry. In next few years, the total goods market value will go up 11 billion USD."

Highlighting ONGC initiatives on localization and opportunities, AP Tripathi , ED-Chief Corporate MM, shared the changes in procurement policy of ONGC:

- **PPLC Policy** - Under this policy, purchase preference of 10 percent is granted to LC - lowest techno commercially acceptable bidder.
- **MSME Policy** - In this, participating MSMEs within a price band of L1+15 percent is allowed to supply up to 25 percent of tendered quality subject to matching to L-1price. As per the procurement policy, 358 items are reserved for exclusive purchase from MSMEs.
- **DMEP Policy** - Purchase preference provided to DMEP subject to meeting value additions.
- **GeM Policy -** ONGC has made policy provisions for procurement items available on GeM. The total value of an order on GeM for FY 2020-21 is Rs 37 crores.
- **Global Tenders Policy -** Under this policy, the government has notified that global tenders will not be issued for procurement up till Rs 200 crores and ONGC will be implementing this policy.
- **DMI & SP** - Under this policy, ONGC provides a preference for domestically manufactured iron and steel products. However, exceptions have been sought in the case of 13CR casings.

He underlined that 80 percent of the purchased done by ONGC is from indigenous vendors. Being the leader in localization, ONGC is the first to implement a purchase preference policy. To promote Make in India initiatives, ONGC is already placing development orders to new vendors.

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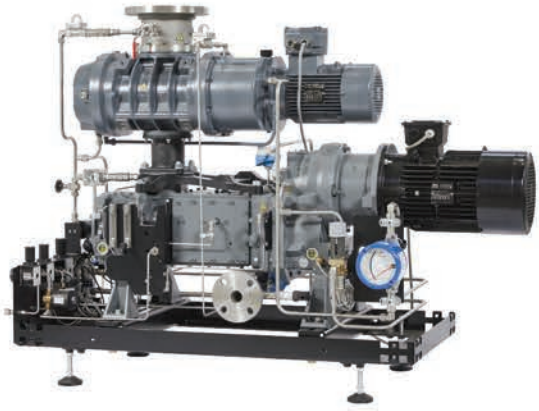

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IndianOil and Total (France) form JV to offer high-quality bitumen derivatives

SM Vaidya, Chairman, IndianOil

New Delhi, India - Indian Oil Corporation (IndianOil), India's largest refiner and marketer of petroleum products, and Total, a multinational energy major with headquarters in Paris, France, have announced the formation of a 50:50 Joint Venture (JV) company that will manufacture and market high-quality bitumen derivatives and specialty products for the growing road-building industry in India. IndianOil is the largest player in the Indian bitumen market, while Total is the leading bitumen manufacturer and supplier in Europe. The two companies have already established a business relationship in India, notably in LPG and fuel additives.

The new JV will combine the R&D and marketing strengths of both IndianOil and Total to manufacture and market innovative bitumen formulations and superior quality products such as polymer-modified bitumen, crumb rubber-modified bitumen, bitumen emulsions and other specialty products. The JV will set up manufacturing units across the country with cost-effective logistics solutions, keeping innovation, safety and sustainability at the helm of its operations. The JV will also explore the possibility of catering to other South Asian markets.

Patrick Pouyanné, Chairman & CEO, Total

SM Vaidya,Chairman IOCL said, "The JVC will combine IndianOil's credentials as India's flagship national oil company and Total's strength as an international energy major. It would cater to B2B customers involved in road infrastructure development both in the government and private sectors, and I am confident that this would bring a revolution in road construction in the country by providing superior technology products at competitive prices."

"The JVC would bring in latest technologies and formulations for polymer-modified bitumen and other fast-growing non-conventional derivatives such as cold mix & micro-emulsion, block bitumen, etc. to the Indian market. The operations of the JVC would commence by taking over an existing plant of Total at Jodhpur. It would also set up six new greenfield plants at Panipat, Koyali, Haldia, Barauni, Visakhapatnam and Chennai in the first four years. The investment planned towards these new plants is about Rs. 226 crores," he added.

"India is a strategic country for the future of Total and we are delighted by this partnership, yet another testimony of our commitment to this fast-growing market," highlighted Patrick Pouyanné, Chairman and CEO of Total. "Today,

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Total is further cementing its longstanding business cooperation with IndianOil into a strong and sustainable new partnership. With this agreement, we are pursuing the growth of businesses with key Indian energy players, adding to our ongoing developments in renewables, gas and power."

The Government of India has a strong focus on developing the country's road infrastructure with mega projects like the 'Bharatmala' project, which envisages development of 34,800 km of roads at an estimated investment of over Rs. 5 lakh crore (approx. USD 66 billion) in the first phase. The demand for aggregate material and manufactured material for the highway construction and rehabilitation sector in India is very high, especially for good-quality bitumen derivatives. The IndianOil and Total JV will offer high-spec products using sustainable technologies. GK Satish, Director, Planning & Business Development and Christian Cabrol, Sr. VP, Asia Pacific & ME Total, signed the agreement on behalf of their organizations.

Bulk drug & medical device parks expected to attract cumulative investment of Rs 77900 crore

New Delhi, India: Union Minister of Chemicals and Fertilizers, D.V. Sadananda Gowda has said that his Department of Pharmaceuticals has taken several measures to create suitable environment for development of domestic capacity in the pharma sector . He said Prime Minister Narendra Modi has recently said that 'India's Pharma Industry is an asset not just for India but for the entire world. It has played a leading role in reducing the cost of medicines especially for developing countries.'

D.V. Sadananda Gowda, Honourable Union Minister, MoC&F

The Minister said that to strengthen country's drug security, the Government is committed to build Atmanirbharta in the pharma sector. Government has launched schemes for development of three Bulk Drug Parks and four Medical Device Parks across the country. Apart from increasing Central assistance for development of common infrastructure facilities in the parks, Union Government will also extend Production Linked Incentive (PLI) to manufacturers of bulk drugs and medical devices in these parks. He added, Government will provide incentive at the rate of 5 % on incremental sales for a period of five years from Fiscal Year 2021-22 to 2025-26, with total outlay of Rs 3420 crore. Department of Pharmaceuticals has already released evaluation criteria for selection of units for this scheme on July 27, 2020. A time period of 120 days has been given for filing applications. He said it is the right time for companies to take advantage of this scheme.

The two-pronged strategy of incentivizing production and creation of common infrastructure will offset higher cost of production. This will make domestic companies as competitive as their peers in foreign countries, and provide a level playing field to them. within a period of 2 -3 years, due to right policies of the Government under the leadership of Honourable Prime Minister,

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pharma sector will become AtmaNirbhar, not only in sense of meeting domestic requirements but also for fulfilling global demand of low cost - high quality medicines and medical devices. The schemes for development of bulk drug & medical device parks are expected to attract cumulative investment of about Rs 77900 crore and can generate about 2,55,000 employment. "For medical device sector alone, investment could be to the tune of Rs 40000 crore with generation of 1, 40,000 new employment opportunities," he added.

GMM Pfaudler to acquire majority stake in the global business of Pfaudler Group

Tarak Patel, MD, GMM Pfaudler

Mumbai, India: GMM Pfaudler Limited ("GMM" or "Company") today announced the signing of definitive agreements to acquire a majority stake in the global business of its parent, the Pfaudler Group ("Pfaudler") from the private equity firm Deutsche Beteiligungs AG Fund VI ("DBAG"). As per the agreements, GMM (directly and through its subsidiary Mavag AG) and the Patel family will acquire, a 4% and 26% equity stake respectively in the Pfaudler Group. DBAG will continue to retain the balance 20% stake. The consideration for the 54% stake acquired by GMM, which is expected to be around USD 27.4 Million, will be funded by the Company through a mix of internal accruals and debt.

Pursuant to the acquisition, GMM shall become the ultimate holding company with the entire business of Pfaudler being consolidated into the Company. The Company will have a consolidated revenue of Rs. 20 bn. and EBITDA of approximately Rs. 2.5 bn. GMM will become the world leader in corrosion-resistance technologies, systems and services with 12 manufacturing facilities across 8 countries and 4 continents and employing around 1,500 people.

Tarak Patel, Managing Director, GMM said, "Over the last 5 years, we have shown an unparalleled track record of growth at GMM and it is now time to take our Company to the next level through this transformational acquisition. Being an integral part of Pfaudler for more than 3 decades, not only do we understand the business very well but have also managed to build a collaborative relationship with the different Pfaudler units around the world. This transaction is unique from the stand point that it combines the strengths of three very different partners - Promoter family, Professional Management and Private. Equity which we believe will help extract synergies and create value for all stakeholders. On a personal level and as the third generation of a family business that began in 1963 it is a moment of great pride to see." GMM will become the world leader in corrosion-resistance technologies, systems and services with 12 manufacturing facilities across 8 countries and 4 continents and employing around 1,500 people.

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Siemens and SAP Join Forces to Accelerate Industrial Transformation

Berlin, Munich, Germany - Siemens and SAP SE (NYSE: SAP) announces a new partnership that will leverage their industry expertise and bring together their complementary software solutions for product lifecycle, supply chain and asset management so their customers can deliver new innovation and collaborative business models that will accelerate industry transformation globally. Through this agreement, both SAP and Siemens will be able to complement and integrate their respective offerings in order to offer customers the first truly integrated and enhanced solutions for product lifecycle management (PLM), supply chain, service and asset management. This will enable customers to form a true digital thread integrating all virtual models and simulations of a product or asset with real-time business information, feedback and performance data over the entire lifecycle. Silos between engineering and business have existed in enterprises for decades. This new partnership will help customers to break down these siloes so manufacturers, product design teams and service managers have the information needed to quickly create and manage customer-centric product and service offerings.

Two flagship Aditya Birla Group companies join hands to promote a circular economy

Mumbai , India - Hindalco Industries Ltd., a global leader in Aluminium and Copper, has entered into a Memorandum of Understanding (MoU) with UltraTech Cement Ltd., India's largest manufacturer of cement and concrete, to deliver 1.2 million metric tonnes of red mud (also known as bauxite residue) annually to UltraTech's 14 plants located across 7 states.

Globally, 160 million metric tonnes of red mud is produced annually and stored in large tracts of land which is a serious industry challenge. Hindalco is the world's first company to achieve 100% red mud utilisation across three of its refineries. Red mud generated in the alumina manufacturing process is rich in iron oxides, along with alumina, silica and alkali. The cement industry has developed the capability to process red mud as a replacement for mined minerals such as laterite and lithomarge in its process. The company is supplying red mud to UltraTech Cement plants where it has been proved to be an effective substitute for mined materials, successfully replacing up to 3% of clinker raw mix volume. Use of red mud reduces the cement industry's dependence on natural resources and promotes a circular economy.

Satish Pai, Managing Director, Hindalco, said, "Hindalco has been working with cement companies to develop high-grade inputs for the construction industry. Hindalco has built a strong customer base and supplies red mud to over 40 cement plants every month. We have achieved 100% red mud utilization at three of our refineries and our vision is to achieve zero-waste alumina production across our operations. Hindalco's actions underscore our commitment to embracing solutions that have the potential to deliver long-term sustainability impact and transform the future."

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Vartika Shukla assumes charge as Director (Technical) of EIL

Vartika Shukla, Director (Technical) , Engineers India Limited (EIL)

Vartika Shukla has assumed charge as Director (Technical) of Engineers India Limited (EIL) w.e.f. August 1, 2020. She graduated in Chemical Engineering from Indian Institute of Technology, Kanpur in 1988 and is certified with an Executive General Management Program from IIM (Lucknow) and started her career as a Management Trainee in EIL's Process Division in 1988. She possesses over 32 years of extensive consulting experience comprising Design, Engineering and Implementation of complexes in Refining, Gas Processing, Petrochemicals, Fertilizers etc. She has led to the successful completion of many prestigious projects for clients in Oil & Gas and Petrochemical Industry both in India and Overseas.

She has a wide spectrum of experience across diverse functions of the Technical Directorate. She has steered Process Design, R&D and the entire functions of Engineering i.e., Piping, Equipment, Instrumentation, Electrical, Structural etc. She has been steering several new Initiatives in the areas of BioFuels, Digitalization, Energy Efficiency, Make In India and StartUp Initiative of EIL. She is credited with forging several Collaborative Partnerships for expanding the Technology Portfolio of EIL. She is an active member of prominent industry forums like FIPI, CII and FICCI and has served on the Editorial Board of FIPI Journal. In recognition of her outstanding contribution to the Oil and Gas Sector and has been bestowed with several prestigious accolades namely, first PETROFED Woman Executive Award, SCOPE Excellence Award and MoP&NG Innovation Award with her team. Prior to this, Vartika Shukla was holding the position of Executive Director (Technical) in EIL..

Industrial piping major CPP bags large orders worth Rs 300 million

Mumbai, India - At a time when Indian industries were struggling to restart the manufacturing services, Mumbai based Chemical Process Piping(CPP) India's leading industrial piping solutions company has not only restarted operations but also bagged combined large orders worth approx Rs 300 Million (US $4 Million) from renowned Engineering Procurement and Construction companies (EPC) for critical Chemical piping and Spray Headers / Piping for Flue Gas Desulphurisation (FGD) plants in India.

CPP has been at the forefront of Indian industrial piping solutions catering to a range of industries right from Power, Chemical, Desalination to Oil & Gas. CPP will supply critical Chemical piping to Tata Chemicals, GACL, Nirma while Spray Headers / Piping for Flue Gas Desulphurisation (FGD) will be supplied to L&T, amongst others. CPP has been successful in bagging over 80 % of the orders for Spray Headers and Piping for projects across India during the COVID

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Mr. Vijay Rajpurohit, MD, Chemical Process Piping

19 pandemic. CPP possess the capability to manufacture from 15 mm up to 4000 mm diameter Pipes and Fittings.

Mr. Vijay Rajpurohit, MD, Chemical Process Piping shared, "Being the pioneers and market leaders since last 56 years in industrial piping solutions in India, we have had the privilege of working with established giants like Tata Chemicals, GACL and L&T. Bagging these orders from them have once again demonstrated that CPP is the partner of choice for the best and biggest in the industry. The experience and technical knowhow at our disposal give us a unique outlook to providing piping solutions to any project on any scale."

Due to the strict lockdown, CPP and Indian manufacturing in general lost close to 2 1/2 months of production. However, during unlock-down 1, CPP could restart the operations rapidly and the workforce strength reached upto 90 % of its original strength. This enabled the company to start operations to meet the market needs. The operations started slow since the new SOPs and rules had to be followed. The workforce number reached 100 % capacity by the end July 2020.

He further added, "Team CPP is the key to this success for the company as many of the executives and especially the workforce chose to stay in the city rather than head to their native places. This enabled us to start the manufacturing process faster and we were one of the first off the block in our industry. We are also negotiating orders in the global markets. The fact that CPP offices worked seamlessly during the lockdown speaks volumes of their ability to quickly adapt to any changing situation. CPP has ensured that the contracts for critical chemical piping and Spray Headers/ Piping for Flue Gas Desulphurisation (FGD) plants are not only won but also actual work began with execution of the same."

UFlex Chemicals introduce range of innovations in flexible packaging

A market leader in flexible packaging solutions, UFlex Chemials has successfully launched Flexpack 5100, a semi-film forming PU developed for surface as well as reverse inks. It provides high gloss for surface inks and good lamination bond for reverse inks and provides suitability for both flexographic and gravure printing processes. The new product Flexpack 5100 is free of chemical compounds like TDI, MDI and Tin making it ideal for indirect food additives for packaging and suitable as pew new BIS notifications IS 15945:2020 for safe printing inks. The company has also introduced FLEXCOAT PC OPV- 1009, an environment-friendly water-based Overprint Varnish (OPV) for printing over paperboard used for playing cards and CI FLEXMATT Two Components OPV, a matt coating specially developed for CI Flexo printing process. This 'soft-feel' overprint varnish provides excellent adhesion on a variety of substrates including PE, PET, BOPP etc. besides excellent matt effect and scuff resistance. It complies with food packaging regulations and is most suitable for hygiene care products. ■

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IndianOil to implement integrated PX-PTA complex at Paradip

The Indian Oil Board has given its go-ahead for the implementation of an Integrated Para-Xylene (PX) and Purified Terephthalic Acid (PTA) complex project at Paradip, Odisha, at an estimated investment of ₹ 13,805 crore. The PX-PTA complex shall be integrated with IndianOil's Paradip Refinery, which is operational since 2015. This plant, along with the upcoming MEG (Mono-Ethylene Glycol) plant of 357-KTA capacity at Paradip, would be a ready source of feedstock for IndianOil's upcoming 300-KTA textile yarn manufacturing project at Bhadrak in Odisha, and can similarly facilitate other textile and polyester projects in the region. The PX/PTA project will be completed by early 2024. The petrochemicals complex will have a PX production capacity of 800,000 tonnes per annum, which would be the feedstock for production of PTA. The production capacity of PTA would be 1,200,000 tonnes per annum. PTA is the raw material for the production of polyester along with MEG. IndianOil's MEG production facility is already under implementation at Paradip and will become operational towards the end of 2021.

IndianOil is currently executing 2814 projects spread across the country with a cumulative cost of ₹2, 05,100 Crores.

Out of these, the Refineries division of IndianOil has 622 ongoing new projects with a total outlay of ₹1, 18,141 crores. In the current financial year, already over ₹818.35 crores have been disbursed to the workers engaged in these ongoing projects. To meet the future energy demands needed to boost the Indian economy, IndianOil is augmenting the capacity of its Barauni Refinery from 6.0 to 9.0 MMTPA at an estimated cost of ₹14,810 crores. This capacity augmentation project alone would generate over 9 lakh man-days of work during the current FY.

Other IndianOil projects also include the EnnoreThiruvallur-Bengaluru-Puducherry-Nagapattinam-Madurai-Tuticorin Gas Pipeline with a total project cost of ₹6025 crores. Over 50% of this project has already been completed and has generated over 3 lakh man-days in the current fiscal. Over 50% of the ₹5,654 crores Mono Ethylene Glycol (MEG) project at Paradip Refinery is completed. The 3,338 Crores worth Paradip-Hyderabad Pipeline is also nearing completion with over 80% of the project already completed. This project has generated over 2 lakh man-days in the current fiscal.

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BPCL resumes work on over 2,100 projects in Mumbai and Kochi

Bharat Petroleum Corporation has resumed work on as many as 2,118 projects involving a capital expenditure (CAPEX) of around ₹50,300 crore over three years. The company plans to complete 10 projects worth ₹18,766 crore (both CAPEX and operational expenditure) in this fiscal and the biggest two of them are in Kochi which is its largest refinery with capacity of 15 million tonnes capacity. The projects include propylene derivative petrochemical project (PDPP) at the cost of ₹5,246-crore and motor spirit block project (MSBP) at the cost of ₹3,289-crore.

BPCL is also setting up Resid up-gradation project at Mumbai refinery with Poly propylene Project at Rasayani of 3 MMTPA capacity with 450 KTA of polypropylene. The CAPEX for this project is Rs 18000 crore and this project is at the FEED stage. A New Kerosene Hydro Treatment Unit of 1.5 MMTPA capacity for Diesel Maximization at Mumbai refinery with the CAPEX of Rs 697 crore. This project is delayed by almost an year and likely to be commissioned by December 2022. LOBS Unit revamp to enhance production of 300 KTA to 450 KTA in Mumbai refinery. The CAPEX for this project has been reduced from Rs 945 crore to Rs 640 crore. This project has been delayed by almost 6 months and will be commissioned by December 2021.

L&T Hydrocarbon Engineering signs MoU with NTPC for CO2 to Methanol Plants

L&T Hydrocarbon Engineering (LTHE), a wholly-owned subsidiary of Larsen & Toubro (L&T), has signed a memorandum of understanding with NTPC Ltd., a Maharatna PSU on 19th August 2020, wherein LTHE shall be the Engineering, Procurement and Construction Management partner to build CO2 to Methanol demonstration Plant in NTPC Power Station. This plant will comprise of three sub-units namely CO2 capture from Flue Gas, H2 production by electrolysis of water and catalytic conversion of CO2 & H2 to Methanol.

MoU was signed by Subramanian Sarma, Whole Time Director and Senior Executive Vice President (Energy) and Ujjwal Kanti Bhattacharya, ED (Projects), NTPC Ltd. in presence of C K Mondol, Director (Commercial), NTPC Ltd. and other senior officials from L&T and NTPC Ltd.

Under this MOU, LTHE and NTPC will further collaborate to accelerate the development and subsequently commercialize CO2 to Methanol plants. Subramanian Sarma said, “We are delighted to be a part of this initiative of NTPC in the field of clean energy. This development towards establishing CO2 to Methanol plants is an important step

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towards India's commitment to combat climate change. LTHE, together with NTPC, will leverage its vast experience in engineering, construction and project management to successfully deliver this demonstration project"

UFlex Group plans to infuse Rs 2,000 cr in Karnataka

UFLex Group is interested in investing Rs 2000 crore in Karnataka for plastic production. The company had talks with the authorities to produce biodegradable plastic and land requirement. The project is expected to be completed in two phases and will include Zero waste unit and accommodation for workers

Talcher Fertilizers to expedite coal gasification project

Talcher Fertilizers Ltd, , a joint venture company of GAIL India Ltd, Coal India Ltd, Rashtriya Chemicals and Fertilizers Ltd and Fertilizer Corporation of India Ltd (FCIL) is setting up the first Ammonia urea project to use coal gasification for urea production in the country. The plant will produce 2.38 million tonne cubic metres per day of natural gas equivalent synthesis gas from coal. ■

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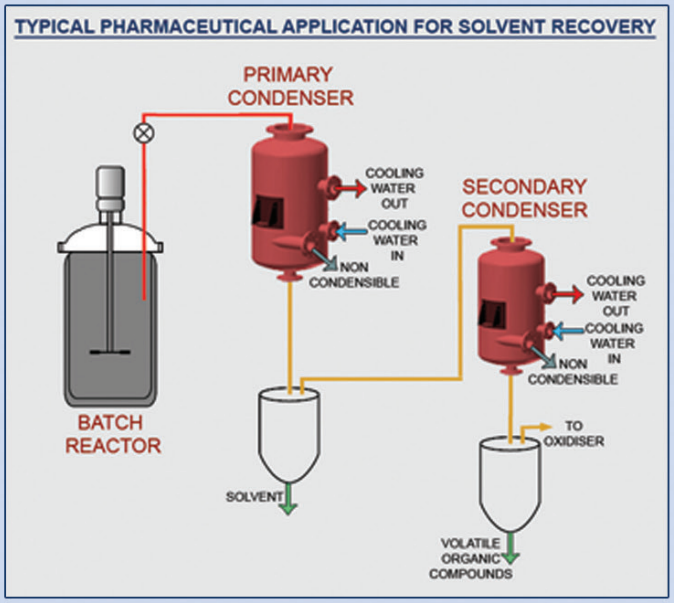

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Extruders for Polyethylene & Polypropylene Plants: Criteria for Selection Of Energy Efficient Design

Extruder or Pelleting is a critical package unit in every Polyolefins (PO) plant namely Polyethylene (PE) and Polypropylene (PP). PE can be either HDPE (High Density PE), LLDPE (Linear Low Density PE) or MLLDPE (Metallocene LLDPE) or LDPE (Low Density PE). PP can be either Homopolymer PP, Random Copolymer PP or Impact Copolymer PP (also sometimes called Hetero Phasic PP).
Extruder package has four main attributes which underline its importance in any PE / PP plant. First, it is the largest package unit in the plant. Second, it is the most expensive package in the plant. Third, it is the most power or electricity consuming item in the plant. It consumes approximately 65 to 70 % of power consumed by the whole plant. And four, to some extent, it is independent of the technology selected. In spite of the above, the Extruder package remains relatively less understood in any PE / PP plant. This article intends to focus on specifications and selection criteria in order to address the above attributes.

Every PE or PP plant has proprietary reaction system which is licensed by the respective Licensor. The reaction system is typically followed by resin degassing and product purge bin. The resin degasing separates the resin from the vent gases. Vent gases are processed further to recover monomers, other HC and N2 (e.g. Ethylene, Propylene, Butene 1, Hexene 1, Iso Pentane, Iso Butane, N2 etc.) and returned to the reaction system.

Polymer resin in powder form is collected in product purge bin wherein the residual catalyst and co-catalyst is typically deactivated and the resin is further fed to the Extruder package which converts polymer resin in powder form in to pellets or granules and is called product or product in pellet form. The product pellets are further conveyed to blending silos, storage silos and finally to packaging section to bag the product in desired packages typically 25 kg bags, jumbo bags or big bags (500 to 1000 kg) or simply filled in to containers for transport. The

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Extruder package is preceded by the polymer additives section. The different type of additives depending on product application are added to resin and fed to Extruder. The polymer additives typically include primary antioxidants, secondary antioxidants, process stabilisers, slip agents, anti-block agents, nucleating agents, whiteners etc. in different composition required by specific polymer application.

The Polymer additive package can be procured separately or along with Extruder package as per the procurement philosophy of the licensee. The polymer additives and polymer resin powder are fed to the Extruder Feed Hopper which is the feed point for the Extruder package. At the end of the Extruder package, the pellets are collected in the Pellet Hopper from where the pellets are conveyed to the blending silos.

Thus the Extruder package starts from the Extruder Feed Hopper and ends with Pellet Hopper. This generally forms the entire scope of the Extruder vendor.

Extruder Package – Main Components

Extruders are either resin powder fed or resin melt fed. LDPE and solution PE process feed melt to the Extruder. Other PE and PP processes feed resin powder to the Extruder. This article is intended to cover only the resin powder fed Extruders. Also the Extruders will be of Co-Rotating Twin Screw type only which is the industry norm.

LDPE and solution PE process which are melt feeding Extruders can either be single screw or twin screw. Single screw Extruders are quite common while

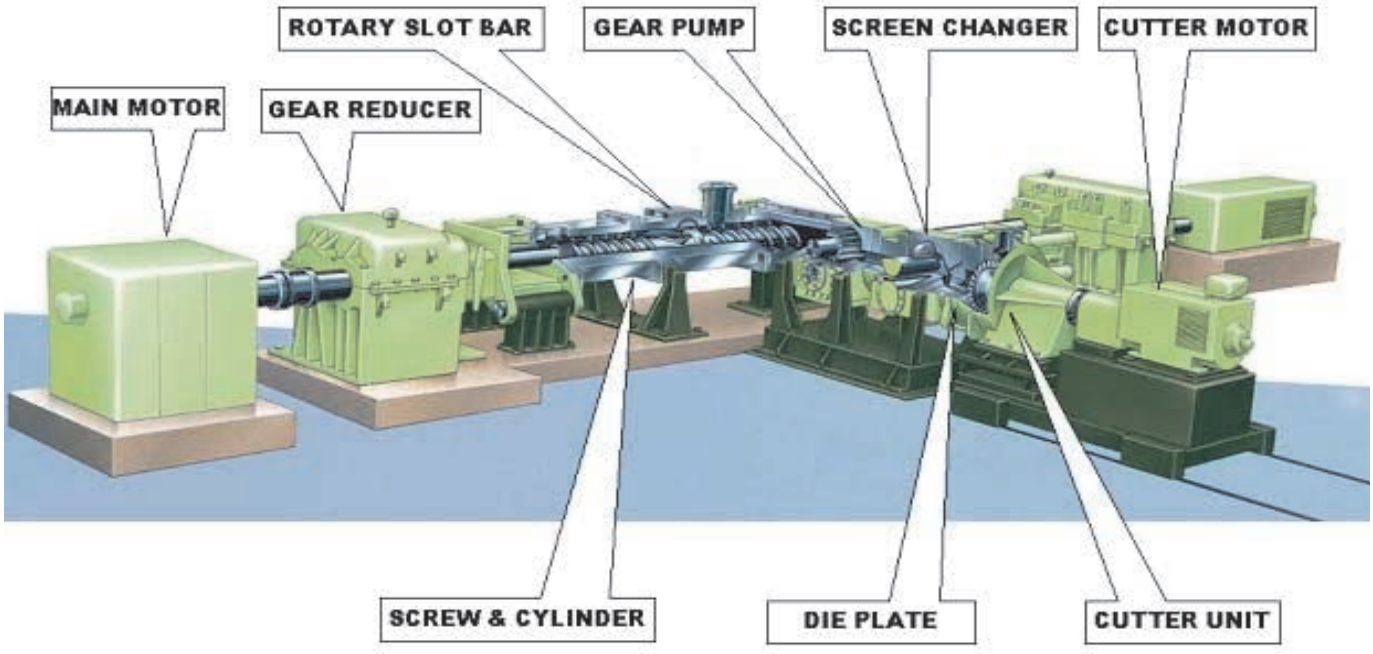

Fig 1: Typical Extruder Set-Up with Gear Pump

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handling product MFI (Melt Flow Index) in excess of 1. Inherently duty demand by melt fed Extruders is low because of absence of melting zone and to some extent mixing zone. Twin Screw Extruders are preferred only when MFI is fractional that is less than one e.g. 0.5.

All other PE and PP processes are resin powder fed and use twin screw Extruders. Hence the focus of this article is only on twin screw Extruders which account for nearly 75 to 80% of all PE and PP. The Extruder package is a large unit in any polymer plant consisting of several components. (Fig.1)

Main components of the package include

- Main Extruder or Mixer as it is sometimes called which houses the Screw Elements
- The main Motor for Extruder
- The Extruder Gear Box
- Extruder Vent Housing
- Melt Pump or Gear Pump
- Melt Pump Motor or Gear Pump Motor
- Diverter Valve
- Melt Screen Unit
- Die Plate
- Underwater Pelletizer
- Pellet Water Tank
- Agglomerate Remover
- Pellet Dryer
- Pellet Water Pumps
- Pellet Water Cooler
- Pellet Screener
- Die Plate Hot Oil System
- Hydraulic System
- Extruder Feed Hopper
- Pellet Hopper

The Extruder main Motor Drive is invariably the largest motor by rating in any PE / PP plant and the entire Extruder package consumes approximately 65 to 70% of the electricity consumed by the whole PE / PP plant.

Extruders for PE and PP

The configuration of the Extruder package is essentially the same for PE and PP plant. However, the main Extruder design varies for the two on account of the nature of the polymer.

Differences between PE and PP

- PE Grades vary in MFI (Melt Flow Index), Density and MWD (Molecular Weight Distribution).
- On the contrary, PP Grades vary mostly in MFI and to some extent in MWD but very little in Density. PP has also property called Isotactic Index which is absent for PE.
- PE Grades can either be Homopolymer or near Homopolymer

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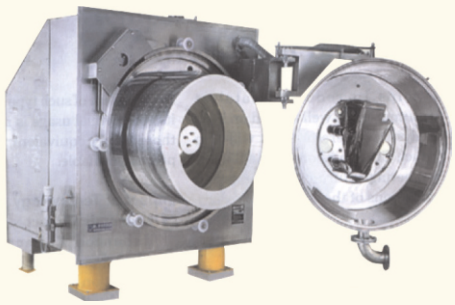

Horizontal Pharma Peeler :

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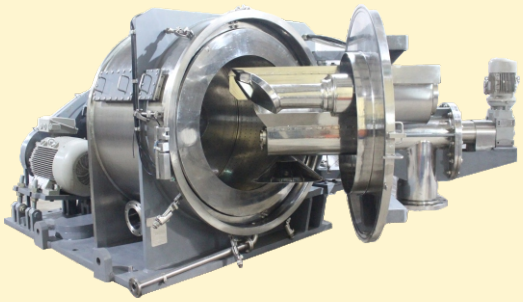

Horizontal Chemical Peeler

Manufactured 1600 mm dia x 1000 mm depth

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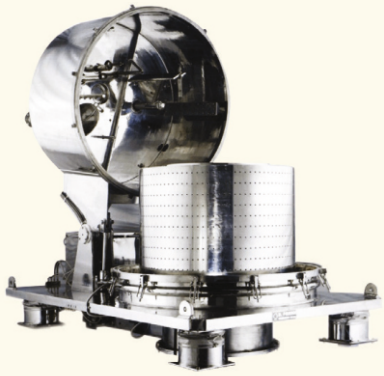
- Deep Basket with Screw Conveyor



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with little incorporation of co-monomer or with large incorporation of co-monomer up to 10%.

- PP is made as Homopolymer or copolymer. The copolymer PP contains generally Ethylene up to 6% which is called Random PP. The Impact Copolymer PP contains "Rubber" phase in the form of PE and is also called "Hetero Phasic" for same reason. The Rubber phase in PP can vary approximately from 10 to 30%. PP therefore varies in MFI and in type in terms of Homopolymer, Random Copolymer or Impact Copolymer.
- PE is extruded at temperature ranging from 190-250°C due to inherent lower melting temperature of PE.
- PP is extruded at much higher temperature ranging from 230-290°C due to inherently higher melting temperature of PP compared to PE.

Extruder Specifications

Extruder package is specified either by the licensor for the new plant or by the licensee - either in consultation with the licensor or independently, based on the experience for the expansion. The licensor has obligation to provide the process specifications for the Extruder package for a new plant. The licensee has freedom to improve over it for their benefit. The following guidelines will outline the basic specifications, whether process or mechanical, which can be used by the licensee or the purchaser to improve or optimize the specifications. These specifications will automatically assist in formulating selection criteria.

The Extruder package specifications comprise mainly of following parameters in terms of performance for capacity and product quality:

Capacity

Usually specified for three cases namely: Normal, Maximum and Minimum.

The typical range is:

- Normal = 100%
- Maximum = 110 to 120 %
- Minimum 50 to 60% of Normal which is = 50 to 60%.

For Example, Normal / Maximum / Minimum = 60 TPH (Tonnes per Hour) / 72 TPH / 36 TPH.

The Extruder vendor will typically offer performance warranty or guarantee based on the Extruder capability for the reference product mix (mix of different product grades). Vendor can either agree on all the parameters or suggest deviations for some of the product grades.

The commercially operational maximum Extruder capacities range from 80 to 100 TPH from the reputed vendors keeping in line with rising single line PE / PP plant capacities. Typical performance

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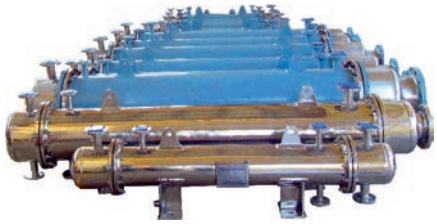

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Typical Performance Requirement for PE or PP

Description	Unit	Example Grade
Warranted Product		Name of the Grade
Product Type		HDPE / LLDPE / MLLDPE PP Homopolymer / PP Random / PP Impact Copolymer
Controlled Rheology		For PP Only
Melt Flow Index (I 2.16)	dg/min	Licensor to Provide Data
Melt Flow Index (I 21.6)	dg/min	For PE Only
Melt Flow Ratio (I 21.6/I 2.16)		For PE Only
Density	g/cm3	Note 1
Resin Powder Bulk Density	kg/m3	Licensor to Provide Data
Resin Pellet Bulk Density	kg/m3	Licensor to Provide Data
Shear Rate Viscosity		Licensor to Provide Data
Enthalpy	kwh/kg	Licensor to Provide Data
Flow Rate - Minimum	kg/h	50 % + 1% Additives
Flow Rate - Normal	kg/h	100 % + 1% Additives
Flow Rate - Maximum	kg/h	120 % + 1% Additives
Normal Inlet temp at Mixer Hopper	C	Note 2
Melt Screen to Remove all Particles Greater than	mm	Note 3
Maximum Resin Temp at Die Plate	C	Note 4
Total Specific Energy Input at Normal Rate	kwh/kg	Note 4

Typical Values Only for Example

Note 1	0.905 for PP
	0.918 to 0.935 for LLDPE 0.940 to 0.963 for HDPE
Note 2	50 to 70 C
Note 3	Typical 1.4 to 2.5 for PP Typical 1.4 to 1.5 for PE Licensor to Provide Data for Each Product
Note 4	Typical 0.150 to 0.250 for PP Typical 0.140 to 0.250 for PE Licensor to Provide Data for each Product

Table 1: Typical Performance requirement for PE or PP

requirement template is shown in Table 1

Licensor to Provide Data for each Product

The performance requirement has to be specified for all the warranted PE and PP grades appropriately for Extruder vendor to configure and design the package suitably. The Extruder vendor will design the Screw Configuration optimally based on the required product performance range notably considering high melt flow grades, low melt flow grades, fractional melt flow index grades, LLDPE film, HDPE film, BOPP film, PPTQ film, blow molding grades from very small to very large size, Pipe grades, BM Pipe (Bi Modal) grades, Metallocene grades, PP Random grades, PP Impact Copolymers etc.

In short, the Extruder is expected to perform

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- **High Speed Mixers**
  Ranges from 0.5 KL To 20 KL.
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- **Continuous Nitration Systems**
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  Operates continuously for 24X7

10 KL Twin Shaft Dispersor

25 KL SS 904L Reactor

62 KL Limpeted Storage Tank

optimally for range of grades, different applications, density, MFI i.e. low to very high molecular weight and wide range of molecular weight distribution with the given screw configuration.

Depending on the product mix, the vendor can sometime propose two Die Plates i.e. Die Plates of two different Hole Numbers or Hole Size or combination of both to cater to vastly different set of properties, e.g. vastly different MFI. Vendor can also propose two different speeds for Main Motor. The purchaser can suggest option of variable speed drive. Similarly requirement of Melt Pump is governed either by vastly different MFI or Die Plate temperatures or Extruder capacity. Some licensor can mandate not to use Melt Pump if the licensor proposes to use higher Die Plate temperature. Salient design features are summarised below for critical Extruder components. These guidelines have been developed based on the norms for the best practices and the industry experience with different licensors, different technologies and vendors who are industry leaders, supported by relevant reference literature [1] [2] [3] [4].

Main Mixer Motor

It can be single speed, two speeds or variable speed drive. Single speed motor is recommended if the product mix is not very large in range of MFI. Two speed motor is recommended if the product mix is reasonably large in terms of MFI thus allowing to operate the Extruder at optimum speed based on the product mix. Variable speed drive or variable frequency drive is recommended as the energy conservation measure at the design stage if the product mix has large range of MFI and there is a strong possibility of operating the plant at different rates from Turn-Down (TD) to full capacity. The choice of motor speed is governed by the initial investment decision by the client e.g. large variable speed drive will be substantially costlier than single speed or two speed motor. Though variable speed drives appear attractive, very few really prefer it. The most common drives are one speed or two speed.

Melt Pump Motor

Variable speed drive - always a variable speed drive because of the nature of the service.

Underwater Pelletizer Motor

Variable speed drive- always a variable speed drive because of the nature of the service.

Mixer Processing Section

Twin Screw – Length/Diameter Ratio (L/D)		
Polymer	**Without Melt Pump**	**With Melt Pump**
HDPE	18-24	18-21
LLDPE	18-24	18-21
BM HDPE	Not Applicable	23-29
PP	24-30	21-24

Table 2: Twin Screw Extruders – L / D Ratio (Typical)

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Diameter (D) and length to diameter ratio (L/D) depends on type of polymer, product mix and residence time or capacity as shown in Table 2.

It can be noticed that Melt Pump reduces the L/D ratio. The longer lengths would mean relatively higher residence time. The screw profile is optimised according to L / D ratio.

Melt Pump or Gear Pump

Inlet design pressure rating shall equal or exceed discharge pressure rating of Mixer. Design discharge pressure is usually minimum 300 kg/cm2g.

Screen Pack

It will cater to different opening specified in the product performance requirement. Clean pressure drop shall be generally 100 kg/cm2 for all warranted products.

Die Plate

Single Die Plate will normally cover a Melt Flow ratio of 1:50.

Pressure drop can vary from minimum of 20 to maximum of 180 kg/cm2. The maximum pressure drop is guided by the "partially blocked" scenario which is time dependent as well as grade dependent and which restricts the flow and can constrain the Extruder capacity.

Die Plate Holes

Number of Die Plate Holes are typically in the following range:

Pelleting Water System

Pellet Water Tank

Tank working volume shall be minimum of 3 minutes of Pellet Water Pumping, e.g. for 600 m3/h pump, Tank working volume shall be minimum 30 m3.

Pellet Water Pump

Typically 12 to 16 m3/T of Pellet Rate with 12 as minimum, e.g. for 60 TPH Extruder capacity, 60 * 12 = 720 m3/h.

Agglomerate Remover and Pellet Dryer

Agglomerates are typically defined as polymer particles or pellets having

Die Plate Holes for PE and PP				
Type of Polymer	**MFI**	**Maximum kg/h/Hole**	**Limitation Due To**	**Diameter of Die Holes**
PP	Full Range	15 to 25	Delta P	3 to 4mm
HDPE	Full Range	12 to 17	Delta P	3 to 3.5mm
LLDPE	Full Range	8 to 12	Melt Fracture for Film Grades	3 to 3.5mm

Table 3: Die Plate Holes for PE & PP

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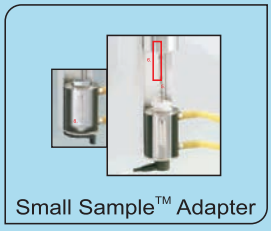
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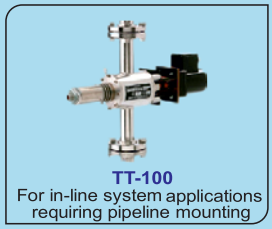
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equivalent diameter more than 13 mm (0.5 inch). Normal rate of removal of agglomerates:

- Normal = 0.015 % of total resin rate by weight
- Start-Up = 0.30 % of total resin rate by weight in first 2 minutes

Pellet Dryer: Moisture in the pellets at the outlet of Dryer = 0.05 % maximum by weight (500 ppmw)

Pellet Water Cooler: Design cooling duty shall be minimum of 15% above highest pellet cooling duty for each of the warranted products.

Pellet Water Piping (If supplied by the Extruder vendor): Minimum 15 seconds from Pelletiser to the agglomerate Remover assuming 55°C water temperature. Maximum pellet temperature allowed is 80°C for PE and PP.

Extruder Feed Hopper and Pellet Receiver

Extruder Feed Hopper to have minimum of 6 minutes and maximum of 12 minutes hold-up volume. **Pellet Receiver (also called pellet mass flow meter)** to have minimum of 5 minutes and maximum of 10 minutes hold-up volume.

Hold-up volume is required to provide a positive solid seal and absorbs flow fluctuations.

Resin Feed Properties for Granular PE or PP Bulk Density – Specify for PE or PP

Particle Size: Typically 75 to 850 micron (200 to 20 US Standard Screen)

Particles < 75 microns & > 850 microns to be maximum 1%

Polymer Additives are typically added up to 1% by weight of Resin Feed in the form of powder or pellets

Pellet Product Properties

- Maximum 0.05% moisture by weight
- Free of Agglomerates over 13 mm equivalent diameter
- Substantially free (minimum 98% of pellets) of tails (filaments, shreds or shavings attached to pellets) and marriages (joined pellets)
- Free of degradation (black spots)
- Free of single or multiple voids
- Uniform additive dispersion
- Uniform Pellet Size and Shape:
- Length of pellets, diameter of pellets, symmetry of pellets – all minimum 99%
- Bulk Density of Pellets: to be specified for PE or PP
- Pellet material particle size to be between 0.5 to 9.5 mm minimum 99%

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Looking Forward

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The three vendors who dominate the Extruder market globally and offer machines up to 100 TPH are:

- Coperion of Germany
- Japan Steel Works (JSW) of Japan
- Kobe Steel of Japan

All the PE and PP technology licensors recommend these three as approved vendors.

Extruder Energy Input

The main source of energy input into Extruder package is from the Main Mixer Motor which is by far the largest motor in the polymer plant which accounts for approximately 65 to 70% of the total power consumption. Thus any attempt to reduce the power consumption in the Extruder package needs to start from the Mixer or Extruder itself.

The resin powder is fed to the Extruder and is converted to molten state or to melt by shear forces applied by co-rotating twin screw. This power is transmitted by electric motor or Main Extruder Motor through the Gear Box to the co-rotating screws. The resin powder in the Extruder Hopper at about 50- 60°C is fed to the Extruder and is heated generally by steam in the barrel to its melting range depending on MW and MWD of the polymer grade. Once fully melted in the melting zone, the melt is further heated for easier processing i.e. kneading and mixing, then conveying through Screen Pack and through the Die Plate to eventually form the pellets in the pelletiser.

This entire energy; assuming there is no melt pump; is transmitted by Main Extruder Motor.

The Energy thus required is:

- Q * MSEI / (MME * MGE * MTE) = MKW (KG / H * KWH / KG) / (MME * MGE * MTE) = (KWH / H)

Where

- Q = Total Feed = KG/H
- MSEI = Motor Specific Energy Input = KWH / KG
- MKW = Mixer Power Input, KW
- MME = Mixer Motor Efficiency = 0.92 to 0.96 (Typically when motor operates at or above 75 % of its rating)
- MGE = Mixer Gear Efficiency = 0.95 to 0.97
- MTE = Mixer Thermal Efficiency = 0.92 to 0.97
- Considering average values for example: MME = 0.94, MGE = 0.96, MTE = 0.94
- Q * MSEI / (0.94 * 0.96 * 0.94) = Q * MSEI / 0.848 = 1.179 * Q * MSEI = MKW
- **Or MSEI = MKW / (Q * 1.179) = 0.848 * MKW / Q**

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Thus this becomes the simple but basic formula for computing Extruder energy efficiency which underlines the importance of efficiency of motor, gear box and mixing.

If the Melt Pump is also part of the Extruder, then the equation will include Melt Pump power input and its efficiency added to the equation.

Hence the best efficiencies are obtained when the Extruder is operated at higher rates i.e. at or around design rates or even higher without affecting product quality.

Specific Energy Index (kWh/kg) is also a function of MFI i.e. lower the MFI higher is the Specific Energy in general for PE as well as PP. Beyond a certain MFI, Specific Energy practically remains the same. Higher MFI will require lower energy input or lower SEI than lower MFI. Lower MFI would mean higher melt viscosity and hence higher melt temperature and the vice versa. This data is best obtained from the licensor.

Conclusions

- The specifications and selection of the extruder package has increasingly become important because of rising capacities of single line PE and PP plants which routinely range from 400 to 600 KTPA.
- The article elaborates the salient features of Extruders for energy efficient design and accordingly the strategy for specifications and selection of the package unit which is the most expensive unit in the plant. The Extruder Operation consumes about 65 to 70% of plant's total energy in terms of power and hence the article focuses on items which are critical to power consumption for
- The monitoring of Extruder for energy efficient operation using empirical equations is a matter which can be dealt with in future work. ■

Author

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Polyolefins Technology Consultant

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Opportunities Continue to Outweigh the Challenges

Dr. Jaimin Vasa
President
Gujarat Chemical Association

Traditionally, the European Union (EU) and United States (US) were the key chemical hubs globally. Together they contributed to nearly 40% of global chemical sales till 2006. However, the Great Recession of 2008 changed everything. Developing countries started faring better than the relatively mature economies of the West. Over the last decade, the core of the chemical industry has shifted from the West to Asia, with China being the key benefactor. Manufacturers in the Asian region enjoy low labour costs, relatively relaxed environmental norms and government subsidies..

China's chemicals industry had surpassed all other nations. This is reflected in rising China's share in global chemical sales, which increased from 24% in 2010 to 37% in 2018. During this phenomenal growth period, the focus of China was more on infilling the huge and rapidly growing domestic demand. There is a direct link between investments, innovation (measured by research and development, or R&D spend) and global competitiveness. Investments in China's chemicals industry have risen led by a large consumer base and favourable government policies. Easy availability of low-cost capital and labour, government subsidies and relaxed environmental norms have helped the

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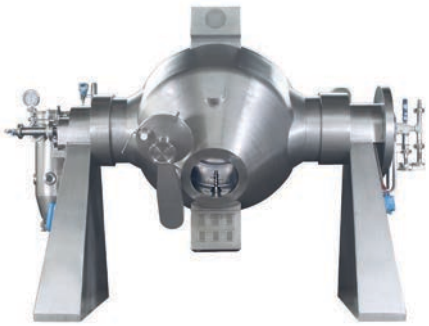

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region serve as a production base for leading global vendors.

Consequently, chemical players in China invested heavily in R&D and capital investments during 2007-2017. On the other hand, countries such as the EU and Japan saw a mere 1-2% rise in capital spending and R&D expenditure. Of late, capital spending in mature economies has slowed down owing to factors such as stringent environmental norms, slowing domestic market demand and availability of cheaper imports. Moreover, slower gross domestic product (GDP) and consumption growth in developed countries has reduced the need for incremental capex in this segment.

Chinese government has mandated the construction of compulsory effluent treatment plants and imposed green tax on the chemicals industry to combat pollution. As a result, the overall cost of production is likely to go up with capital expenses incurred towards effluent treatment as well rise in compliance cost.

The domestic chemicals industry in China is witnessing a slowdown as a result of slower economic growth. China is also losing ground on decreasing cost competitiveness China's specialty chemicals market has seen a downturn in recent years due to various factors. Most prominent being the introduction of stringent environmental norms, which has led to the shutdown of several chemical plants.

Major factors that have contributed to a slowdown in the specialty chemicals market in China include changing global trade dynamics. Factors such as global slowdown and the US–China trade war have also impacted the production growth in China. Currently, the US accounts for nearly 15% in China's export basket. However, the continuation of trade war and resultant increase in tariffs could have negative implications for its trade and subsequently the domestic capacity and production in China.

Chinese government has mandated the construction of compulsory effluent treatment plants and imposed green tax on the chemicals industry to combat pollution. As a result, the overall cost of production is likely to go up with capital expenses incurred towards effluent treatment as well rise in compliance cost. The cost is expected to be higher for the smaller non-integrated plants operated by medium- and small-scale players. This is likely to impact production in the medium term and thereby overall chemical exports.

Over the last five years, the labour cost in China has more than doubled as compared to India thus rendering Chinese

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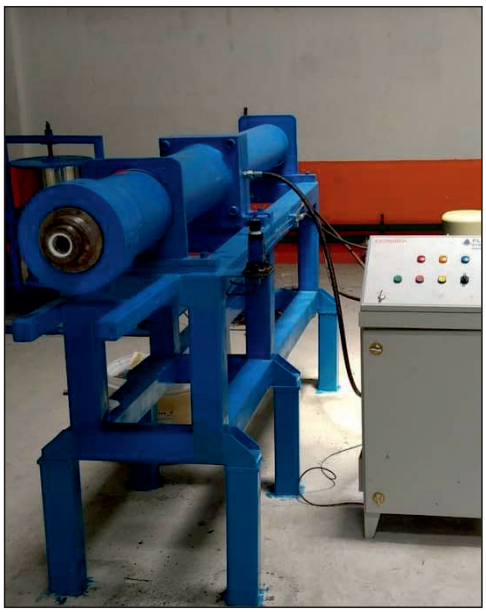

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manufacturers uncompetitive vis-à-vis India in terms of labour cost.

This slowdown provides an opportunity to India to enhance its share in the global export market growth of chemicals and specialty chemicals is dependent upon growth in major end-user industries such as construction, textiles, automobiles and consumer durables. Specialty chemicals consumption in the country is low compared with the global average. This provides enormous opportunities for growth of this industry.

Closure of plants in countries such as EU and China owing to increasing environmental concerns has opened doors for Indian manufactures to invest further in chemical sectors. While India also faces threat from environmental concerns, the threat is limited to smaller players and shall serve as an opportunity for larger players to capture the market. In fact, some of the large players have established themselves in global markets like the EU and US and have active export revenue share, which will help them to seize the opportunity India likely to benefit from downturn in China Prospects of the domestic chemicals industry are intrinsically linked with the overall growth in the economy as well the export market. India is a net exporter in segments such as dyes and pigments, and this trend is expected to continue. However, slowdown in the global economy is likely to hamper the overall growth potential for chemicals. Nevertheless, despite shutdowns in China and lack of capacity additions in other developed countries, India still stands to benefit in the export market. Also supporting the growth in India is its ability to manufacture at a lower price compared with its western counterparts. This along with the emergence of established players bodies well for Indian manufacturers.

Nevertheless, opportunities in the segment continue to outweigh the challenges. Domestic demand growth coupled with opportunities in the export market show remarkable ability of India to establish itself as a global chemical manufacturing powerhouse

The worsening coronavirus crisis has emerged as a threat to global economic growth. But if it leads to disruption in production of chemicals in China's Hubei province, the epicenter of the outbreak, then it may benefit Indian manufacturers Hubei one of China's top producers of dyes has a large chemical industry, and the closure in 2016 of Hubei Chuyuan led to a jump in shares of Indian producers multifolde.

Hubei has a large chemical industry, and the closure in 2016 of Hubei Chuyuan - one of China's top producers of dyes. "Currently none of the Hubei industries seem to have been impacted and dye intermediate prices have also not rallied. ■

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Case Study: Amplifying Energy Efficiency in Agro-processing Unit

Energy management is vital for any operation in an industry and more so in agro processing , where the cost accounts for approximately 70% of processing cost excluding that of raw material cost which is approximately same across all other agro industries. This case study brings insight into the pragmatic approach to revamp the facility and making it energy efficient.

The positive impact of using efficient energy management system in agro-processing industry is very evident and visible on multiple fronts. On environmental aspect as this leads to lower consumption of power, fuel and water, reduction in need of resources, improvement in product quality, betterment of HSE standards reduction in downtime due to equipment breakdown, increase in overall life of equipment and helps to maintain low heat and sound levels thus creating better work spaces.

The practices of running smoother operations, lower requirement of resources, good energy management enable the manufacturers to be cost effective, economically viable, profitable and most importantly stay ahead of the competition.

Electrical Energy

Earlier power and fuel consumption for normal grade products was 1500 KWH power per ton and diesel consumption was 120 litres per ton to meet heat requirements.

The team reduced the power consumption in the following manner and accomplished less than 1000 kWh per ton as well as reduced the consumption by 500 kWh per ton that was approximately 30-35%. The team conducted many internal and external audits related to power consumption and added the experience and observations during the operation.

In terms of power saving following steps and changes done to achieve 1000 kWh per ton power consumption.

The team carried out the studies and measurements of power consumption across different operations like – hydration, grinding, conveying of wet and dry material, sieving, reactors, blending and packing, lighting and cooling etc. The studies revealed that out of 1500 kWh per ton of power consumption 70-75% of power was getting used in grinding operation 10-12% in conveying operation and balance in rest of the operations.

- **Grinding Process:** To reduce power consumption, the team started with the grinding process and assessed the actual need of power. The first step was to pre- treat the material to reduce the power consumption during grinding and optimized power usage by simultaneously increasing the utilization level of power and reducing the losses by taking following steps:
  - **Technology up-gradation –** Opted for proper grinding equipment with latest technology, which led to the reduction in energy losses in the form of heat, sound, vibration and unutilized oversized equipment.
  - **Switch to efficient technology –** Replaced old grinders and low efficiency motors with energy efficient grinders and motors. In maximum cases, the payback period was 6-9 months.
- **Conveying Systems:** This phase, involved working on the conveying systems. The team replaced most of the lean phase pneumatic conveying systems with the dense phase pneumatic conveying systems and used gravity conveying wherever applicable. The experts redesigned all the lines, fans, cyclones etc. in the pneumatic conveying systems wherever necessary. This resulted in reducing the conveying power drastically by more than 60%.

  This led to two positive outcomes from the process of redesigning the conveying system were reduction in operating equipment and increase in the product yield from 95% to 97% which thus led to to increase in production volume and cost reduction.
- **Reactors & Blenders:** This phase involved working on the reactors, blenders and the studies revealed that higher rotation per minute (RPM) led to more power utilisation and increased breakdowns. The team established the best suitable RPM with the help of Variable frequency Drives (VFD) installed on reactors and blenders. After changing gearboxes and motors, VFDs were removed from the system. Operating the equipment on best suitable lower RPM led to increase in efficiency of operation, decrease in power consumption and the very positive outcome of lesser equipment breakdown.

- **Other Initiatives:** Based on studies in rest of the areas like lights, cooling, packing etc. and observations, all the changes were made that were required to minimize the power consumption. And also installed roof solar power plant on available suitable roof spaces and wind mill also in Gujarat for production of low cost and eco-friendly generation of electricity.

The most important outcome was while there was targeted reduction in power consumption, this whole exercise brought remarkable change in the working conditions as well. There was significant reduction in sound and heat level of plants, drop in reworking since the operations ran more smoothly than earlier. Replacing the oversize older equipment with state-of - the – art, efficient technologies with the right capacity allowed us to have extra space. There was considerable reduction in the inventories that led to cost savings in operations and with lower maintenance costs and the plants could now be run for longer hours and increase the production.

The whole exercise has a very positive impact on improvement in working conditions directly and on the motivation levels of workforce on the shop floor to work. The manpower not only worked in a more disciplined way but we there was also a notable increase in retention.

Reduction in electrical power consumption reduced the connected load and maximum demand (MDI) requirement of electrical power from the state electricity board thus resulting in reduction in fixed cost of electricity up to an extent. After working on saving the electrical energy, there is regular monitoring of the facility for smooth functioning and for any further corrections that may be carried out to enhance power savings and sustain achieved standards.

Thermal Energy

For the process plants, 2nd main cost after electricity is the heat energy utilised for hot water, steam and hot air. The studies on heat energy consumption revealed that 75-80% is required for hot air followed by 10-15% for hot water and balance 5-10% in the form of steam. It was found that during generation of hot air about 45% heat is lost in the atmosphere and utilization of fuel is higher due to lower combustion efficiency, higher oxygen levels in flue gases and some losses during heat transportation because of improper line sizes, poor insulation and leakages etc.

- **Hot Air Unit:** Since the unit was using diesel as the fuel it was not possible to increase utilisation efficiency because of the smoke in the flue gases which imparted black colour to the product and degraded the quality of finished product. Additionally there were problems due to leakages in tube in heat exchangers that would create sudden problems such as uncertainty

in processes, unanticipated breakdowns which led to increase in cost and poor product quality.

The team considered replacing diesel with natural gas and after satisfactory evaluation on data and trials discarded the old diesel hot air generators and installed natural gas based hot air generators with high quality gas train and gas burners.

In the natural gas based utilisation mode, hot air with flue gases are injected directly into the system that leads to huge energy and cost savings. In place of 120 lit of diesel to produce 1 metric tonne of product, the unit requires only 65 SCM gas including 20 SCM of hot water and steam. This system is eco-friendly and enables and it is easy to maintain consistency in product quality. Since the Piped Natural Gas (PNG) is lighter than air, it eliminates the possibility of any untoward incidents in case of leakage, there is no requirement of having on-site fuel storage which further makes it a safer option. Moreover its availability, lesser fuel cost, reduced storage and transportation cost etc. offer cost benefits. The team experienced noteworthy changes as the new equipment could be installed in lesser space and required lesser maintenance.

- **Hot water & Steam:** After completing the revamp of hot air unit, the team evaluated the quantity of hot water and steam for process as well as calculated the difference between generation and requirement. After bringing down the transportation losses up to desired levels and modifying the way of application for effective use, the team could save approximately 20-25% in quantity of hot water and steam.

  After the PNG connection, the company went on to install natural gas based electricity generator of small capacity for back up with most efficient heat recovery unit to fulfil requirement of steam and hot water which could operate in case of unprecedented grid power failures.

Calculations & Results

The table summarizes the cost of product before and after the changes, all parameters are based on 1 tonne of production.

Considerations for calculation

- Average size plant capacity : 5000 MTPA (Approximate Difference: Rs. 6.5 crore per annum)
- **Product :** Difference in finished product and by product (low grade): Rs.100,000/ per tonne
- **Electricity:** Cost of 1 KWH = Rs.8/-

Parameter	Before	After	Achievement (%)	Saving (INR)
Electrical Power	1500 KWH	1000 KWH	33%	4000
Heat Power	120 lit Diesel	65 SCM natural gas	35%	9000-1950=7050
Product Yield	95%	97%	2%	2,000
Total	-		-	13050

Table 1: Parameters before & after changes were carried out

- **Diesel:**
  Density of diesel = 0.85 kg/ lit,
  Calorific value of diesel = 10,000 kcal/ kg,
  Average price (as on 11th August)
  = Rs. 75/ per litre
- **Pipe Natural Gas:**
  Density of PNG = 0.8 kg / cubic meter,
  Calorific value of Natural Gas= 12500 K cal / kg
  Price of PNG = Rs. 30/ SCM

Thus the calculation shows energy cost reduced from Rs.21000/- per tonne to Rs. 7950/- per tonne that translated to approximately 62% saving in energy and had many other positive benefits.

Effluent Treatment Plant

The team worked on reducing energy cost in Effluent Treatment Plant (ETP) that was earlier based on aerobic treatment and required large quantities of chemical and oxygen provided with the help of air blowers. Effluents can be treated in agro based industries using anaerobic processes. The team took the initiative to redesign the ETP plant and added the anaerobic reactor. This eliminated the use of chemical and since the requirement of oxygen could be reduced, this led to increase in major savings in power consumption. The anaerobic reactor produces considerable amount of methane gas which is utilised to meet the heat requirement.

The journey to become energy efficient set the company on the path of attaining sustainable growth through use of eco-friendly technologies which led in creating safer work places, maintaining consistency in product quality, improving operations to become commercially viable as well as cost effective. ■

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Pipeline Integrity:
Out of Sight does not Mean Out of Mind

Integrity of pipeline is now a major focus which may be attributed to a couple of factors, which include new legislation, technical advancements, strict penalties for accidental leakages, environmental concerns , ageing of pipelines and also considering the impact of pipeline related incidents have proven to be fatal. All elements of integrity are important since we know that the weakest part determines the strength of the entire system.

Pipelines are the energy veins of the world. Much of the world runs on pipelines. From the time we get up in the morning until we go to bed at night, it's difficult to find a moment when we haven't used energy transported by a pipeline. Crossing the landscape largely buried, pipelines traverse quiet wilderness and bustling communities, providing the safest and most efficient method of hydrocarbon transportation in the world today. Out of sight does not mean out of mind. Integrity of pipeline is now a major focus which may be attributed to a couple of factors, which include new legislation, technical advancements, strict penalties for accidental leakages, environmental concerns , ageing of pipelines and also considering the impact of pipeline related incidents have proven to be fatal. All elements of integrity are important since we know that the weakest part determines the strength of the entire system.

What should be the objective of a pipe integrity management program?

A pipeline integrity management program should Identify threats to pipeline integrity, potential consequences to the public and the environment in the event of a release, Rank segments of the pipeline system according to the risk each poses, Provide for assessment of the integrity of each segment in a timely manner based on identified threats and the risk to minimize

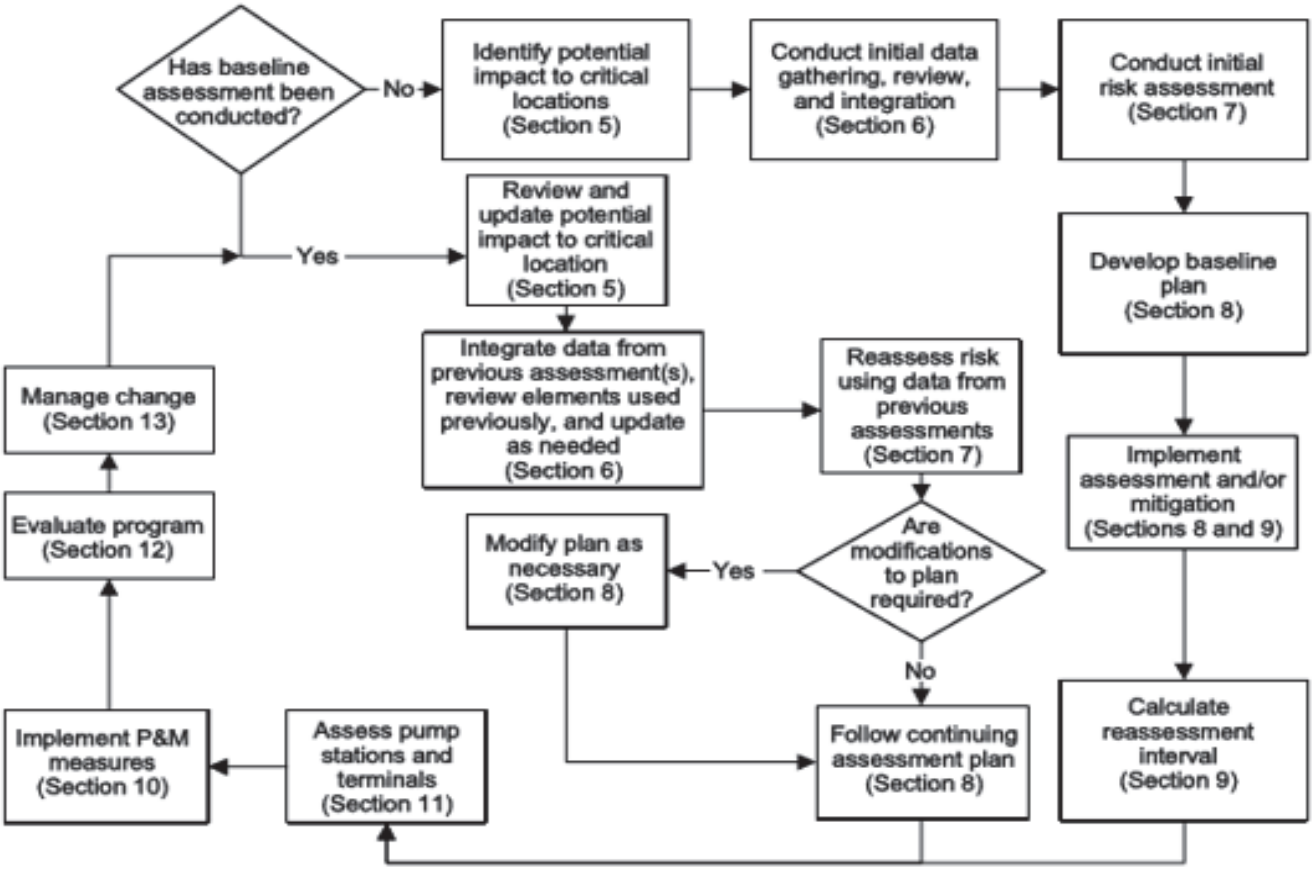

Fig. 1 Typical Process Flow for Integrity Management Programme
Source: - API 1160, 2013 version

the possibility of a release, Specify repairs or mitigative actions to carry out in a timely manner to prevent releases, Establish reassessment frequencies, Define preventive and mitigative measures to address relevant threats including those not covered by integrity assessments, Use the findings of integrity assessments to update and Improve the integrity management process.

What are the threats for pipeline integrity?

Pipeline Integrity threats are mainly categorized to be Time Dependent, Stable and Time Independent. Reassessment of the integrity a pipeline segment subject to a time-dependent anomaly growth mechanism should be carried out at appropriate intervals to minimize the risk of a pipeline failure caused by an anomaly that was too small or was under the reporting size criteria detected in the last assessment growing to a size that would fail at maximum calculated surge pressure or 1.1 times MOP.

Accurate corrosion growth rates are needed to predict pipeline availability as a function of time, to identify the need for

and timing of field investigations or repairs and to determine optimum re-inspection intervals. The consequences associated with using wrong corrosion growth rates range from the inefficient use of resources (time, people and money) on unnecessary repair/inspections to unexpected pipeline failures. The identification of where corrosion is active on a pipeline and how fast it is growing is a complex process which is understood in the general sense but is highly variable

There are various approaches that can be used to define corrosion growth rates for use in pipeline integrity assessments. The major advantage of using repeat ILI data to derive corrosion rates over other methods is that the ILI can provide growth rate information on the whole detectable corrosion distribution density giving visibility of what is happening along the entire pipeline. Further XYZ mapping plots the infrastructure and population density for risk assessment. Fingerprint ILI is warranted for the above to establish the initial pipeline health assessment post commissioning. In specifying a 'fingerprint' inspection the pipeline operator should consider why the inspection being is done, as this will affect the probability of detection (POD),probability of Identification (POI) , defect reporting levels, assessment method and acceptance criteria that should be used.

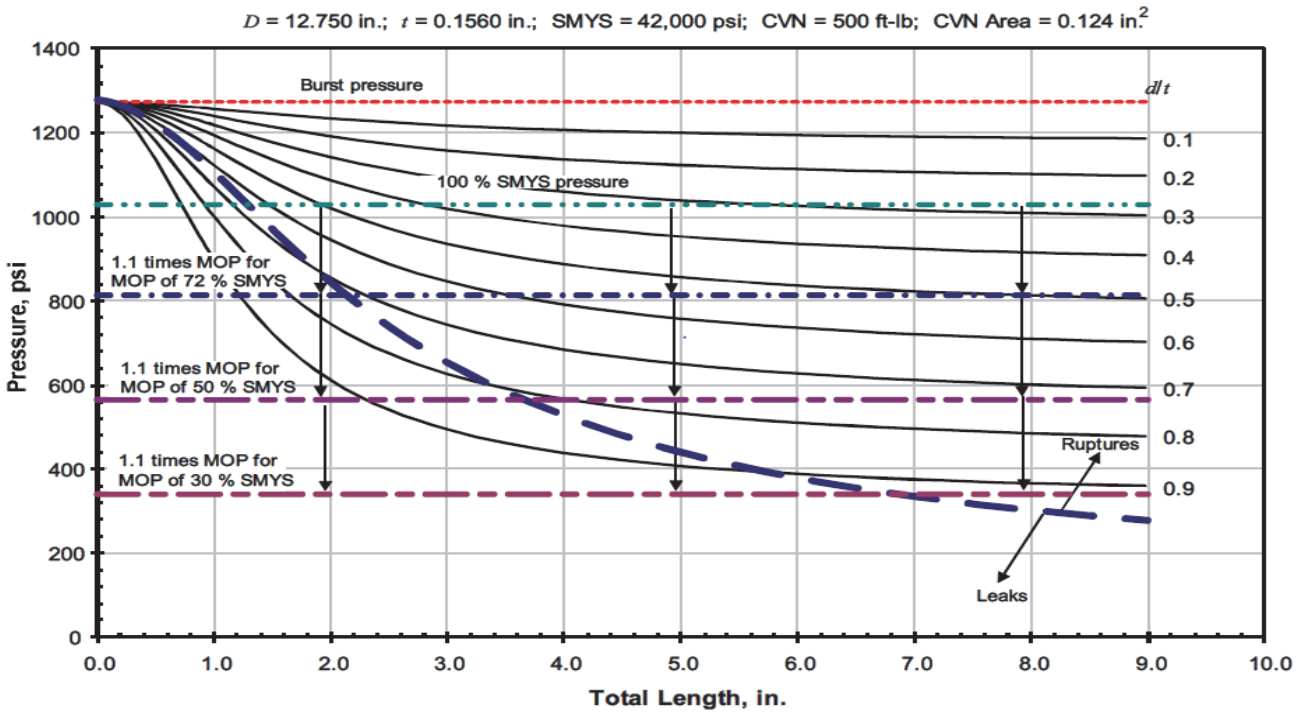

Fig. 2 Typical Reassessment Intervals Based on a Specific Failure-pressure-vs-anomaly-size Mode
Source: - API 1160, 2013 version

The application of fixed rates can be very conservative and will lead in many cases to unnecessary repairs or if the rates are too low to an unsafe assessment of the future integrity of a pipeline. Using location specific (variable) growth rates (both scenarios of applying the maximum rate per pipe joint and defect specific rates) has been found to provide more realistic and targeted predictions of repair needs. The location specific growth rates give accurate predictions of the corrosion severity over time. With the benefit of this hindsight, the predictive analytics employed for evaluating and applying ILI based corrosion rates can be further improved and refined to give more accurate predictions of the future pipeline condition, the response schedule and optimized timing of re-inspections.

Time is now to review multiple-data-set ILI results from several pipe joints with simulated defect locations from ILI surveys. The same has been implemented on BPCL pipelines as for ageing pipelines corrosion growth rates have been derived and very useful in aligning the reassessment intervals. Further the Fingerprint inspections have been implemented on our new pipelines creating a baseline data for the future advanced inspections. BPCL has established stringent inspection criteria at 0.95POD and 0.90POI to establish quality data for analysis. The ILI runs and subsequent signature analysis and data treatment have been very useful in uprating of pipelines and remaining life estimation.

Time is now to convert data to information to add value to the initiatives being taken and the amount being invested towards data gathering. The information gathered over time has to be translated into effective corrosion mitigation/control programs. Reviewing from a deeper understanding of information from corrosion monitoring and other sources is required. For effective corrosion control it is important to understand “where, when and why” pipeline damage takes place – the proactive and investigative approach as discussed shall be of great use and the inputs derived shall have a positive impact on the pipeline integrity matters. ■

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Case Studies:
Failure of Duplex Grade in Heat Exchangers

One of the major refineries in Asia-Pacific is using UNS S31803 tubes in a HX. The subject cooler was in service for 3 years when some leakages were found in the tubes of the HX. The tubes were plugged and HX was operated for another year. During that inspection some more tubes were seen leaking during shell side hydrotest. The leaking tubes were pulled out, spilt open for accessing the condition of damage. Severe pitting was observed at highly localized spots (Fig. 1)

The cooler remained in operation for some more time with a dozen or some tubes plugged. But the operation had to stop as heavy leakage was detected in the HX. There was thorough inspection and shell side hydrotest was carried out and almost 50 more tubes were leaking. Remote visual inspection of leaking tubes indicated white salt deposition and isolated pitting. In one of their condensers they had a severe corrosion in UNS 32750. Within sometime in operation some of the tubes failed. Severe pitting was found in around the corrosion pits. The cooling water was taken directly from the sea with inlet temp at 32 and outlet around 430C. (Fig. 2)

Experimental Procedure

NACE International released the "International Measures of Prevention, Application and Economics of Corrosion Technology (IMPACT)" study, in which it estimated the global cost of corrosion to

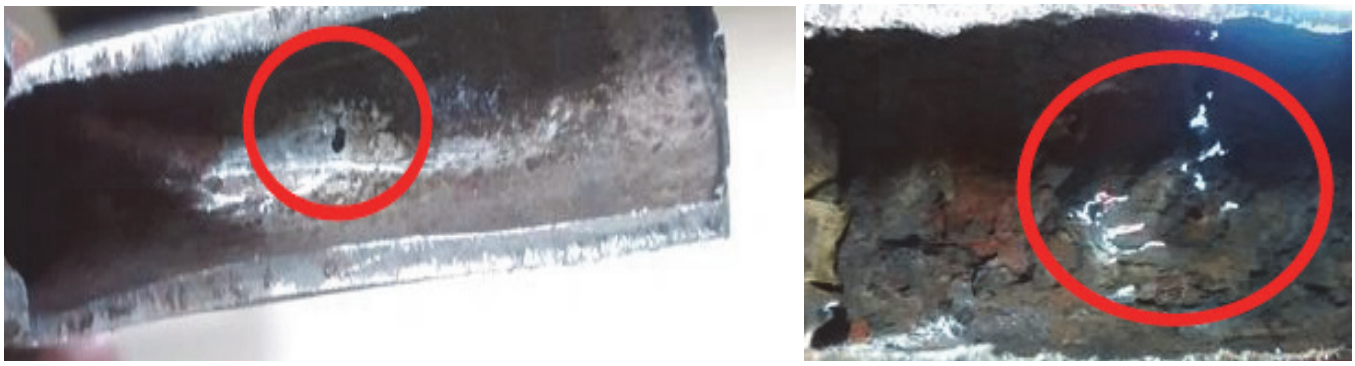

Fig. 1 Pitting corrosion on the Duplex Tubes on the inside diameter

Fig. 2 Pitting corrosion on the Super-Duplex Tubes on the failed samples

be USD 2.5 trillion, equivalent to roughly 3.4 percent of the global Gross Domestic Product (GDP)1 The two-year global study released at the CORROSION 2016 conference in Vancouver, B.C., examined the economics of corrosion and the role of corrosion management in establishing industry best practices. The study found that implementing corrosion prevention best practices could result in global savings of between 15-35 percent of the cost of damage, or between 375-875 billion (USD).

Failures in HX is a common phenomenon in Refineries. It becomes a major concern when materials like UNS 31803 fail pre-maturely in the system. This leads to a lot of stoppages and un-planned maintenance shut-downs with the consequence of loss of productivity. This study will help to understand the application limit of UNS 31803 and UNS 32750 and what's the solution with aggressive chloride environment. The application of Hyper Duplex needs to be understood with cost-effectiveness against very high alloyed austenitic stainless steel.

Operating Conditions

The cooler is used for cooling gas outlet from wet gas compressor on shell side by sea cooling water on tube side. The metallurgy of tubes of cooler is Duplex Stainless Steel as per ASTM A 789 (UNS 31803)2. The shell side gas inlet temperature is 53°C and gas outlet temperature is 38°C. The sea cooling water inlet temperature is atmospheric. Cooling water outlet temperature of cooling water outlet header is 46°C in maximum.

The tubes in UNS 32750 were a part of a heat exchanger (tube side) in a Fluid Catalytic Cracking (FCC) process unit overhead condenser. FCC is a conversion process where various heavy hydrocarbons are converted to lighter, more valuable products via high-temperature catalytic cracking. Following is the information on process conditions. The Shell side contains:

Water + H_2S + Hydrogen + Nitrogen with Inlet temperature at 65ºC and Outlet temperature at 40ºC. Tube side is sea

cooling water with Inlet temperature at 32ºC and Outlet temperature at 45ºC.

Duplex Metallurgy

Duplex stainless steels are called "duplex" because they have a two-phase microstructure consisting of grains of ferritic and austenitic stainless steel. The picture shows the yellow austenitic phase as "islands" surrounded by the blue ferritic phase. When duplex stainless steel is melted it solidifies from the liquid phase to a completely ferritic structure. As the material cools to room temperature, about half of the ferritic grains transform to austenitic grains ("islands"). The result is a microstructure of roughly 50% austenite and 50% ferrite (Fig. 3)

Duplex stainless steel offers excellent resistant to corrosion and very high mechanical strength. The high corrosion resistance of duplex stainless steel ensures significantly more uptime than carbon steels and conventional stainless steels, while the mechanical strength allows for lighter constructions, more compact system design and less welding.

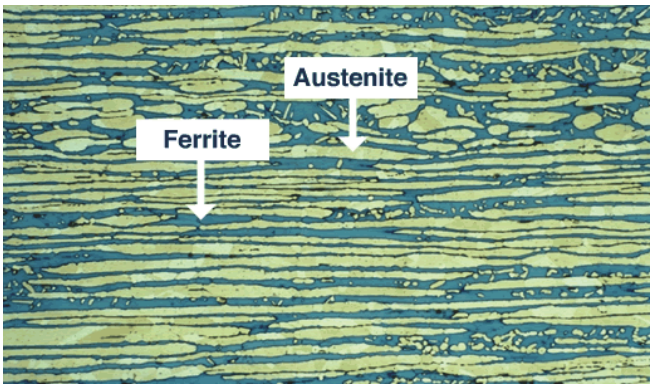

Fig. 3 Typical Microstructure of Duplex (Black phase is Ferrite and the white phase is Austenite)

They are mainly characterized by excellent resistance to corrosion – Stress Corrosion Cracking and Pitting & Crevice Corrosion. Duplex though single metallurgy can have various variants. From lean Duplex to Duplex to Super Duplex to Hyper Duplex. (Refer - Table 1)

Duplex (austenitic-ferritic) stainless steel is mainly characterized by:

- High resistance to stress corrosion cracking (SCC) in chloride-bearing environments
- High resistance to stress corrosion cracking (SCC) in environments containing hydrogen sulfide
- High resistance to general corrosion, pitting, and crevice corrosion

Grade	UNS No	Cr	Ni	Mo	N
3RE60	S31500	18.5	4.5	2.6	0.07s
SAF 2304	S34304	23	4.5	-	0.1
SAF22051	S31803	22	5.5	3.2	0.18
SAF2507	S32750	25	7	4	0.3
SAF2707	S32707	27	6,5	5	0.4

Table 1 : Typical chemical composition of duplex family

Grade	Critical Pitting Temperature (CPT) degree Celsius	Critical Crevice Temperature (CCT) degree Celsius
904L	30	N/A
UNS 31803	35	20
SANICRO 28	45	N/A
254 SMO	75	45
SAF2507	75	50
Alloy 625	>85	35
Alloy C 22	> 85	75
Alloy C 276	>85	45
SAF 2707HD	> 95	70

Table 2 : Pitting and Crevice Corrosion resistance (as per ASTM G48)3 values of various grades

- High resistance to erosion corrosion and corrosion fatigue
- High mechanical strength - roughly twice the proof strength of austenitic stainless steel
- Physical properties that offer design advantages
- Good weldability

Pitting and Crevice Corrosion resistance (as per ASTM G48)3 can be seen h in Table 2.

CPT is Critical Pitting Temperature and CCT – Critical Crevice Temperature

Pitting corrosion and MIC

The pitting resistance of a steel is determined primarily by its chromium and molybdenum contents, but also by its nitrogen content and its slag composition and content. The manufacturing and fabrication practices, e.g. welding, are also of vital importance for actual performance in service.

A parameter for comparing the resistance of different steels to pitting, is the PRE number (Pitting Resistance Equivalent). The PREN (Pitting Resistance Equivalent Number) is defined as, in mass-%:

PREN = % Cr + 3.3 x % Mo + 16 x % N

UNS 31803 cannot withstand such a high chloride level at temperatures of

PRE = 1x%Cr + 3,3x(%Mo + 0.5%W) + 16x(%N)

Grade	UNS	%Cr	%Mo	%N	PREN
SAF2304	32304	23	0,3	0,1	26
SAF 2205	31803	22	3,1	0,1	32
SAF 2507	32750	35	4,0	0,3	43
SAF 2707HD	32707	27	5,0	0,4	49

Table 3 Pitting Resistance Equivalent Number (PREN) of duplex family

more than 35ºC. Hence, UNS 32707 was recommended for this application which can withstand the aggressive chloride environment and temperatures without any failures.

The Pitting Resistance Equivalent Number of the UNS 31803 is at an average around 32 to 33 which is much lower than UNS 32707 (as per Table 3).

Microbiological Induced Corrosion (MIC)

Corrosion of metals by micro-organisms, primarily bacteria, is a well-known and ongoing problem in oil field production and transmission, natural gas transmission, pulp and paper industry, municipal and industrial wastewater treatment, power generation, metalworking and chemical process industries. Documentation in the published literature from the early 1900s of cases of MIC of plain carbon steel and cast-iron pipelines and other equipment by sulfate reducing and sulfur oxidizing bacteria is extensive.

In recent years, numerous cases of MIC of austenitic (300 series) stainless steels (SST) in waters used for hydrotesting, cooling, settling, ballast, run-in, fire protection, etc. have been reported. Piping, storage tanks and heat exchangers along with other process equipment have been affected. Iron utilizing bacteria appear to be the dominating microbial species involved, although others have been implicated. Industries hardest hit with high cost of repairs and replacements, plus lost revenues due to process downtime, are chemical process and nuclear power generation. The main reasons for this are –

- Water not drained following a hydrotest or run-in procedure
- Low water flow through horizontal pipelines and heat exchanger tube bundles
- Water used as ballast during hurricane threats or for settling purposes in newly erected storage tanks
- Water used for emergency situations such as fire protection, with little or no provision for continuous circulation
- Water heel left in horizontal pipelines that were not sloped so low points between supports could drain readily

MIC in itself is NOT a corrosion phenomenon. But the trigger point is the micro-organisms. Finally, it leads to under-deposit corrosion and leads to failure. Materials with higher PREN are generally used to mitigate the problem of MIC.

Results

The failed samples of UNS 31803 and UNS 32750 were received at our laboratory where it was cut at the cross-sectional area. Severe corrosion was found on the

Fig. 4 Corroded Cross Section Sample of Super Duplex

inside of the tubing and reddish-brown oxide layer can be seen and small pits on the inner surface are visible. Deep pit marks were found which results in the leakage of the tubing. (Fig. 4 & 5)

The shell side gas inlet temperature is 53°C and gas outlet temperature is 38°C. The sea cooling water inlet temperature is atmospheric, cooling water outlet temperature of cooling water outlet header is 46°C maximum. With this level of chlorides and temperatures UNS 31803 has a lot of limitations when it comes to pitting and crevice corrosion.

With a CPT (Critical Pitting Temperature) and CCT (Critical Crevice Temperatures) of 350C and 20 0C this alloy is not suitable for this application or environment. When we look at UNS 32707 the material that was recommended for this application or environment suggests a very good pitting corrosion resistance than UNS 31803.

In the other case the corrosion content

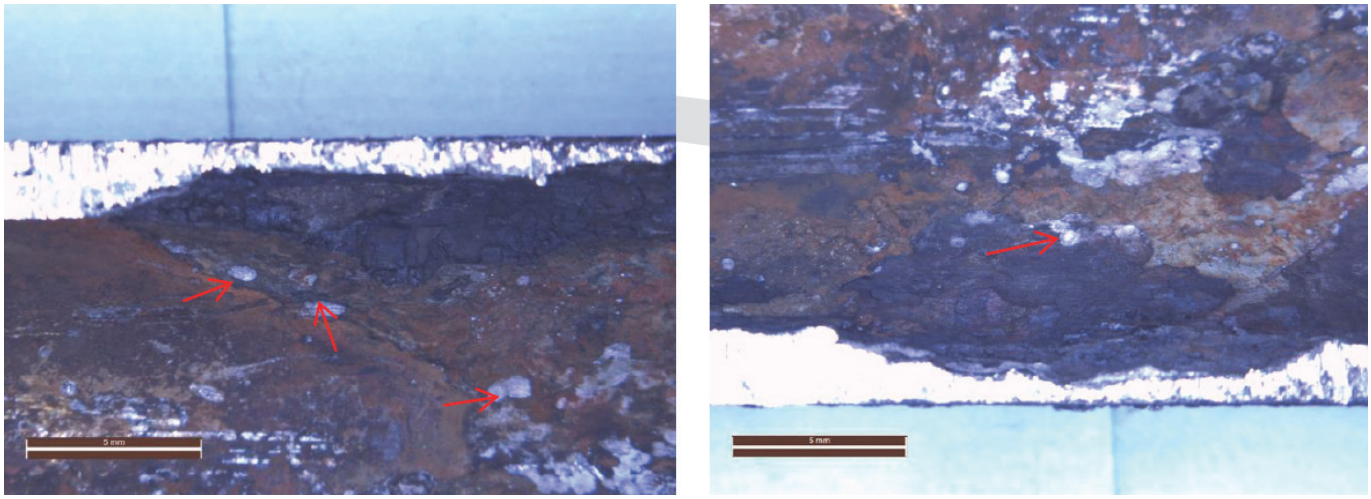

Fig. 5 - Pit marks on the corroded sample shown by red arrow

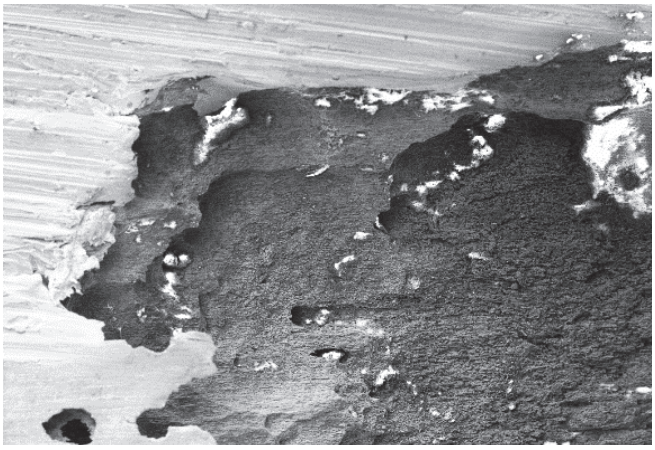

Fig. 6 Cave like structure typical of pitting corrosion

around the pit was very closely monitored. Surprisingly, a high level of Sulphur was seen in around the pit. The cave like structure as seen from the picture (Figure 6) is typical of pitting corrosion. However, a high sulphur content wasn't expected. Energy-dispersive X-ray spectroscopy (EDS) gave the contents at various spectrums as can be seen from Figure 7 and the results of various spectrums in provided in Table 4 The

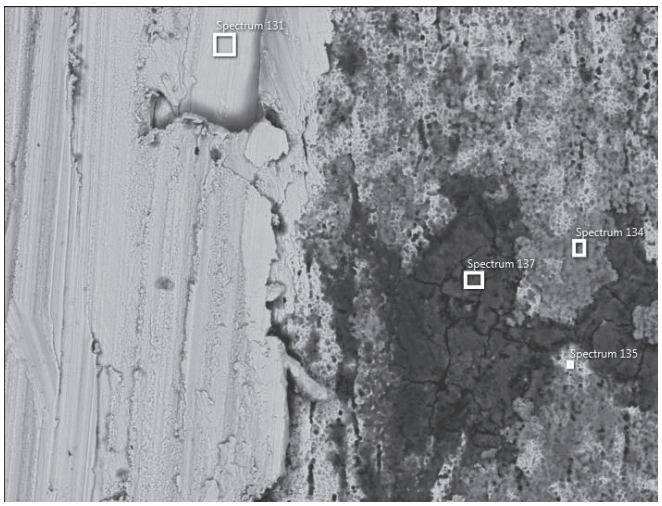

Fig.7 Spectrum marking using EDS

application temperature range provided by the customer is well below of CPT of Super duplex stainless steel. However, the microstructure and the morphology of corrosion with localized deep pits through the wall-thickness as well as cavernous structure with connected tunnels strongly suggest pitting corrosion.

The cooling medium used is untreated seawater. Both mineral sediments from sea water and bio fouling are possible in the use of untreated sea water for cooling. Whitish deposits were seen on the inner surface suggestive of mineral deposits. Beneath deposits, crevice like conditions exist which may lead to crevice/pitting corrosion. The chemical nature of these deposits appears to be a mixture or combination of compounds of calcium, magnesium, silicon and oxides.

A microbial slime or biofilm is formed on the surface of the tube when the inert material is exposed to sea water. This biofilm has a catalytic effect on the cathodic reaction or oxygen reduction which increases the risk of crevice or pitting corrosion. Microbiological influenced corrosion is a not a separate corrosion mechanism, but it can aid in starting other corrosion mechanisms such as pitting or crevice even in conditions not favourable for such corrosion activity.

Spectrum Label	Spectrum 131	Spectrum 134	Spectrum 135	Spectrum 137
O		19.99		36.83
Mg				12.02
Al	0.07			2.71
Si	0.44	2.51	0.29	5.95
P				0.33
S		3.95		3.43
Cl				0.19
K				0.10
Ca		0.41		0.63
Ti				0.14
Cr	25.47	10.07	21.31	5.49
Fe	62.25	48.18	66.76	25.79
Ni	8.10	2.81	7.87	
Cu		7.04		0.81
Zn		2.76		5.01
Mo	2.99	2.27	3.78	0.57
W	0.67			
Total	100.0	100.0	100.0	100.0

Table 4: Results from EDS in the failure analysis report by laboratory (mass %)

Microbiologically influenced corrosion activity is at its highest when temperature is just below temperature at which biofilm is killed, which is roughly about 40 °C. The application temperature is between 32 to 450C, which under appropriate low flow conditions may enable biofilm and microbiological induced corrosion.

SAF 2707 HD is characterized by a very good corrosion resistance in aggressive chloride environment. The chemical composition of UNS 32707 is provided in Table 5 –

This provides this grade a very high PREN of almost 49.

This grade also has very high mechanical properties (Table 6)

Chemical composition (mass %)							
C	Si	Mn	P	S	Cr	Ni	Mo
≤0.030	≤0.5	≤1.5	≤0.035	≤0.010	27	6.5	4.8
Others N=0.4 Co=1.0							

Table 5 – Nominal Chemical Composition of UNS 32707

At 20°C (68°F)

Metric Units					
Proof strength, MPa		**Tensile strength, MPa**	**Elongation, %**		**Hardness, HRC**
$R_{p0.2}$ [a)]	$R_{p1.0}$ [a)]	R_m	A [b)]	$A_{2"}$	
≥700	≥800	920-1100	≥25	≥25	≤34

Table 6 Mechanical properties at 200C

1MPa = 1N/mm

a) R and R correspond to 0.2% offset and 1.0% offset yield strength, respectively.

b) Based on L = 5.65 √S where L is the original gauge length and S the original cross-section area.

This can also lead to some saving in the material as thinner tube wall can be used for the same pressure rating. This will reduce the overall weight of the equipment as well. There will also be a possibility of increasing the heat transfer rate as well increasing the overall efficiency of the equipment and the overall process.

One of the most severe pitting corrosion tests, applied to stainless steels, is ASTM G483 i.e. exposure to 6% FeCl3. In a modified version of the ASTM G48A test, the sample is exposed for periods of 24 hours. When pits are detected, together with a substantial weight loss (> 5 mg), the test is interrupted. Otherwise, the temperature is increased by 5°C and the test continued with the same sample. This test is the benchmark when it comes to the testing for Critical Pitting Temperature (CPT) and Critical Crevice Temperatures (CCT).

The corrosion resistance of UNS 32707 in

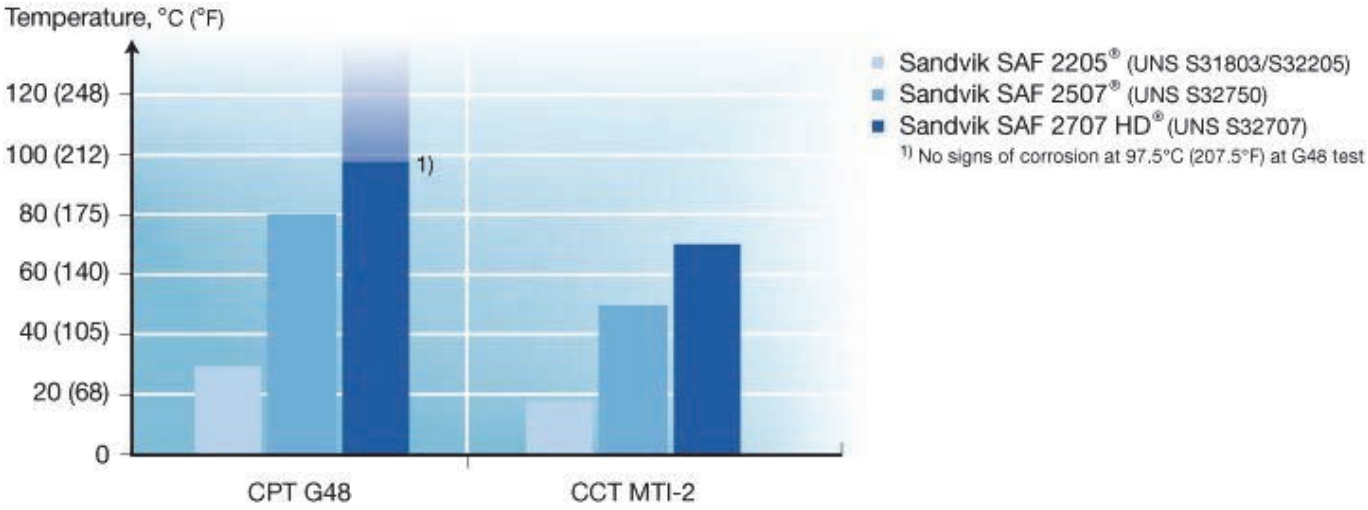

Fig. 8 – CCT and CPT of SAF 2205, SAF 2507 and SAF 2707 HD

oxidizing chloride solutions is illustrated by critical pitting temperature (CPT), determined in a "Green-Death" solution (1% $FeCl_3$ + 1%$CuCl_2$ + 11% H_2SO_4 + 1.2%HCl).

The crevice corrosion test was performed in 6% FeCl3 with a crevice specified in the MTI-2 procedure, where an artificial crevice is mounted on the sample with a torque of 0.28 Nm. The values obtained and a comparison with Sandvik SAF 2507 are given in Fig. 8. All test results show significantly higher values for UNS 32707 than for UNS 32750 and UNS 32205

Full scale extended heat exchanger tests in chlorinated natural seawater

The very good pitting corrosion results in laboratory tests have also been verified in full scale extended heat exchanger tests in chlorinated natural seawater. The residual chlorine content was 0.5 ppm. Model heat exchangers and heat exchanger tubing in UNS 32707 and UNS 32750 welded into UNS 32750 tube sheets and UNS 32707 welded into a UNS S32205 tube sheet were tested for 6 months at each temperature. The inlet temperature of the seawater was 35°C with a seawater flow rate inside the tubes of 1 m/s.

Heat was applied from the shell side with external heating elements and thus a heat flux through the tubes was achieved. As the results in the table show, no pitting was observed on UNS 32707 when the tube skin temperature on the seawater side was 70°C, after tubes were heated from the outside at a temperature of 105°C. At this temperature UNS 32750 experienced pitting, but passed at 50°C. UNS 32205 was attacked by pitting at both temperatures.

Conclusions

- The tubes failed due to the pitting corrosion on the inner wall surface. The samples were analyzed and the limitation of the UNS 31803 and UNS 32750 grade was the main factor in the failure of the HX.
- Looking at operating conditions, pH is basic so the preferential mechanism to be considered is pitting and crevice corrosion due to chlorides and high temperature. The chloride content of sea cooling water is 2.75%, which is very high. Moreover, the temperature of the tube can be conservatively approximated to be around 50°C.
- This implies that the grade UNS S31803, which has a PREN of 32 and low critical pitting temperature and critical crevice temperature of 35 and 200C respectively is not suitable for this application. This grade has limitations when it comes to high chloride bearing environments with

higher temperatures. This is the main cause of the failure of the tubing in the HX.

- In case of UNS 32750 untreated sea-water led to MIC of the tubing wherein the biological activity eventually led to pitting corrosion. It can be mitigated by either chlorination process (but it can have environmental issues) or by upgrading the metallurgy of the tubing.
- UNS 32707 could be a good choice considering the above factors. This grade will not only take of the aggressive chloride levels in the environment and with respect to MIC but also will perform better at higher temperatures.
- Only at much higher temperatures say above 250 to 2700C it's not recommended. In those cases, suitable High Ni Alloys can be chosen.
- We also know that one refinery customer in Europe has chosen to use UNS 32707 vs Cupronickel under similar operating conditions. ■

ACKNOWLEDGEMENTS

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Businesses can only thrive when regulatory environment is predictable

Agrochemicals sales are expected to grow by up to 2% per year over global GDP until 2035. ***Dr Raman Ramachandran, MD & CEO, PI Industries Ltd*** *acknowledges while there is enormous potential for India to be a leading provider of agrochemical active ingredients, intermediates and formulations support from government in ensuring consistent and well thought through regulations governing manufacture and use of agrochemicals will be important.*

Dr Raman Ramachandran
MD& CEO
PI Industries Ltd

August 2020

Revenue of PI Industries from operations registered a growth of 19 % on YoY basis. What were the key drivers for the growth for PI Industries during the last financial year?

PI's business model is unique in its offering across the global AgChem value chain and is based on strategic partnerships. The business is built on end-to-end collaboration with global innovators with ~90% of Custom Synthesis and Manufacturing (CSM) revenues from patented molecules; 60%+ domestic revenues from in-licensed molecules. In our CSM business, R&D capability and commitment to EHS combined with customer-centric approach are highly valued by our Japanese and other R&D based MNCs based in Europe and North America.

PI Industries has been rated by EcoVadis (global platform providing sustainability ratings) in the 'Gold' category for the two consecutive years and PI ranks among the world's top 4% of companies in agrochemical products sector.

In Agribusiness, our capability to develop new products and build brands on basis of consistent value for farmers and channel partners in the Indian market makes us a partner of choice with many Japanese companies for bringing their products to market in India and for many other MNC companies for co-distribution of their new products. These have been key drivers of growth and we hope to continue to grow at past rates in future also.

How has the pandemic affected the agrochemicals supply chains and the market demand? What are your thoughts on the growth so far in this year vis-à-vis same time during the last year for the agrochemicals sector and PI Industries?

With agrochemicals classified as an essential commodity, impact of COVID related lockdown was comparatively lower in the AgChem industry. The timely onset of monsoon and better spread across the country has increased Kharif planting and will lead to higher than average demand. Labour shortages due to COVID related migration has increased usage of labour saving technologies such as herbicides and farm machinery.

Companies dependent on manual activities in their manufacturing plants for instance packing have faced challenges. Similarly, given the geopolitical developments, those companies dependent on China for intermediates or active ingredients would also have faced supply chain challenges. The impact of these factors on PI's business has been low as we have invested in automation and digitization in our manufacturing plants and have progressively reduced dependence on China for intermediates and raw materials.

As per estimates by Roland Berger, agrochemicals sales are expected to grow by up to 2% per year over

global GDP until 2035. What kind of opportunities do you see for the Indian agrochemicals producers for the domestic & global markets?

India has been ranked fourth globally in the production of agrochemicals (crop protection chemicals/ pesticides) after USA, Japan and China, as per IBEF report 2019. Indian crop protection chemicals exports have grown with a CAGR of almost 9% during the year 2015-19. The actual export contribution of crop protection chemicals was 50% of total domestic production (by value) in the year 2019. This will grow to almost 55% in the year 2024 (by value). USD 2.1 billion was export from India and an equal amount of crop protection chemicals were meeting domestic demand in the year 2019. In the year 2024, exports will grow to USD 3.1 billion contributing 55% of total domestic production which is valued at the USD 5.7 billion. (Source: Ministry of chemicals & fertilizers, Dept of chem & petchem, GOI)

Demand for quantity and quality of food in India will continue to be a key driver of growth in India. Phasing out of old molecules due to regulatory reasons coupled with newer farming challenges will drive the market to innovative and safer products. Indian market will thus remain an attractive home market to focus on for Indian companies and also R & D based companies.

The off-patent products segments are attractive opportunities for Indian companies who are one of the most cost-efficient and quality manufacturers. In addition, a few Indian companies have also become recognized global suppliers of key intermediates and active ingredients to MNC crop protection companies who are increasingly outsourcing manufacturing to trusted companies with respect for Intellectual property and high EHS standards.

Factors that position India as a key provider of formulations to the world

- Business conditions in the Indian manufacturing sector continue to remain positive and India has emerged as a large manufacturing base for several key active ingredients
- Surplus formulation capacity
- Scientific talent and well equipped public and private laboratories for developing wide range of formulations suiting local needs
- A pool of expertise in global regulatory processes

Tell us about the position of PI Industries as a generics manufacturer in India and globally

PI is not a manufacture of generics. PI's business model is anchored on trust and respect for Intellectual Property (IP). The business is built on end-to-

end collaboration with global innovators with ~90% of Custom Synthesis and Manufacturing (CSM) revenues from patented molecules; 60%+ domestic revenues from in-licensed molecules.

In CSM, the strategy is to build capabilities in technology platforms having applications in agrochemicals, pharma, electronics, imaging, and various other niche fine chemical areas. In the domestic agri-input business, PI has its focus on increasing the share of in-licensed and co-marketed products to provide solutions to help farmers to be more successful.

What is the scope of opportunities for exports by Indian companies in generic segment producing a wide range of world-class formulations?

There are several factors that positions India as a key provider of formulations to the world. First, business conditions in the Indian manufacturing sector continue to remain positive and India has emerged as a large manufacturing base for several key active ingredients. There is surplus formulation capacity. India has scientific talent and well equipped public and private laboratories for developing wide range of formulations suiting local needs and there is a pool of expertise in global regulatory processes.

How well-positioned is India as the next largest destination for the agrochemicals industry in terms of available capacity & the hub for contract manufacturing and undertaking contract research. What are the key concerns for this industry that still need to be addressed to realize its full potential?

While there is enormous potential for India to be a leading provider of agrochemical active ingredients, intermediates and formulations support from government in ensuring consistent and well thought through regulations governing manufacture and use of agrochemicals will be important. Businesses can only thrive when regulatory environment is predictable. Similarly since, innovation is a key to continued success in this industry, a consistent intellectual property regime (whether patent or data protection) will foster long term success. Government can further facilitate investment and growth by developing AgChem specific industrial clusters with state of art common effluent treatment plants, utilities so companies can focus on technology and customers. EoDB and tax incentives to have a level playing field with other global manufacturing hubs will further catalyse growth.

How do you think should the agrochemicals manufacture de-risk the business to deal with the impacts of vagaries of weather and supply chain disruptions? What are the advantages offered by the Indian Government's Make in India initiatives?

Weather related risks, risks associated with commodity prices are inherent risks of Agribusiness. Successful companies have adopted strategies to mitigate these risks.

At PI, our differentiated business models of export to different geographies balanced with domestic distribution business which is pan India reduces such risks.

What should be the key focus areas in crop protection chemicals for sustainable development of agriculture as well as meet the requirement of Indian population due to non-availability of agricultural land?

While being amongst the most regulated substances, Crop Protection Products are also the most important tool to increase agricultural production to meet the nutritional requirement of a population which is expected reach 9 billion. Sustainability has been the core of innovation in crop protection industry for the past few decades:

- Innovation in new products which require only grams per ha as opposed to kilograms a few decades back and are target specific and hence safer to humans and environment
- Precision agriculture with targeted application using digital technology
- Usage of more biological based products and integration of these with conventional products
- Using digital and data analytics for precise application at the right time
- Safe Use and Stewardship of products are practised and promoted by all responsible companies
- Adoption of sustainable manufacturing practices which results in emission of green house gases, sustainable use of water

Does the product portfolio of PI Industries include bio-based chemicals?

PI's product portfolio in horticulture segment has an active focus on integrating biological products with existing portfolio. We will soon be launching a product for disease control in grapes, Polyoxin D which has a biological basis. This will add to our current portfolio of biostimulant portfolio.

How do you see the growth in the market for Biopesticides & Biostimulants? In your views what could be the possible challenges to create market demand?

Bio-pesticides segment is growing at a rate of 16% y-o-y driven by the demand for "organic" produce. Bio-pesticides will not completely replace the chemical crop protection completely but will be increasingly used in integrated approaches. The main challenge associated with bio-pesticide usage is 'stewardship of the product.' The product requires full integration and a good program based approach for farmers to realise its value. In our country, numerous products of questionable quality are sold as biological products and counter- productive to its growth. ■

"India is a preferential partner for Brazil"

Prof. Galo Antonio Carrillo Le Roux, Director-President of the Brazilian Society of Chemical Engineering (ABEQ) *speaks to Chemical Engineering about the partnership of ABEQ as a Support Partner for ChemTECH World Expo 2021 and the pivotal role of the organization to enable building greater partnerships with Indian industry*

Prof. Galo Antonio Carrillo Le Roux
Full Professor at the Department of Chemical Engineering of the Polytechnic School of the University of São Paulo
Head of the Graduate Program in Chemical Engineering,
Director President of ABEQ

In the last more than 4 decades of journey, what role has ABEQ played in the progress of Brazil's chemical industry?

The "Associação Brasileira de Engenharia Química" (ABEQ – Brazilian Society of Chemical Engineering) was founded in 1975 with the involvement of chemical engineering professionals from industry and academy. In that same year, the first Brazilian Congress of Chemical Engineering (COBEQ) was organized with three hundred attendees and the first number of the "Revista Brasileira de Engenharia Química" (REBEQ – Brazilian Magazine on Chemical Engineering) was released. ABEQ represents the Brazilian Chemical Engineering community in many Regional, Continental and World forums.

As a concrete ABEQ landmark the Brazilian Congress of Chemical Engineering (COBEQ) has reached

1500 attendees in recent years. ABEQ organizes some other topic conferences on Biotechnology and Process System Engineering. ABEQ is also responsible for the edition of The Brazilian Journal of Chemical Engineering, which is now published by Springer and is among 50% most cited in Chemical Engineering field. The "Revista Brasileira de Engenharia Química" (REBEQ – Brazilian Magazine on Chemical Engineering) is still published quarterly with invited articles on Chemical Engineering advances and news from the industry.

To what extent the Brazilian chemical industry been affected because of the pandemic and how is it reviving?

The Chemical Industry was considered an essential activity and kept on working during quarantine, but economical activity went down by around 20% and production was affected.

How supportive is the country's government towards promoting international partnerships for this industry?

It is difficult to say. The current government is choosing new preferential partners. Apparently India is one of these preferential partners.

How does ABEQ enable the small & medium scale players and encourage entrepreneurship for the start- ups?

In fact ABEQ dialogues with many other institutions in Brazilian Society and it can effectively help small & medium scale players by giving them voice whenever is needed.

Tell us about ABEQs efforts to enable engagement between industry & academia for development of chemical industry in the country.

This is our main concern: to make industry and academia work together. There are mainly cultural obstacles that have to be put apart. It is not an easy task.

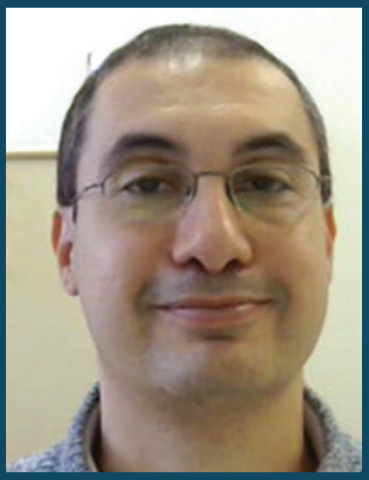
What kind of opportunities are available in Brazil for Indian chemical processing industries & what are entry barriers? How can ABEQ support the Indian players who aspire to Brazilian market?

Brazil is an open market. The main difficulties for someone who comes from abroad to invest in Brazil is to understand Brazilian system which is very complex in terms of taxes, credit, union relations and regulations. ABEQ can provide you with contacts.

What would be the biggest take away for chemical industry in Brazil & India from ABEQ & CHEMTECH's partnership?

The biggest take away is shedding light to the opportunities that can arise by discovering a potential partner with so many common interests and issues. ■

Opportunities in Brazil's Downstream Chemical Industry



Prof. André Bernardo
Vice Director-President of the Brazilian Society of Chemical Engineering (ABEQ)
Professor of chemical engineering at Federal University of São Carlos (UFSCar – Brazil)

Considering the oil market, the Chemical Industry has a perspective of cheaper raw material. However, in Brazil this perspective will be realistic only if oil refining is no longer the monopoly of a single company. The average production cost for an oil barrel in Brazil was USD 35 in 2016. It is known that this cost dropped significantly since then – it is probably around USD 15-20 this year. Ideally, the refineries in Brazil should have access to cheapest oil, but as they are subsidiaries of Petrobras – the state company responsible for ca. 90% of oil production in Brazil – their production carry over the costs of Petrobras, still much affected by political decisions. The selling process of Petrobras refineries was started in April 2019, but interrupted in March, allegedly because of Covid-19 pandemic.

Another expected still stuck action from federal government is the New Market for Natural Gas. Since the good initiative of the signature of a Term of Conduct between Petrobras and Cade – the federal agency responsible for protecting the market concurrency – in the previous government, very little has been done

beyond the sale of some assets by Petrobras. The improvement of legal system that would allow the sustainable increase of the distribution net and the practice of reasonable prices depends on good will of the Brazilian government. In April, the price of natural gas in Brazil was almost R$ 58 per million of BTU (ca. USD 10) while in USA (Henry Hub) it was USD 1.78 per million of BTU.

The Brazilian chemical industry, the sixth largest in the world with sales of around USD 120 billion, has always had a deficit, but since 2003 imports began to detach from exports. The size of the national chemical industry in relation to GDP, which has always grown, stabilized in 2004. Revenue in dollars in 2018 was practically the same as in 2010.

Brazil has become an agricultural power many years ago. Coincidentally, the deficits of our chemical industry are essentially inputs for fertilizers. The case of urea is especially illustrative. Urea is the main nitrogen fertilizer. In Brazil, the only manufacturer of urea was Petrobras through the two factories of Fafen (Nitrogen Fertilizer Factory) in Northeast Petrochemical polo. In 2019, the two factories were closed (hibernated) by Petrobras, as they would not be profitable. Nevertheless, the urea production process has been the same since always. Factories are the same worldwide, except for production capacity. The raw material is natural gas (methane, CH_4) to make ammonia (NH_3) and produce urea with it.

In 2019, Brazil imported 5.6 million tons of urea, or USD 1.5 billion. The eleven largest importers were, in order, were Algeria, Russia, Qatar, Egypt, Nigeria, Iran (until June, with increased U.S. sanctions), Oman, United Arab Emirates, Bahrain, Saudi Arabia and Argentina. The cost of producing urea is (or should be) a direct function of the cost of natural gas. Brazil reinjects 40% of the natural gas it extracts, which means that natural gas is available in abundance. All of Brazil's urea suppliers are countries rich in oil and/or natural gas, but of that list of eleven countries, only four - Russia, Saudi Arabia, Iran and the United Arab Emirates - produce more oil than Brazil. The conclusion is that the third largest food exporter in the world could also produce its nitrogen fertilizer, but gives up of more than one billion dollars in GDP and skilled jobs for not extracting its abundant natural gas at competitive prices.

To sum up, if Brazil modernizes its legislation regarding the exploitation and distribution of natural gas, as well as allowing refineries access to the cheapest oil available, the Brazilian chemical industry may return to growth and recover its profit margins. Otherwise, this sector of the economy will continue to fade away, as it has been happening for at least 10 years. ■

"Capacity expansion of Numaligarh Refinery is a midterm target of Hydrocarbon Vision 2030 for North East"

Bhaskar Phukan , Director Technical, Numaligarh Refinery Ltd *shares insights into the expansion plans of refinery from 3.0 MMTPA to 9.0 MMTPA which includes addition of 6.0 MMTPA refinery at Numaligarh, 1398 KM long crude oil pipeline from Paradip to Numaligarh with 9.0 MMTPA capacity and 654 MMTPA long product pipeline from Numaligarh to Siliguri of 6.0 MMTPA and other upcoming projects in the North East region.*

Bhaskar Phukan
Director Technical
Numaligarh Refinery Ltd

How severely has the current pandemic impacted the refining & petrochemicals industry globally and in India? When do you expect this to pick up?

The refining and petrochemical industry has been severely impacted across the globe because of the cascading impact of current pandemic on both demand and margin. The spread of the virus has forced countries to take serious measures like complete lockdown and restrictions on all modes of travel both within and outside the countries. Demand of automotive fuels, primarily Motor Spirit (Gasoline), High Speed Diesel (Gasoil) and Aviation Turbine Fuel suddenly touched the rock bottom. In India retail demand of automotive fall below 30% of normal demand. The minimum level of demand witnessed during this period was generated from transportation of essential goods and services. During the initial period of Lockdown starting from March 2020, it became difficult for the refiners to sustain refinery throughput even at a very low level with bulging inventories. However, towards the end of April, with phase wise relaxation in lockdown retail demand has picked up and in subsequent months it has recovered to around 60% of normal demand. Further, demand destruction has resulted in over supply of petroleum products in the market globally and this has resulted in steep fall in price of product as well as crude oil. In case of refiner, the margin and profitability is entirely dependent on the spread between product price and crude oil price. During this period the prices of products have fallen sharply and spread of most the products have become very thin. Today, spread of Gasoline is almost zero or negative whereas Gasoil spread is in and around USD 5 per BBL as compared to a normal, spread of USD 12 per BBL. At this level of product spread, it not possible for most of the refiners to meet their operating cost.

In India, demand should get back to normal, but how soon it regains its earlier level will depend on control of the pandemic. As slew of measures are being taken to revive the economy and due to emerging geo politics in the region, we may see strong economic recovery in India and demand will bounce back during next financial year. However, globally we may see some production facilities, both in upstream and refining sectors will close down.

The current crisis has led to major disruption in project execution due to non- availability of work forces. How has this impacted the projects of NRL currently under execution and how have you handled this challenge?

When the lock down came in, NRL were implementing around 17 small to medium projects on the ground wherein around 800 workers were being engaged. NRL

NRL Projects under implementation

India Bangladesh pipeline from Siliguri - Parbatipur (Bangladesh)

6 MMTPA refinery expansion Paradip Numaligarh Crude Oil Pipeline (1398 km, 9 MMTPA)

Numaligarh Siliguri Product Pipeline (6 MMTPA)

2G Bio Ethanol Plant thoeugh a JV with M/s Fortum 3V Netherland and M/s Chempolis Oy, Finland

was fortunate to have carried on with the projects barring initial couple weeks of the lockdown wherein as a precautionary measure, we had decided to restrict entry of workforce into the project premises. During these two weeks, we arranged the facilities to ensure enhanced hygiene at work places, put the monitoring systems in place for adherence to protocols for working during pandemic. Number of migrant workers were limited and NRL collaborated with contractors to ensure proper accommodation food arrangements for these workers and they stayed back during the entire lockdown period and continued their work.

NRL is currently implementing India-Bangladesh product pipeline from Siliguri to Parbatipur (Bangladesh). This project got impacted as land acquisition activities at Bangladesh suffered due to Lockdown at Bangladesh. However, process of land acquisition has now restarted.

NRL is also implementing a Bio Refinery in Joint venture mode, activities of this project are on though some delays were unavoidable to travel restrictions.

NRL has received EC from 6.0 MMTPA refinery expansion project. It will have associated pipelines, Paradip Numaligarh Crude Oil Pipeline (PNCPL) and Numaligarh Siliguri Product Pipeline (NSPPL). All major activities like selection of licensors, engagement of engineering consultants, preparation of site etc. went on as planned during the lockdown period.

We ensured that all protocols of social distancing are put in place at the project site. We have engaged a dedicated team to monitor adherence to protocols by each and every individual working at project site like measuring temperature, ensuring use of mask and gloves, etc. Initial days, when there were scarcity of masks, we got cotton cloth masks made through local groups who received stitching skills with equipment previously from our CSR fund, we produced our own ethanol based hand sanitizers, made our own automatic hand sensitization machines were placed at designated locations for use across the project area. Temperature measurement at all entry points were made mandatory.

We started work from home for almost all the functions like commercial, marketing, finance and HR with only 50% employees of these functions attending office. All the meetings are being conducted on a virtual platforms. Our IT team has ensured that adequate bandwidth and software licenses are available. A close coordination is maintained local administration and disaster management team. The situation was unprecedented and nobody was prepared to handle a pandemic situation of this magnitude. However, we could reinvent our own work culture to respond to the situation.

Tell us about the recently awarded NRL expansion project to increase refining capacity from 3 MMTPA to 9 MMTPA. How will this project be a part of Hydrocarbon 2030 vision of the Indian Government?

We have been pursuing the proposal for expansion of the refinery from 3.0 MMTPA to 9.0 MMTPA with addition of new refinery train of 6.0 MMTPA. The project is an integrated project with three major components, a 6.0 MMTPA refinery at Numaligarh, 1398 KM long crude oil pipeline from Paradip to Numaligarh with 9.0 MMTPA capacity and 654 MMTPA long product pipeline from Numaligarh to Siliguri with 6.0

MMTPA capacity. This project has been approved for implementation by

> The refinery is designed to manufacture 0.5 MMTPA of LPG, 1.6 MMTPA of BSVI grade of MS and 3.4 MMTPA of BSVI grade of HSD. As the configuration has a petro FCC, NRL will be in a position to manufacture good quantity of propylene.

the Cabinet Committee of Economic Affairs (CCOE) on 16th January 2019 at an approved cost of Rs. 22,594 Crores. We have also received Environmental Clearance from Ministry of Environment, Forest and Climate Change (MoEFCC) on 27th July 2020. M/s McKinsey & Company was appointed as Technical & Management Consultant (TMC) for the expansion project. We have finalized the configuration of the refinery and already selected licensor for Diesel Hydrotreating (DHDT) unit, Motor Spririt Block and Gasoline Desulphurization Unit. Licensor selection process is in progress for other units like Resid Processing & Treating Unit (RPTU) and Petro Fluidized Catalytic Cracking (PFCC). The contracting strategy for implementation of the project is also finalized. We have appointed the project management consultant and one of the EPCM for the project.

Before finalization of the configuration of the refinery a market study was conducted with the help of Price Waterhouse & Coopers (PwC) to identify the future demand supply gap in market fed by NRL, which primarily the NE region and Eastern part of India. We have also tried to identify future opportunities for export to the neighbouring countries surrounding the NE region. The configuration is designed to keep flexibility in the refinery in both fuel maximization mode as well as propylene maximization mode considering demand future demand scenario and value addition opportunities from the refinery product mix. The refinery is designed to manufacture 0.5 MMTPA of LPG, 1.6 MMTPA of BSVI grade of MS and 3.4 MMTPA of BSVI grade of HSD. As the configuration has a petro FCC, NRL will be in a position to manufacture good quantity of propylene.

Capacity expansion of Numaligarh Refinery is a midterm target of Hydrocarbon Vision 2030 for North East released by Ministry of Petroleum and Natural Gas. The region has a long history of hydrocarbon industry from being the place of Oil & Gas discovery in India. Capacity expansion of NRL will not only product availability to fuel growth in the region but also built the much needed infrastructure for import of crude oil to the region for the other three existing refineries operating in the region. IOCL has already signed agreement with NRL to bring 2.0 MMTPA of crude oil to their Bongaigaon and Guwahati refinery through the Paradip Numaligarh Crude Oil Pipeline.

How will this project enable economic & industrial development in the North Eastern region of India? Will the products be made available for the smaller businesses to set up downstream industries?

The project has the capability to revitalize the hydrocarbon industry in the NE region. The crude oil pipeline will ensure availability of imported crude oil in the region where domestic production of crude oil is dwindling and existing four refineries including NRL is not being able to operate the refineries at full capacity. Additional product availability will support some of the projects already chalked out in the NE hydrocarbon vision 2030, viz. Gas grid connecting all states of the North east , wherein NRL is both investor and anchor customer, this company is now known as Indradhanush Gas Grid and has made some progress in project implementation. Other projects like Numaligarh - Dimapur - Imphal LPG Pipeline, Numaligarh – Imphal – Moreh (Myanmar) POL Pipeline and Numaligarh - Itanagar POL Pipeline will gradually become reality post expansion of the refinery. These pipeline projects can ensure reach of petroleum products to the areas with a difficult terrain. Further, NRL will be in a position to

supply HSD to Bangladesh and Myanmar on a sustained basis.

On the socio economic front the project has the capability to generate employment directly and indirectly through service providers and ancillary units. There is potential to establish sulphur based fertilizers and chemical units, speciality chemical units based on the additional products and downstream plastic units based on polypropylene from the new refinery train. NRL has been working as a vehicle for industrial development of the region and it will not miss any opportunity to support smaller business units in the region based on raw material available from the new refinery unit.

NRL has taken a major leap by investing into the 2G Biorefinery project. What is the status of this project and when is this likely to be commissioned?

NRL conceptualized the implementation of the 2G Bio Ethanol Plant towards fulfilment of attaining self-sufficiency in energy and using green fuel with a target of 10% Ethanol Blending in Motor Spirit. NRL joined hands with M/s Fortum and M/s Chempolis to make a strategic entry into the field of producing ethanol, from non-food cellulosic feedstock 'Bamboo' which is available in abundance in North-Eastern states of India. The integrated bio-refinery complex will produce fuel grade Ethanol and other platform chemicals like acetic acid and furfural alcohol. It is estimated that 300 TMTPA of dry bamboo will be consumed as raw material and produce 49 TMTPA of Ethanol, 11 TMTPA of Acetic Acid, 18 TMTPA of Furfuryl Alcohol, along with combustible residue in the form of bio-coal and Stillage. Bamboo residue shall be used as fuel to produce steam and electricity. The technology being used is based on selective fractionation of biomass and coproduction of multiple products.

The project will have a positive impact on the rural economy with continuous income generation to bamboo farmers, growth in transportation and employment generation.

Assam Bio Refinery Private Limited is a Joint Venture Company among Numaligarh Refinery Limited, M/s Fortum 3V Netherland and M/s Chempolis Oy, Finland and was incorporated on 4th June 2018 with an authorized share capital of Rs.150.00 crore. As on 31st March 2020, the paid up share capital of ARRPL was Rs.135.00 crore. NRL holds 50% share in the company and the balance is held by M/s Fortum 3V Netherland and M/s Chempolis Oy, Finland. The registered office of the Company is at Guwahati, Assam with its operational headquarters at Numaligarh. Project activities are progressing as per plan with commissioning target of early 2022. Basic and detailed engineering jobs have been

completed, major long lead items are ordered and substantial progress has been made in civil construction work at site.

Tell us about the progress on Numaligarh – Paradip crude oil pipeline project.

The 1398 Km long crude oil pipeline from Paradip to Numaligarh with 9.0 MMTPA capacity has been conceived as an integral part of the NRL' refinery expansion project. The objective of this project is build the infrastructure for transportation of crude oil to the NE region, both for NRL and other NE refineries. 2 MMTPA of the pipeline capacity has been allocated with IOCL.

Basic design engineering for major portion of the PL is completed with Engineers India Limited appointed as EPCM for all components of the project. The Right of Use (ROU) acquisition in the state of Odisha is in progress. We are exploring sharing ROU with Gas Authority of India Ltd (GAIL), Indradhanush gas Grid Ltd (IGGL) or Oil India Ltd (OIL) for major portion of the PL.

NRL entered into the land leasing agreement with Paradip Port Trust for the Crude Oil Terminal at Paradip. Basic engineering of the Crude Oil Terminal at Paradip is completed and COT is planned to operate on built own and operate basis. At present entire investment on PL is envisaged to be made by NRL.

The PL project is included as a National Infrastructure Project by Govt. of India and expected to be completed by March 2024.

Many Indian refiners are scaling up their existing capacities and also going ahead with the downstream expansion to produce petrochemicals for domestic consumption & exports. In your view, what should the refiners do to make themselves immune to sudden market shocks?

Dependency on petroleum products for the growth of the economy of this country will continue for some time. Unless some radical intervention is made, consumption of petroleum products in the transportation sector is expected to increase. There could be a marginal impact due to penetration of CNG vehicle and EV. However, in the long run the market is likely to saturate. Refineries are already building their new capacities integrated with petroleum complex or they are keeping provision to integrate with a petrochemical complex. Firstly, refiners are increasing their GRM by extending the value chain or adding value to the product mix. Secondly, refiners are trying to achieve flexibility to change their product mix between automotive fuel and petrochemicals depending on the market. In my opinion this is right strategy looking at the uncertainty in future. ■

"India has got all what it takes to deliver on this vision"

Dr. Sunil Kulwal, CEO, Indo Gulf Fertilisers *says, "Indian products enjoy a far greater reputation in global markets compared to products from many other countries of Asia. Right policies of the Government will act as a catalyst to deliver on this vision of our Honourable Prime Minister." In an exclusive interaction he talks about the revival of this sector and growth plans of company.*

Dr. Sunil Kulwal
CEO
Indo Gulf Fertilisers

Tell us about the impact and performance of Indian fertilizers sector since the onset of pandemic.

Since Covid-19, Indian fertiliser sector walked extra miles and put in lot of hard work to meet full requirement of all agri inputs of our farmers, providing them solid support during this once in a century crisis. The fertiliser industry worked overtime to ensure that all agri inputs : be it fertilizers, or soil health products, or crop protection products, or seeds, or even advisory services; whatever farmers wanted were delivered to them in a meticulously planned manner. I would like to also tell that the Ministry of Fertilisers and Chemicals extended their fullest support beyond call of the duty to the fertiliser industry and farmers during the Covid-19 period to keep the wheels turning at all times. The Ministry of Fertilisers and Chemicals coordinated on almost real time basis

with multiple Government Ministries like Railways, Finance, Home to ensure that all issues and impediments faced by the industry, once brought to its notice were immediately addressed. This was a defining period, when superb work was done by Secretary, Additional Secretaries, Joint Secretaries, and Directors under a very able guidance of Honorable Cabinet Minister D. V. Sadananda Gowda and the Minister of State Mansukh L. Mandaviya in a very well-coordinated manner. They all deserve the highest praise for the great work done by them during this unprecedented crisis time.

How well positioned is Indian Fertilizer sector globally to realize Make in India initiative?

Fertiliser is a key input for agriculture. Our Honourable Prime Minister has given a vision of doubling the farmers by the year 2022. This is a very important objective. The industry has worked and will continue to work along with the Government to provide all required support to farmers to improve their productivity.

Similarly, 'Atmanirbhar Bharat' initiative of our Honourable Prime Minister is a visionary thought. India has got all what it takes to deliver on this vision. It has got entrepreneurial capabilities, right technology, a large consumer base, States who are keen to promote industry etc. Right policies of the Government will act as a catalyst to deliver on this vision of our Honourable Prime Minister. Indian products enjoy a far greater reputation in global markets compared to products from many other countries of Asia. Therefore, promotion of domestic industry will not only help to make India's own requirement and become 'Atmanirbhar' but will also help it to become 'Factory of the World' meeting global product requirements in a sustainable and cost effective manner.

May we have your comments on the revival of Indian fertilizer sector by the Indian government?

The Indian fertiliser sector today is completely controlled. In case of Urea, prices are completely controlled and the Urea prices have remained stagnant for more than 10 years since 2010 with no price increase. Among the large developing countries, Indian farmers pay the lowest price for Urea. The impact of this tight control on Urea prices has been very severe on the industry, and its return on investment is very poor. The lower return woes get further compounded due to huge amount of subsidy remaining unpaid to the industry by Government causing serious liquidity stress. In fact, the Government does not subsidize the Indian Urea industry, but subsidizes the farmer by facilitating him to buy Urea at much lower price than the cost what industry incurs. The Government reimburses the cost to Urea industry, that too not on the actual cost basis but on normative basis, which was fixed long back at much lower levels than what the industry incurs, thereby compounding the industry's challenges. It is high time that the Government increase Urea price, releases subsidy to the industry

in timely manner and help the industry to regains its much needed health. Hence, it is ripe time to revisit the Urea pricing policy and evaluate options for full decontrol or bringing Urea into Nutrient Based Subsidy scheme (NBS) which would address large part of the challenges, would allow judicious and balanced application of fertilizers and guarantee a better soil health.

How do you see the markets pan out in the future?

The fertilizer industry plays an important role both in employment generation, and in meeting the food requirement of world's growing population. The global fertilizer industry has undertaken tremendous investments over the last decades to increase production in order to ensure access to this vital input for the world's farmers. The consumption of fertilizers has grown nearly six-fold between 1961 and 2017 (from 32 to 186 million nutrient tons. The industry has also vastly improved its production efficiency as well as emphasized the need for efficiency at the farm level by promoting effective plant nutrition based on the "4Rs" – applying the right nutrient, at the right rate, at right time and at right place.

As per International Fertilizer Association (IFA), the current nutrient consumption of ~ 186 million tons is likely to grow by 1.1% per year through 2022 for nitrogen, by 1.6% a year for phosphate and by 2.2% for potassium. Nitrogen is the most important primary nutrient, accounting for 57% of total global consumption. The largest producers of fertiliser are also the largest consumers, namely China and India.

Nitrogen market is more fragmented than potash and phosphate markets. In Nitrogen, top 3 players accounts for only ~15% of total world capacity, where as in phosphate top 3 players account for ~24% of capacity, and in potash top 3 players account for ~49% of capacity. The three main grain crops, wheat, rice and corn (maize), consume about half of all fertilizer globally

India, since independence, has come a long way in the world of Agriculture. Today, the country ranks second globally in farm outputs, assuring employment for more than 50**%** of the Indian working population in agriculture & related activities, and contributing 17–18% to the country's GDP. India has not only become self-sufficient in food grain and horticultural production but also has become a net exporter of agriculture produce having exports of Rs. 2.70 lakh crores and imports of Rs. 1.37 lakh crores in 2018-19. From an importer and a significant recipient of food aid to meet domestic food requirements in the early sixties, India has emerged the largest producer of pulses & jute and the second-largest producer of rice, wheat, sugarcane, cotton, fruits, and vegetables in the world in a span of past 40 years.

This growth, as one would be aware, is clearly an outcome of a scientific and systematic approach towards agriculture that has been adopted and appropriately practiced. One of the key and extremely

important element of the agriculture sector is Crop Protection Chemicals (CPC) and this plays an important role in ensuring the nation's food security. In between sowing to harvesting, the crop gets attacked by various pests and diseases that infect, consume, or damage crops, thereby significantly reducing the quantity and quality of food production.

What are the challenges that still need to be addressed?

In any business, challenges are neither surprising nor unavoidable. A few of the obstacles the nation's agriculture sector currently faces are deteriorating soil conditions, low farm yields and occasionally a high quantum of pesticide residual, which results in products not being qualified for exports. There are many challenges along the way. But when there are challenges, there are countless opportunities. There are opportunities of increasing farm yield, quality of produce and farmers' income. It's a journey that will allow us to discover the art of possibility when we work mutually with farmers, agri-universities and Indian and global experts – all to bring the best to our farmers and help them to be more prosperous.

How did you turn around the business since you took over as the CEO for this business?

After considerable deliberations, Indo Gulf Fertilisers defined its purpose as 'Prosperous farmers through innovative solutions.' The purpose of Indo Gulf Fertilisers says all about reasons of its existence. Every member of team Indo Gulf Fertilisers is fully committed to help the farmer to grow more with less, thereby helping the farmers to earn more than what they are earning currently. The two specific products what Indo Gulf Fertilisers developed through years of research are "Customised Fertilisers" and "Oorja".

Customised Fertilisers is a crop specific and soil specific fertiliser, which is produced in the state of the art plant of Indo Gulf, where in each granule of the fertiliser carries all the nutrients in the predetermined mix. Cutomised fertiliser help farmers to provide the right nutrients to each and every seed, thereby each and every seed gets the required nutrients to grow into a healthy plant. Similarly, its organic soil conditioner product Oorja provides organic carbon to the soil in easy absorption manner which helps the plant grow healthy. "Oorja", when applied as a basal dose during sowing, develops a very strong root zone of the plant, helping it to absorb the required nutrients from the soil more efficiently. These make the plant very strong.

Indo Gulf Fertilisers has done almost 5,000 trials of these products in different States of Ganges Plains over last few years. Through use of these products, farmers got an improved yield between 10 to 15% on an average for multiple crops. The costs what the farmer has to incur additionally on these two products is only a portion of what the farmer realizes through higher production and therefore, the farmers generally got

good cost benefit outcome by using these products.

How are you preparing for the future growth?

Keeping this growing need for a healthy solution in mind, Indo Gulf Fertilisers (a Unit of Grasim Industries Limited) has developed an improved nutrient and mineral delivery system (Customized fertilizer) that is crop and soil specific, through dedicated years of research. With the use of crop-specific customised fertilizer, the crops can grow stronger with higher inherent capabilities to fight diseases.

Indo Gulf Fertilisers has also developed and launched an organic soil conditioner product "Oorja," which, when applied as a basal dose during sowing, develops a very strong root zone of the plant, helping it to absorb the required nutrients from the soil more efficiently. These make the plants very strong. There had been instances when a virus attack was seen in a particular farm field, the quantum of infected plants, in the area where Oorja was applied, was much less, as compared to, the area where Oorja was not applied. This clearly demonstrated that providing the right quantum of nutrients to the plants, allows for development of inherent capabilities to resist the viral attack in a more effective manner.

Indo Gulf's purpose is "Prosperous farmers through innovative solutions". In order to achieve this that our vision is to be a premier agri-solutions provider. Our focus is on prosperous farmers while sustaining organisational growth. Currently operating across seven states in India, the business has expanded from being a urea organisation and producer to implementing solutions for the whole agriculture sector. That includes seeds, pesticides, plant health products and soil conditioners.

Our goal is to be a pan-India agri-solution partner. For Indo Gulf to achieve its desired expansion plans, the company will start offering its Shaktiman brand of products to additional states in the near future. It will also collaborate with agriculture universities, where agri experts provide knowledge and solutions to farmers to achieve higher yield and better quality products.

Increasing digitalisation is another element what we will focus in a big way. By expanding its digital systems, Indo Gulf will be able to better communicate with farmers about the weather and yield – while also offering education and advice. Digitalisation is going to be the future of agriculture. Innovation and technology will improve current practices drastically and help both farmers and organisations. Thus, key focus areas for Indo Gulf Fertilizers include digitaliztion, provide agri solutions to farmers, and Farmers Prosperity through innovative solutions. ■

Breaking Barriers to Energy Management

Often, we read reports in newspaper that the import bill of India's crude is rising and note that India is ranking after China and USA on energy consumption. Before we take pride in the position number `three' as the indicator of the growth of the Indian economy; let us pay attention to the following facts:

Fact 1:

Countries	GDP $T	Energy consumption	Energy Intensity (Indicator)
		Billion KWh	Energy utilized per T$ GDP
USA	18	30000	1667
OECD EU	18	21000	1167
China	14.4	45000	3125
India	2.9	10500	3621

Some may argue that GDP should be taken as PPP basis. But that is because of extremely high utilization of the manual power and not `produced 'energy consumption.

Fact 2:

Countries	Energy Consumption 2019	Energy Consumption 2035	% Change
	Billion KWh	Billion KWh	
USA	30000	~30000	1%
China	45000	52000	14%
India	10500	18643	77%

Fact 3: Cost of CAPEX is not less than 12% in India; whereas in Europe or USA it is merely 2 to2.5%.

Fact 4: Even though our cost of CAPEX charged by financial institutes are making them fat but factually today they are loaded by NPAs; mainly from the Power plants.

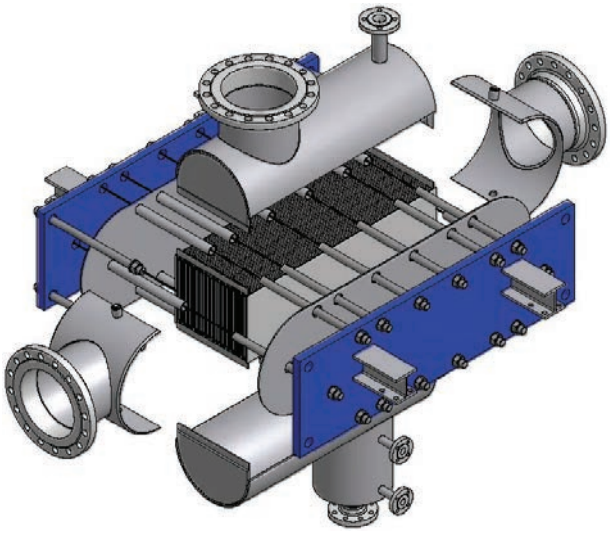
What does this mean?

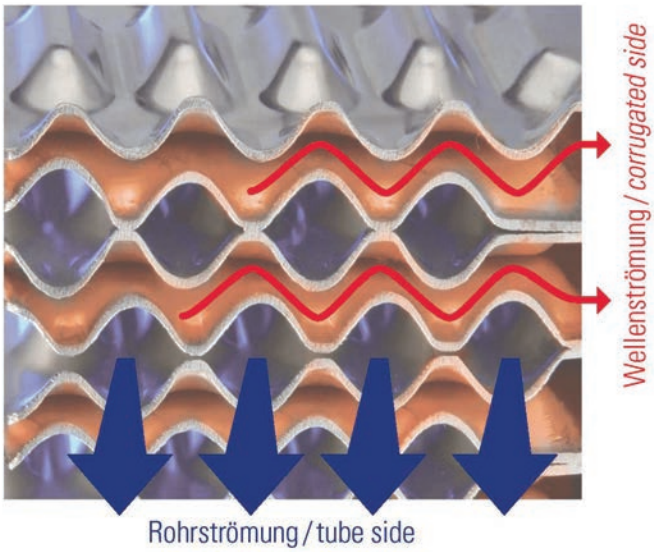
Before we conclude let us analyse little bit more.

- In almost all the processes in textile, pulp and paper, cement, iron ore to steel, caustic soda etc., the energy cost ranges between 25~35% of the production cost.

- In the chemical process companies the biggest consumption of energy is through steam production. Steam is consumed in Evaporator, Drier, Steam Compressor, Distillation and Steam Ejector. Now read the functions and how the energy can be saved in each case.

Evaporator: Here solvent is evaporated from the solution. Solvent is mainly water. After the evaporation, the solution contains higher concentration of the non-volatile substance. This process demands heat and it comes from steam. An effective higher degree of multiple evaporation system with an efficient preheater working on the close temperature approach can definitely reduce the steam consumption to half. `Hybrid' range of heat exchanger which is combination of the 'plate' and 'tube' characteristics can help in increasing the numbers of the `effects' within the same pressure drop limits at





lower 'delta T' as well. Utilizing a plate heat exchanger with close temperature approaches of 2 degree Celsius will save extra steam over normally utilized `S&T' exchanger where approach temperature has to be more than 5 degrees Celsius.

Drier: Outdoor air is preheated in the exchanger by steam. In the fluidized bed type drier, the heated air is utilized to remove the unwanted moisture from the moist product. The quality of the `centrifuges' plays an important role to remove the liquid from the moist product before it enters the drier. The heat exchanger for heating air is a critical component to bring the air outlet temperature close to the steam temperature. A lower degree of steam can be utilized here. Compact fin tube heat exchanger is a powerful operation, still not so famous in the process industry.

Steam Compressor: Steam compressor can reduce the steam consumption demand in the whole process industry;

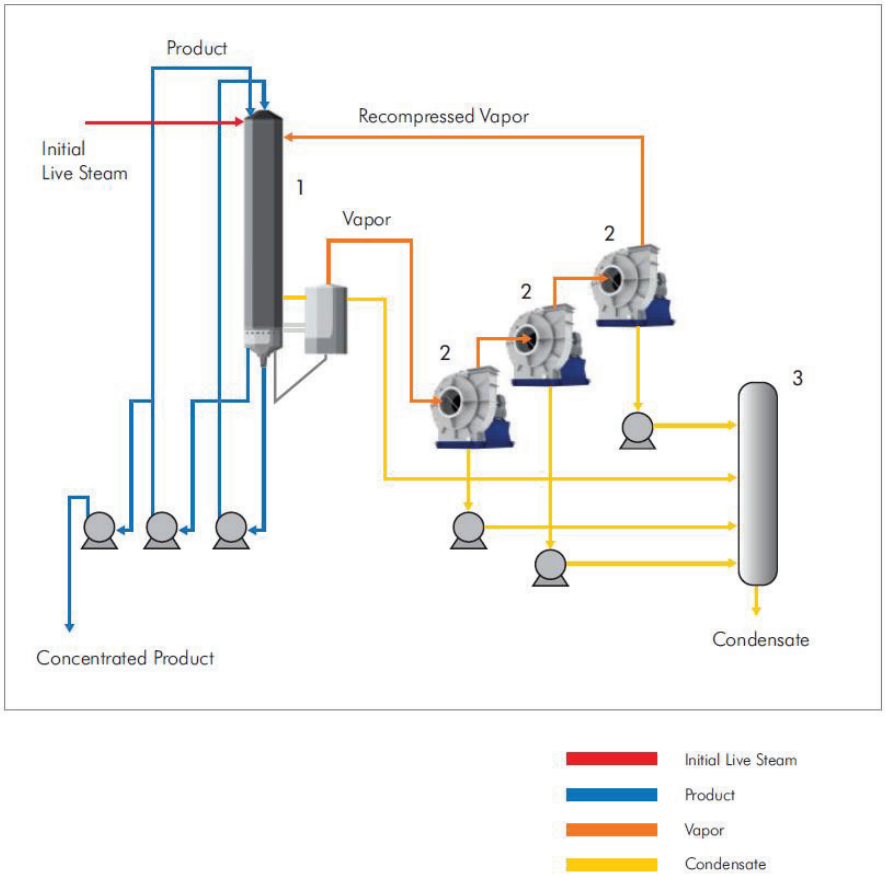
as the electricity is cheaper source of the energy than the boiler.

Distillation: In distillation, a fluid is partly vaporized by boiling. This vapor holds a larger concentration of the more volatile substances than the original fluid. The distillates leave the distillation column to condenser. The remaining liquid in the column has a concentration of the substances with a higher boiling point. This process is divided into the several steps termed as fractional distillation. The various distillates can be utilized to pre-heat the incoming fluid in several stages near to the boiling point utilizing the distillates heat after the condenser. Utilizing the `plate heat exchangers' we can decrease the fuel demand in the entire system. Industry is still not utilizing the full potential of the plate heat exchangers.

Steam ejector can additionally rationalize the distillation columns.

Energy Management

Adopting the many possibilities of Energy Management practices; it is possible to decrease the energy consumption in the process industry. The possibility of saving 40% of the current utilization of the energy exists in most of the companies. Now how to implement the Energy Management in the process industry:



1. Falling Film Evaporator
2. Steam Compressor
3. Condensate Drain

- It starts with an Energy Audit.
- Senior Management involvement is must to successfully lead it.
- Monitor the Energy use by metering each section of the energy utilization. It has to be recorded and gaps should be analysed from the established possibilities.
- Technology adoption as suggested above and managing it is important.
- The establishment of the Coordinating team involving process engineers is an important aspect. These process engineer's selection should be from maintenance and Project engineers background. It will help.

The driving force for the process companies to implement energy efficient measures are:

- Market related incentives to increase the competitiveness and increase the profitability of the operation.
- Overall, it is important for all of us to collectively ensure that we increase the potential of earth to survive us for generations on earth. And hence the Co2 emissions are important aspect to be controlled through lesser utilization of the fossil fuels. We therefore collectively are responsible for the balance sheet of earth too. It is something political leadership has to address together and rise above the country goals.

The barriers to implementation are summarized below with the solutions.

Economic Barrier : Aversion to technology adoption by management because of short term vision of pay back period. Generally it is due to lack accurate information and decisions are made as rule of thumb. Perfect example of Neo-classic economics.

Behavioural Barrier : Individuals within the organisations have inertia towards energy efficiency decision making process. It depends how effectively it is understood as the management priority and if this is trustworthy for the stakeholders. Thus, credibility of the information source is very important for the onboarding process. Moreover, the information ought be simple and specific in the personalized form. Thus, psychology plays an important role .

Organizational Barrier: Energy coordinator has enough power to implement the goals and has a ability to reduce the Energy gap/paradox. The energy culture in the organisation to respect the environment is must.

Conclusions

Overall we can say that we have potential to save 40% of the energy consumed. We can identify the methods in chemical process industry to help save this amount of energy in steps of 3 to 4 years by establishing the Energy management cell with a set defined framework presented. The barriers to the energy management can be won over if management adopts

to the technology available and have access to the capital available. It is in the hands of the Central Bank and Executive leadership to increase the electricity prices by 20% and make the capital availability through financial institutions in the range of 4 to 5% with special intensives on the `CO2 emissions scheme'. NPAs will reduce in power sector. Since Capex availability will not be a deterrent in the economy; business will flourish more. If India can grow with the wasteful energy consumption; it is sure we will have tremendous potential with decreased input energy cost to production. We will have green earth, growing industry with bankers flourishing too having `honest' balance sheet through boost to the economy with technology orientation. Last but not the least; if CO2 emissions are brought near to the agricultural land besides earth, sea acting as `sump' and moisture of evaporating green plants effects are combined. ■

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"Translate this crisis of global supply chain disruptions into value creation"

Agrochemicals are highly regulated globally and Industry players fully support it as it is required to protect the environment, farmers as well consumers. Time to time regulatory reforms are critical to keep pace with the evolving global regulatory ecosystem and improve ease of doing business. ***Sanjiv Lal, MD & CEO, Rallis India*** *shares his views on changing market dynamics, opportunities and potential of this industry.*

Sanjiv Lal
Managing Director & CEO
Rallis India

What are your views on the changing market dynamics of agrochemical industry in India and globally?

In a predominantly agrarian country like India, with its expansive landmass and crop diversity aided by varying agro-climatic conditions, it has high growth potential for the crop protection industry. Growing population and urbanisation lead economic development is providing wider opportunities in agriculture. India is a leading producer of multiple agriculture commodities and over the past few years India is emerging as an important player in the global agriculture commodity trade. Agriculture technologies including Crop protection chemicals play a critical role in sustaining our agriculture success as we are facing increasing biotic and abiotic related challenges in agriculture.

Farmers need technologically advanced and highly effective solutions not only to protect their produce but to enhance and improve produce quality to international standards. Compared to other countries, use of agro chemicals in India is relatively low and choices of chemicals available for Indian farmers is also significantly lesser. Crop loss due to various pests can be addressed through adequate and appropriate use of agro chemicals and seed technologies. Hence with focus on agriculture by the government is likely to lead to growth of the agro chemicals sector domestically.

Global agrochemical market is nearing USD 70 billion and India is placed at 5th position behind Brazil, USA, China & Japan with the top five countries representing more than 50% of global consumption. In the recent past the industry witnessed consolidation among leading players and top five firms represents nearly 60% of the Industry. We see great potential for agrochemical industries in India in the coming years driven by increasing domestic demand as well as opportunities in the fast growing exports markets.

What role are Indian agrochemical manufacturers likely to play to fill the gaps in global supply chains?

70% of the industry is dominated by off-patent generics and this provides an opportunity for Indian agrochemicals industry to play a larger role by building on its strengths. Our expertise and global competitiveness in chemistry provide opportunities for multifold growth of the agro chemicals exports which is currently estimated over USD 3 billion and is growing at 12% CAGR over the past five years.

Globally, the COVID-19 pandemic disrupted supply chains, however,

agrochemical manufacturers can translate this crisis into value creation. Supply chains are an important lever for agrochemical manufacturers. By focusing on cost-effective procurement, manufacturing and an efficient logistics process, companies can optimize cost and ensure availability of the right quality and quantity of products.

Furthermore, backward integration and progressively strengthening the procurement process are some of the key aspects for supply chain management.

The Government of India is supportive and taking steps to encourage the agrochemical industries initiative of making India a Global agrochemicals Powerhouse. India is being viewed as an alternative source as part of the risk mitigation strategies being adopted by MNCs to address emerging supply chain challenges.

What are your thoughts on the challenges & opportunities for both major & small scale players in India?

India's under-penetration of crop protection products consumption per hectare, limited availability of land and irrigation and farmers' enhanced awareness about best farming practices, presents promising growth opportunities to the country's crop protection and seeds industry. With the arable land that India is blessed with, enhancing farm productivity is the key lever to meet the growing need of food to keep pace with population growth and the emerging needs of fast growing urban population. India is a vast country and thus it provided opportunity for major as well as small players in the Industry.

Agrochemicals are highly regulated globally and Industry players fully support it as it is required to protect the environment, farmers as well consumers. Time to time regulatory reforms are critical to keep pace with the evolving global regulatory ecosystem and improve ease of doing business.

Our experience in GST as well as many initiatives on enabling user friendly tax systems has helped in improving the efficiency as well as effectiveness of both direct and indirect tax collections as well as compliance. Similar reforms will help in effective implementation of various regulations to support and promote safe use of agrochemicals, weeding out spurious products and bringing uniformity to reduce efforts of complying with multiple statutes.

One of the key concerns of the MNCs and perceived as a roadblock for facilitating manufacturing in India as well as introduction of new molecules is the lack

of globally compliant IPR and registration process.

Further, to tap the emerging global opportunity we need to promote investment in manufacturing by providing and enabling infrastructure. We should encourage investment in R&D which will provide us competitive advantage by developing and adopting high end technology.

Adoption of appropriate GM technologies has helped in improving productivity in leading agriculture economies. Brazil's emergence as the leading agriculture economy in the last decade is a result of this and also fueled growth of a vibrant agrochemical market in that country. We as a country have to address regulatory challenges in this area to make farming more competitive and sustainable.

Tell us about the key concerns that need to be addressed for agrochemicals manufacturers to achieve self-reliance?

The industry needs a transparent and faster regulatory mechanism which encourages manufacturing, research & development, exports and faster adoption of new age technology. Industry will have to work closely with the government in globally showcasing India's advantages as a manufacturing hub. Appropriate policy actions for providing incentives in attracting investments in manufacturing as well as research and development will go a long way in rapid growth of this sector.

Agrochemical manufacturers can translate this crisis of global supply chain disruptions into value creation by focusing on cost-effective procurement, manufacturing and an efficient logistics process, companies can optimize cost and ensure availability of the right quality and quantity of products

We also need to address ease of doing farming further which will enable a more vibrant domestic demand of agrochemicals aimed at improving productivity in terms of quality and quantity of agricultural produce. Initiatives from the government such as doubling the farm income, direct benefit transfer of subsidy as well as minimum income support scheme, recently announced multiple path breaking agriculture reforms etc. are the right steps in this direction.

Need to fast track initiatives to develop

cost effective alternate domestic sources and appropriate backward integration to make our industry "Atma Nirbhar" so that global agrochemical supply chains can rely on us as an alternate in terms of cost, time, quality, and quantity.

What are the future plans of Rallis India ?

Today, India has come a long way in achieving self-sufficiency in food and is emerging as an important player in global trade of agricultural commodities. Seeds and Crop Protection are important elements driving agricultural productivity. This holds a significant growth potential for Rallis, not only in India but also overseas. Hence, our business strategy is centered around the crop care business for domestic and international markets and, the domestic seeds business.

As part of our domestic crop care business, we are focused on leveraging our long association with farmers across India by meeting the evolving needs of the farming community through introduction of new technology products. This is being supported with investments in manufacturing and R&D.

For our international business, our focus will be to build capacity and capability for manufacture of a larger number of off-patent active ingredients to service our business partners and also to tap into the contract manufacturing opportunities emerging from the current global supply chain dynamics of active ingredients and agro chemicals intermediates.

Our seeds business is presently driven by hybrid paddy, maize, millet and cotton. We will continue to invest in research activities to introduce new products. Our endeavour is to significantly enhance our cotton and maize portfolio leveraging the work presently underway at our biotech lab as we seek regulatory approvals for insect resistant and herbicide tolerant technologies. We are building our vegetable business and looking at opportunities in few relevant field crops.

We are witnessing a paradigm shift in digitisation and innovation which has paved the way for major disruption across industries. As a science led company, our efforts will be on leveraging digital tools for efficiency in our operations both at the manufacturing end as well as market end.

Considering all these aspects we will be investing in manufacturing, R&D and digital in coming years to increase our footprint both in domestic as well as international arena. ■

"Isolating from China will require huge efforts and reasonable amount of time"

Registration of the new product is really something which consumes a lot of time and is expensive as well. If the government eases this process in terms of the time lines. This can really attract new entrepreneurs as the industry has a good potential. ***Rajesh Agarwal, MD, Indian Insecticides Ltd (IIL)*** *is of the opinion if medium and small industries are supported well by the government they can contribute in providing the good quality agrochemicals.*

Rajesh Agarwal
Managing Director
Indian Insecticides Ltd (IIL)

How have the market dynamics changed for the agrochemical manufacturers in India since lockdown?

Initially we witnessed a gap of demand and supply that was mainly due to the availability issues of the raw material and manpower. As the Government has given special relaxations to the agriculture sector our team has been working hard to provide the necessary assistance to the farmers. Though we expect the demand to come in but costing is surely going to take a hit. We have taken the initiative to reach out to the farmers through different online audio visual techniques to keep them informed about using the agrochemicals in the right and judicious way.

What is the total demand of agrochemicals in India and how is Indian agrochemicals industry linked in the global supply chains in terms of import & export of products and agro intermediates? Which are the major countries Indian agrochemicals manufacturers depending on for the intermediates?

Total agrochemical market in India stands around Rs. 18-20,000 crore and relatively same amount is agrochemicals are exported from India. India relies on China, Japan and some other countries for imports of agrochemicals. Initially the imports did get affected because of the lockdown but now business is getting better and supplies from international markets are close to the normal. Although the cost and time for logistics has increased but we have to bear with this and plan accordingly. It is not only the imports but the exports of agrochemicals from India have also taken a hit, since our country is one of the major suppliers of these chemicals globally.

How has IIL responded to the market disruption and how do you plan to go about securing the supply chain for the company?

Raw material supplies and manpower have been the biggest concerns during the recent market disruption. We are striving hard to maintain regular supplies to the maximum possible extent. In terms of the raw materials we are working on the substitutes and adding new vendors to meet the requirements. Manpower is the most crucial for the operations and we have provided all kinds of facilities for our employees for their safety in all respects.

Globally the economies are talking about isolating China. In your view, to what extent can the intermediate imports be minimized and how much time will it take for the Indian agrochemical industry to achieve self-reliance in the true sense?

See, this looks very good in discussion, but practically it would be really difficult. But if the Government decides something of this

tune for all industries especially chemical and pharma, this would require huge efforts from them and will take reasonable amount of time. Though every company is trying to meet the requirements locally, there is a competition that exists and cannot be denied. This would require us to rely on them to a certain extent. However, we can reduce our dependence on China though through backward integration.

What is the scope of investments in agrochemicals manufacturing in India and what would it take for India to become a global agrochemicals producer?

As an agrarian economy, there are huge opportunities available for the agrochemicals industry. Registration of new products is very time consuming as well as expensive. If the Government eases this process in terms of timelines, it can attract new entrepreneurs as the industry has a great potential. Presently, the Government is working on bringing in new technology products to the country which have been off patented and can add value for the Indian farmers. There are lot of medium and small industries, which if supported well by the government, can contribute in providing the good quality agrochemicals to the farmers.

As one of the largest players in India's agrochemicals sector, what are the future plans of IIL and how do you plan to leverage this opportunity?

Though every company is trying to meet the requirements locally, there is a competition that exists and cannot be denied. This would require us to rely on them to a certain extent. However, we can reduce our dependence on China though through backward integration.

Opportunities are immense. While Agro chemical industry is growing steadily, IIL is growing at a better rate. With farmers moving towards the better technology and new age farming, requirement of crop protection is now more significant than ever. IIL is committed to bring out new products from its tie ups with international partners and research. This will help the farmers to get the latest technology within their reach.

IIL has 5 different R&D themes with focused 5 different R&D centers that are working in this direction. We also have a product discovery R&D center in JV with OAT Agrio, Japan, one of its kind in India. We have a long pipeline of products and plan to launch nee technology products year on year that need to be used in lower dosage and are safe for the environment. ■

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Efficient Handling of Scaling & Fouling in Cooling Water Circuit

Mohan Chavan
CEO, ECOMAX Solutions Pvt. Ltd

Since the inception of Ecomax in 2014, how has the market for clean technologies evolved in India across the chemical processing industry?

Chemical processing industries, especially pharma sector has always been very receptive to the energy efficiency technologies. I have been observing this even before the inception of ECOMAX. Most of the low hanging energy conservation measures were already implemented by the industries. ECOMAX was especially formed to address inefficiencies due to scaling & fouling in the cooling water circuit. Since inception we got very good traction in Pharmaceutical & Building sectors. One of the leading pharma company around Pune was the first one to give us an opportunity for installing our product. Over the years ECOMAX products are demanded by various industries, we observed that since last two years Chemical Process industries have shown tremendous interest to implement energy & water saving solutions developed by ECOMAX.

What is the market size of clean technology solutions in India and which are the key segments that are expected to see significant demand?

Clean technologies as such cover a wide

spectrum such as renewable energy, energy efficiency, energy storage and water & wastewater management. Total market size for clean technologies is over USD 25 billion. If I talk of market size specific to our products or solutions, it would be over USD200 million which is growing at the CAGR of 4.5 to 5%. I believe in the current scenarios, energy efficiency & water saving technologies or products that offer an attractive payback say less than 2 years are expected to see significant demand because industries are trying to utilize every opportunity to cut down their operating costs.

Tell us about the key technologies offered by your company to handle the scaling problems in the heat exchangers and cooling water circuits.

ECOMAX is the pioneer in India in offering technologies that mitigate scaling & fouling problems in heat exchanger & cooling water circuits. ECOMAX products are based on original patent pending designs. ECOMAX offers following technologies:

Automated Online Tube Cleaning System which help to keep heat exchangers clean online, thereby avoids scaling in the tubes & maintains the efficiency by improving heat transfer. Chemical less Cooling Tower Water treatment system which avoids chemical dosing in the cooling towers, removes scale from circulation water & reduces blow down water consumption up to 80%. Chemical less chilled Water treatment system that helps to condition the chilled water in closed loop by avoiding bacterial growth, sludge & corrosion.

What is the extent of losses that an industry may have if scaling or fouling is not addressed in time?

Scaling or fouling affects the equipment efficiency drastically, if I talk of the losses in water cooled HVAC chillers it would be up to 20%, in power plants the steam consumption can be higher say up to 5%. In case of process heat exchangers, the output would reduce drastically resulting into huge loss. Just to quote an example of Solvent Recovery Plant in a Pharma company, by implementing Automatic Tube Cleaning System for Shell & Tube heat exchangers, solvent recovery improved by about 2.5% resulting into savings that recovered the investment in less than 3 months. ■

Sandvik Materials Technology – A company driven by innovation and expertise

Recently, Sandvik added a new cold finishing tube manufacturing line at its Mehsana Mill, in Gujarat western India, on January 30, 2020. The new high-tech line, mainly aimed at the production of heat exchanger tubing and for other demanding industrial applications, doubled Sandvik's cold-working capacity in India and thus allow for swifter delivery times across the Asia Pacific region.

Expanding range of nickel alloys

Sandvik has been introducing the enhanced product portfolio in Nickel alloys. Now, Sandvik in India is able to produce many of these products which fall under our famous Sanicro® brand, such as Sanicro 276 (C-276), Sanicro® 30 (Alloy 800), Sanicro® 41 (Alloy 825), Sanicro® 70 (Alloy 600) and Sanicro® 625 (Alloy 625), Sanicro® 28 (Alloy 28), Sanicro® 31HT (Alloy 800HT) and C-22 etc.

Apart from Duplex metallurgy, Sandvik has been able to build up on the Austenitic portfolio creating a complete package for the various critical applications especially within the chemical segment.

Fully integrated production – from melt to final tube

Sandvik maintains a highly integrated and sustainable manufacturing process, with tube products made from 84-percent recycled metal using efficient manufacturing processes. Driven by a "zero defects" philosophy and ambitious targets, the mill secures full traceability from melt to final tube. This means that individual heat exchanger tubes can be traced in every step of the production process back to the individual melt, heat and lot. Every tube undergoes a battery of chemical and mechanical tests, including positive material identification (PMI), so customers always know the

material they receive is what they ordered.

New Patented Alloy in Austenitic Family

Innovation is the DNA of Sandvik. Our R&D is continuously working on the latest metallurgical developments especially for the O&G, Refinery and Petro-chemical segments.

"Sandvik recently patented its new alloy, Sanicro 35 globally launching it in September 2020. This is an interesting addition to our already existing strong nickel portfolio. It will not only reduce costs for our clients but can also be a very cost-effective upgrade when it comes to super-austenitic alloys," says Vikram Pandit, Regional Technical Marketing Manager, APAC.

New possibilities for our customers in India

"It's part of our ongoing commitment to customers in India to improve the availability of our top-quality products, broaden the portfolio and become the most reliable, one-stop-shop in the region. Sandvik is looking forward to more such initiatives in near future to enhance the customer experience," says Sunil Wankhede, Regional Sales Manager, India.

Creating Values across the chemical segment

Sandvik is especially known for the high corrosion resistant alloys across the world. The high-end product program will strengthen our position within the chemical segment. All the products are designed for very critical applications," says Mohan Gawande, Manager Chemical Business.

Local R&D support for Material Selection

Sandvik has also enhanced its services for the end-users in terms of failure analysis, material selection etc. This has been a key feature of our commitment to customer service. We have been able to create a great amount of value for our customers by these value-added services. ■

Contact

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A compact, efficient pre-cooler for compressed air

Yielden Filtration is a Malaysian leader in the air treatment industry, providing air and liquid filtration products that safeguard production lines and workers throughout Asia. With a vision to be an expert in compressed air solutions, Yielden is widely recognized for offering customers highly efficient, robust and sustainable systems based on state-of-the-art technologies from global suppliers.

End-users of compressed air systems have a number of requirements, and ensuring a high level of moisture separation is particularly critical for their operations. If not properly removed from the air, condensate can cause corrosion or freezing issues, damage the piping, or even create difficulties when using pneumatic tools. For these reasons, different types of dryers are a standard component when treating compressed air.

A challenge of climate

However, due to Malaysia's ambient heat, Yielden's customers can see compressed air discharged at temperatures as high as 50°C. These temperatures can create problems for the dryers as well as other downstream equipment such as filters and autodrains.

To solve this challenge, Yielden designs systems with a water-cooled pre-cooler prior to the drying phase. This makes it possible to bring the discharged compressed air down to 35°C – the ideal temperature for adsorption and refrigerant dryers – or even cooler. The pre-cooler has the added benefit of removing some of the moisture in the air before it enters the dryer, thus enabling a more efficient, smaller and more cost-effective solution for the end-user.

Shell-and-tube type heat exchangers have traditionally been the dominant pre-cooler solution for compressed air applications. While this technology is well proven for these duties, it comes with significant drawbacks. First, shell-and-tube designs are incredibly bulky, requiring substantial floor space and thereby driving up the price of installation. They also suffer from low thermal efficiency, which inevitably results in high operational costs over time.

Choosing an innovative alternative

Yielden was therefore looking for a smarter solution to their pre-cooling challenges.

They found it in Alfa Laval's brazed gas-to-liquid plate heat exchangers. The Alfa Laval GL model features a compact design with a footprint that is approximately one fifth that of a comparable shell-andtube unit. For Yielden's end-customer, this translates to huge savings in both floor space and lifetime costs.

The Alfa Laval GL reliably removes condensate from the air stream and lowers the temperature of the compressed air to the necessary 35°C or below. Thanks to a good built-in moisture separator and autodrain, it is often possible to eliminate the need for an additional standalone water separator. Furthermore, unlike shelland-tubes built in carbon steel, the stainless-steel construction of Alfa Laval's plate heat exchanger design offers much higher thermal efficiency with additional robustness, enabling significantly greater operational sustainability and reliability over time.

For Yielden, the difference speaks for itself. By choosing the Alfa Laval gas-to-liquid design over traditional shelland-tubes, they can offer their customers a, dependable solution with the lowest possible total cost of ownership, reduced floor space, and improved environmental impact.

Apart from precooler application – GTL heat exchanger widely used for other applications as such

1. Exhaust Gas heat recovery
2. Compressed air heat recovery
3. Charged air cooling
4. General Heat recovery.

USP

- High operating temp – upto 750 deg.
- Low pressure drop
- Designed for atmospheric pressure application
- Compact

Alfa Laval GL heat exchanger

The Alfa Laval GL product line is an ultra-compact, high-efficiency solution engineered to meet the unique challenges of simultaneously working with gas and liquid media. A revolutionary new design handles very high temperatures with very low pressure drop. ■

For more information scan the QR code

Contact

Alfa Laval India Pvt Ltd
Cell: +91 98408 66760
E-mail: india.info@alfalaval.com
Website: www.alfalaval.in

Forty Years of Granulation of Chemicals

New milestone for IPCO's Rotoform System

Chemical processing and handling equipment manufacturer IPCO is celebrating 40 years' continuous production of its market-leading Rotoform granulation system. The development of this innovative rotary drop forming technology in 1980 brought new levels of quality and productivity to the market and changed the face of chemical granulation. A premium quality formed product – one with consistent specifications – enables safer, easier handling during storage and transportation.

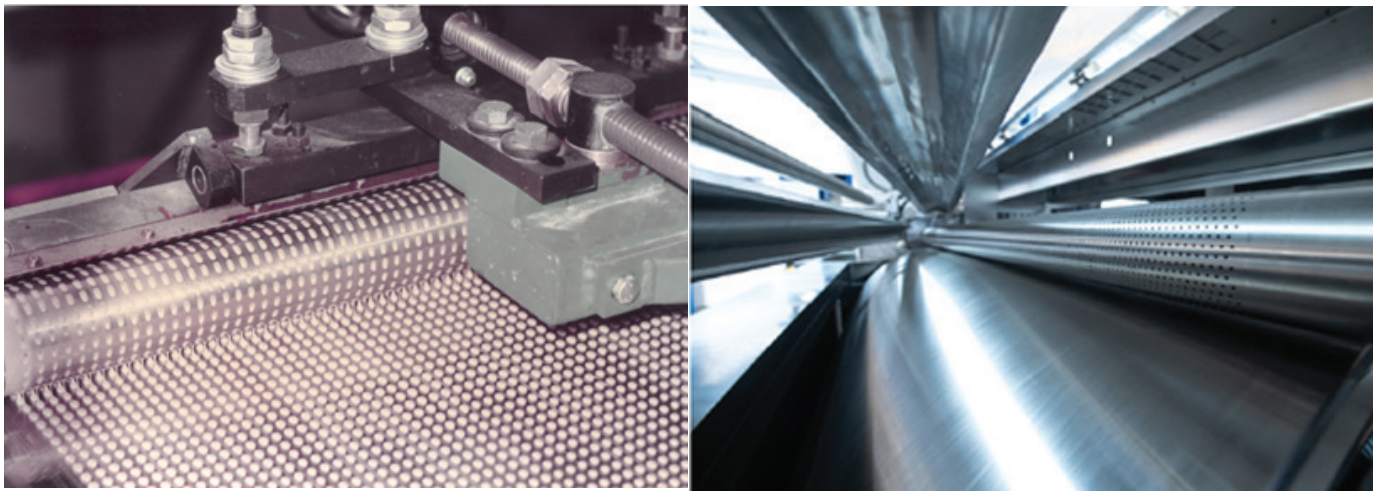
Such is the quality and reliability of granulation delivered by Rotoform that it has gone on to sell more than 2000 systems to date.

"We had been supplying flaking systems since the early 1950s," says Johan Sjögren, Managing Director of IPCO's Equipment division, "and our ranges now encompass storage and handling solutions too, but the introduction of Rotoform was a defining moment in our company's history. It put us on the map in this respect and the system remains the market leader to this day."

While the core principle – direct-from-the-melt solidification on a steel belt cooler – remains unchanged, Rotoform technology has undergone significant advances over the years.

In 2013 the company introduced the 4G (4th Generation) Rotoform, the foundation of an entire family of models designed to meet specific process requirements. These include the granulation of abrasive and sedimenting materials (e.g. catalysts and suspensions), melts requiring a high feed temperature (e.g. bitumen, resins), the pastillation of subcooling melts in supercooling plants (e.g. photo chemicals) and the handling of high viscosity products (e.g. chocolate, hot melts and resin).

"Rotoform has been a cornerstone of our portfolio for forty years," says Johan Sjögren. "By continuing to focus on how we can make it better, faster and even easier to maintain, we are confident that it will carry on playing a central role in chemical processing for another 40 years and more."



Continuous development of IPCO Rotoform granulation technology from 1980 to 2020

The Rotoform Process

The Rotoform consists of a heated cylindrical stator, supplied with molten product via heated pipes and filter, and a perforated rotating shell that turns concentrically around the stator. Drops of the product are deposited by the nozzle bar across the whole operating width of a continuously running stainless steel belt.

A system of baffles and internal nozzles built into the stator provides uniform pressure across the whole belt width, providing an even flow through all holes of the perforated rotary shell. This ensures that all granules are of uniform size, from one edge of the belt to the other.

The rotation speed of the Rotoform is synchronised with the speed of the steel cooling belt to allow gentle deposition of the liquid droplets onto the moving belt. Heat released during cooling and solidification is transferred via the steel belt to cooling water sprayed underneath.

This water is collected in tanks and returned to the water recooling system; at no stage does it come into contact with the product.

After the drop has been deposited onto the steel belt, any product residue on the outer shell is returned to the Rotoform via a heated refeed bar which keeps the outer shell clean.

The product droplets are then discharged as solid, hemispherical granules at the end of the cooling system. To eliminate the possibility of product damage during discharge, a thin film of silicon-based release agent is sprayed onto the steel belt.

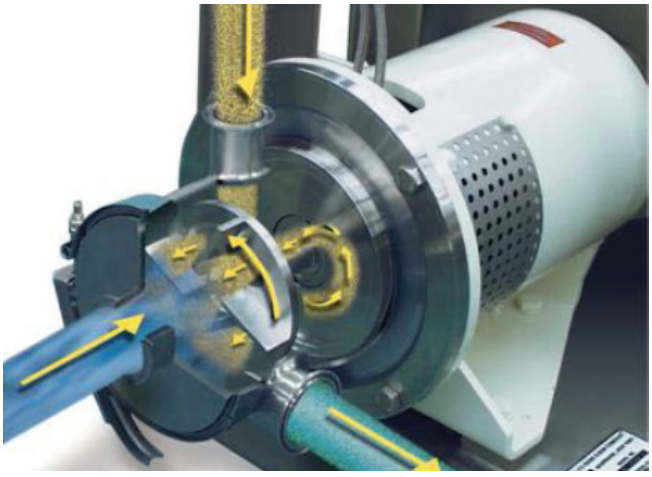
This process offers a number of environmental advantages. As the cooling water never comes into direct contact with the chemical, there is no risk of cross contamination. Secondly, solidification takes less than ten seconds, resulting in very low emission values. And low levels of dust levels mean no need for exhaust air treatment. ■

Dissolve solids rapidly with advanced SLIM Technology

ROSS mixers, blenders, dryers, and dispersers serve the requirements of the chemical industry in virtually every industrialized country around the world. We have the experience and production capacity that no other manufacturer of specialty mixing and blending equipment can match.

For demanding dissolution requirement, consider the Solids/Liquids Injection Manifold (SLIM) technology available on batch and inline Ross High Shear Mixers. It is a novel method of delivering solids below the surface of the liquid and right where rigorous mixing talks place. A ported rotor and stator specially designed to generate powerful vacuum draws powders directly into the high shear zone of the mix chamber. Solids are prevented from floating on the liquid surface. SLIM technology is ideal for the rapid introduction of difficult to wet solids. Wet-out is virtually instantaneous: although the powder, pellets or granules are injected at fast rate, it does not lead to lump formation.

Operation of a SLIM system is simple, just by turning on the mixer and inducting powders. The inline SLIM mixer is usually installed at floor level, offering operator convenience. SLIM combines the mixing



of powders and liquids simultaneously by injecting powders directly into a specially engineered high-shear rotor/stator mixer, where the powder is immediately dispersed into the liquid stream. In most applications, these new solid/liquid injection systems shorten mixing cycles dramatically.

The High Shear Mixers with SLIM from Ross are best for high volume dispersion. Whereas for CMC dispersions, Dual-Shaft and Triple-Shaft designs are available ranging from 1 gallon laboratory up to 4000 gallon production models. ■

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Use of Graphite Heat Exchangers in Chemical Industries : Graphite India Ltd

In chemical industries Graphite MOC equipment are commonly used to handle corrosive chemicals like HCl acid, H2SO4 acid, Phosphoric acid & various Organic chemicals. These equipments can be used for applications like Condenser, Heater, Cooler , Evaporator, Absorber & Reboiler etc. Most of these equipment are designed & used for specific duty conditions.

However, in manufacturing of some chemicals number of Graphite equipment's are required to handle various processes in a single system. In such cases these Graphite equipments become integral part of std. plants & machineries to manufacture of such products. Here are the details of some systems in which number of Graphite equipments are used.

HCL Synthesis units

In caustic industries HCl synthesis units are used to produce commercial grade HCl acid as by product. Basically Caustic soda , the main product is produced by electrolysis of sea water. During this process H2 & Cl2 are liberated which needs to be consumed continuously to produce Caustic soda.
In HCl synthesis unit H2 & Cl2 gases are

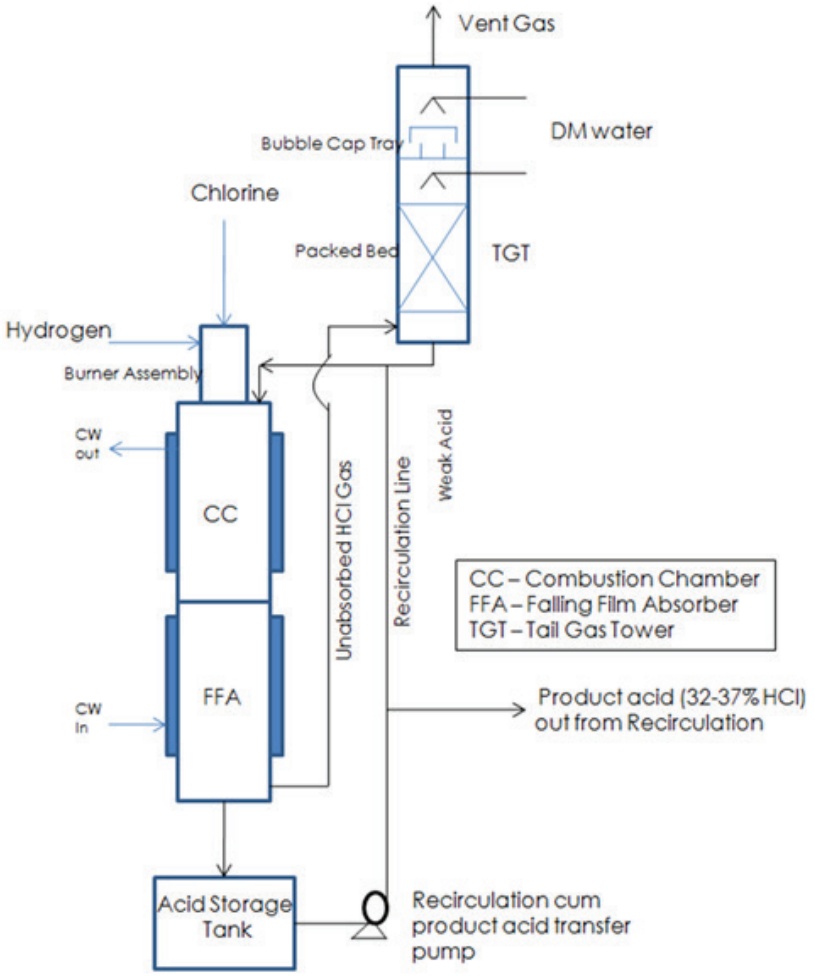

Fig. 1 HCL Synthesis Unit

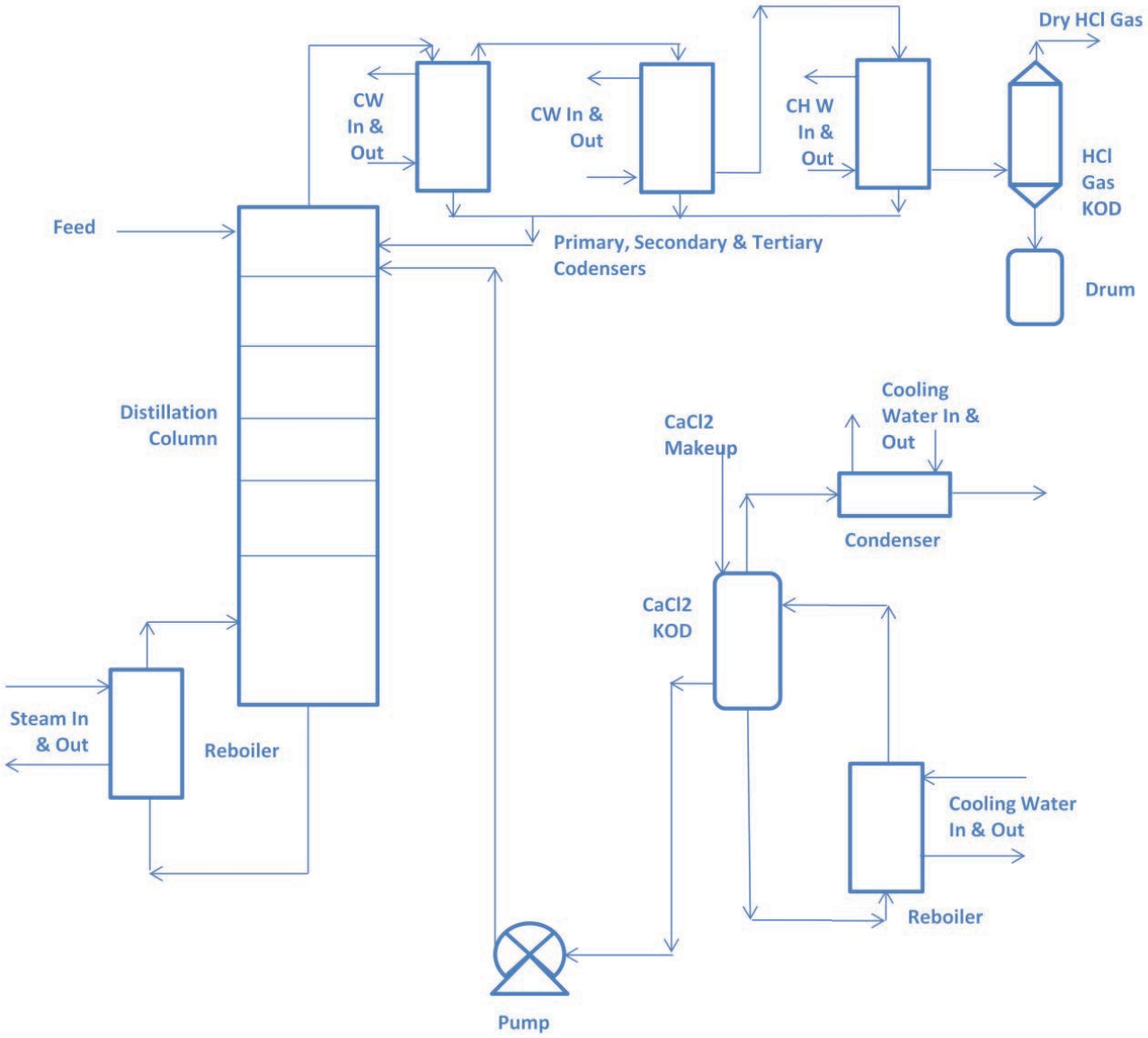

Fig. 2 Dry HCl Gas generation unit

burnt in a Graphite combustion chamber to produce HCl gas. This Combustion chambers in nothing but a hollow cylindrical vessel in Graphite MOC encased in a MS shell. This combustion chamber is fitted with a Graphite burner at the top to feed the Cl2 & H2 gas streams. Inside the Combustion chamber the Cl2 is burnt in H2 atmosphere & HCl gas produced. This is further absorbed in a Falling film Graphite Absorber, mostly Block type design. The unabsorbed HCl vapors from absorber is further feed to a Graphite packed column, which is also called Tail Gas tower. These 3 no. Graphite equipment forms Main items of HCl synthesis units used to produce HCl acid.

Dry HCl Gas generation units

In chemicals industries Dry HCl gas is required for use in various processes . Most common method is to Evaporate commercial grade HCl acid to get required

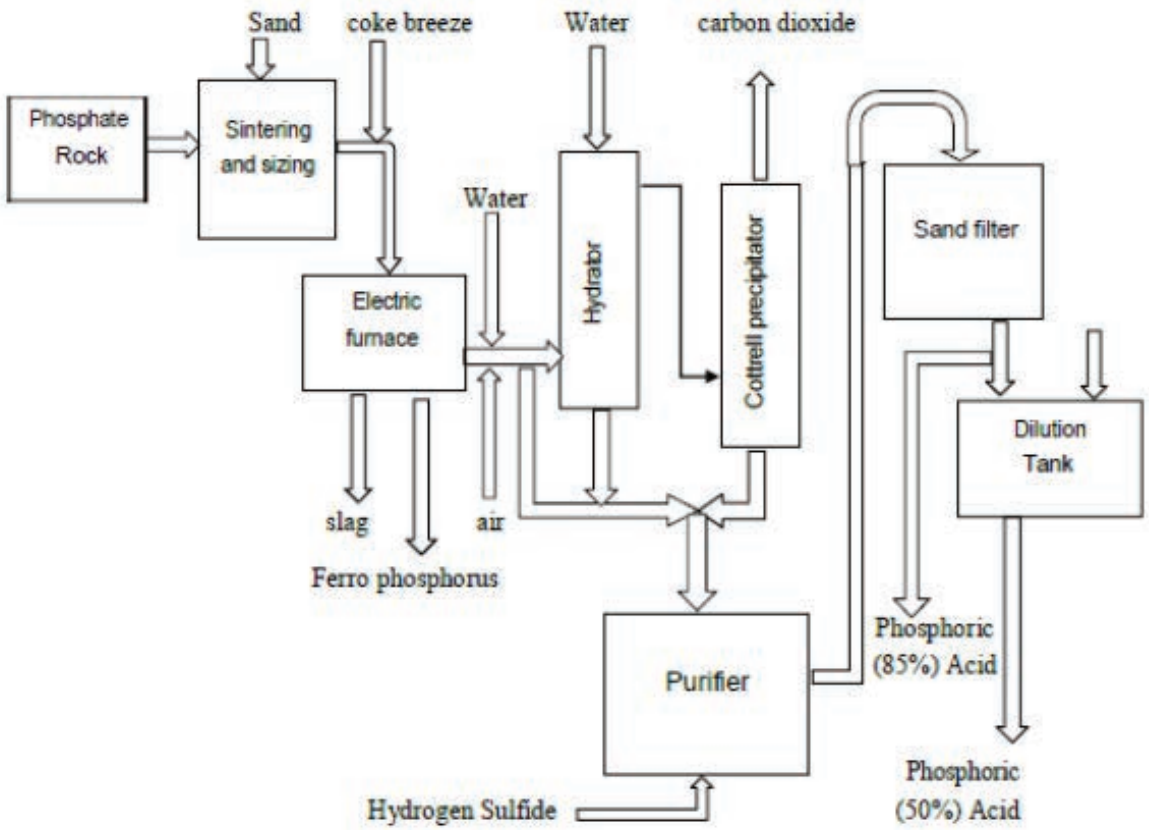

Fig. 3 Process Flow diagram for Pure Phosphoric Acid Plant

quality of Dry HCl gas. Such systems essentially require a Graphite column having Sieve type trays for HCl distillation, Graphite block type heat exchanger to be used as Re boilers & series of condensers. There are 2 routes to produce Dry HCl gas, one is 22 % by product route which needs to be consumed in some other process or 1 % route which can be easily disposed in effluent. In case of 1 % by product route, for Ca Cl2 circuit additional Re boiler & Condenser are required which are in Graphite MOC.

Pure Phosphoric acid

Food grade Pure Phosphoric acid is used in large variety of food supplements & Beverage products . In India many new projects are coming up to produce this Pure Phosphoric acid. Graphite Equipments like Tray type columns, Block type Heat exchangers Shell and tube type Heat exchangers & Graphite piping are commonly required equipments in this kind of projects. ■

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M. V. Rao
Managing Director
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Fenix™ Process Technologies is a company founded by Technocrats having decades of industrial experience in the field of Process Design, Equipment Design, Process equipment Manufacturing, System Integration, Plant Design, Plant Modifications, Automation, Project Management and Process Consultancy. Our objective is to provide the best Engineering Services, Reliable Equipment's and Complete process lines to our customers in the field of Distillation , Solvent recovery, Used oil re refining , Edible oil refining(Chemical & Physical), Oil Pre Treatment for Bio Diesel, Biomass , Methanol , Biodiesel distillation and Glycerin Purification, Edible oil/Fat Modification, and Bio Ethanol/Ethanol De-Hydration. Fenix also offer specialized licensing technologies for Biodiesel, Sodium Methoxide and Methyl Amines production technologies.

The project activities are complemented by the company's manufacturing unit producing variety of structured packings and other internals, distillation columns, metallic random packings and trays, heat exchangers, mixers, reactors and evaporators etc.

We are also supported by technology partners, Professional Consultants & Research Scientists in the field of Process Development, Equipment Design, Plant Engineering through 3D Modelling, Plant automation, Instrumentation and Program Logic design and System Integration. Having worked closely with industry segments, we understand the needs of a diverse range of esteemed clients. We use our engineering expertise to offer complete equipment and to supply fully integrated systems for the above industries. We intend to continually use our national and international network to offer most technically advanced products for the process systems and help our customers in the technical evaluation, tendering and procurement services

By focusing on core processes we can assure our customers that we will provide appropriate, well designed, reliable, and

state of the art technology that is of excellent value for their money. In all of our commercial and engineering activities we seek to maintain open and trustworthy dealings. By maintaining these standards, both internally and externally, we will continue to offer professional service of the highest quality.

Industries & Applications

Chemical Industry
- Solvent Recovery Systems
- Purification of Chemicals
- Absorption
- Extraction
- Reactive Distillation

Food Industry
- Edible Oil Refining

Pharmaceuticals Industry
- Solvent Recovery Systems

Alcohol Technology
- Fuel Ethanol

Aromatics Sector
- Menthol Recovery

High Vacuum Distillation of Perfumery Products Bio Diesel
- Bio Diesel Production
- Methanol Recovery
- Glycerol Purification

Technologies

Distillation Technology
- Solvent Recovery Systems
- Batch & Continuous Distillation Systems
- Multipurpose Solvent Recovery Systems

Liquid-Liquid Extraction
- Packed Columns
- Agitated Packed Columns
- Agitated Tray Columns

Fats & Oleochemicals Technology
- Dry Fractionation
- Fat Splitting
- Fatty Acid Fractionation
- Glycerine Purification
- Hydrogenation
- Soap Plant

Edible Oil Refining
- CentiMix Degumming
- FlexiBleach Bleaching
- Eco2Flex Deodorising
- HiVac Heat Exchanger

Biodiesel Technology
- Biodiesel Plant
- Glycerine Recovery
- Methanol Recovery

R&D Set-up (Skids)
- Pilot Trials
- Semi Production Scale Plant
- Skit Mounted Pilot Plants

Process Technologies for Oil & Gas Industry
- Used Oil Re-refining
- White Spirit Plant
- Crude Oil Refining
- Vacuum Distillation Unit

Evaporation Technology
- MEE - Falling Film
- MEE - Forced Circulation
- Agitated Thin Film Evap / Dryer

Equipments for Process Industry
- Columns ▪ Heat Exchangers
- Reactors ▪ Vessels etc.

Contact

E-mail: raomv@fenix.in
Website: www.fenix.in

3 Decades of legacy of design, Manufacture and supply of Process Equipment like Agitators, Reactors, Heat Exchangers...

THERMOTECH

AGITATOR

REACTOR

HEAT EXCHANGER

SIDE ENTRY AGITATOR

REACTOR

SHAMPOO AND CREAM MIXER

We introduce ourselves as one of the leading organizations to Design, Manufacture and Supply of process equipment such as Agitators, Reactors, Mixing Tanks and Heat Exchangers.

Having Manufacturing legacy and last 30 years of and many backed up by state of art, infrastructure and successful execution of many prestigious projects to our credit.

Our strength is construction of Agitators, Reactor/ Mixing Vessel with most optimum solution for agitation of fluids for the said application. Till date we have manufactured more than 10000 Agitators and 3000 Reactors, Vessels, Heat Exchangers.

Our workshops equipped with latest generation machineries supported by our staff having exhaustive experience manufacturing process equipment, has established a sound, reliable alternative in the market, helping us to achieve the

Agitator

repeat orders from our reputed customers.

Presently we have two manufacturing units with total manufacturing area of 80,000 ft2 equipped with state of the art facility to meet the qualitative and quantitative requirement of the customer.

We have also exported to many countries and are on global vendor code of many multinational Companies. Performance of our equipment is wining us repeat contract from existing customers and 80 % of our business comes from repeat orders.

We cater to many reputed companies like BASF India Ltd, UPL Ltd, Sudarshan Chemicals ,Deccan Fine chemicals ltd, Rallis india ltd ,SRF ltd , Lubrizol India, Asian Paints, Berger Paints, Indigo Paints, Pidilite Industires, Cipla Ltd,Dr. Reddys Laboratory, Biocon Ltd , Sun Pharmaceuticals, ,Centrient Pharmaceuticals, Fermenta Biotech , Emami Agrotech Desmet ballestra, Praj Industries, Praj Hipurity, Aditya Birla chemicals ,Coromondal International etc. ■

Contact

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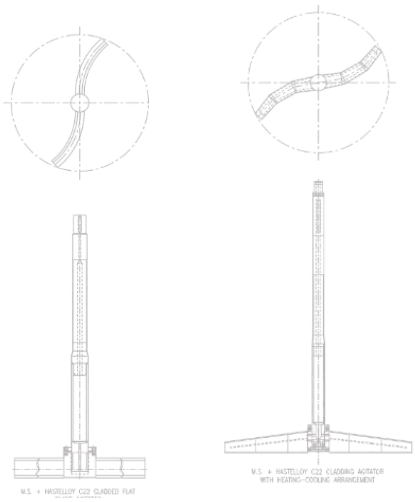
Continuous Improvements in Glass Lined Equipment



The Glass line industry has traversed far ahead with numerous updations during the last couple of decades. Being a fast growing, currently the glass line industry has evolved as an independent sector; with some obvious challenges, today it has established its demand in the chemical & pharmaceutical requirements.

Suryamani Glassed Steel Equipment Private Limited (SGEPL) now competes aggressively in foreign market also. In a very short span of SGEPL, have showcased the true spirit of Spartan by accomplishing many projects of varied nature. SGEPL mainly manufacturers Glass line processing equipment namely Reactors, Storage Tanks, Heat Exchangers, Agitated Nutsche Filter/ Dryer (ANF/ANFD), Distillation Columns, Agitators, Pipes & Pipe Fittings etc. The company is spread across 32000 sq. m. area out of which nearly 20000 sq. m is allotted to meticulous Manufacturing Unit (I) of fabrication, Glass lining, assembly and R&D of fascinated landscape with an ethnic built up of administrative complex. SGEPL equates and strives to stay updated with the changes technological advances and requirements of the market with modish applicable machines and software. The company aspires to provide with the brand new and cutting edge services in promise time frame.

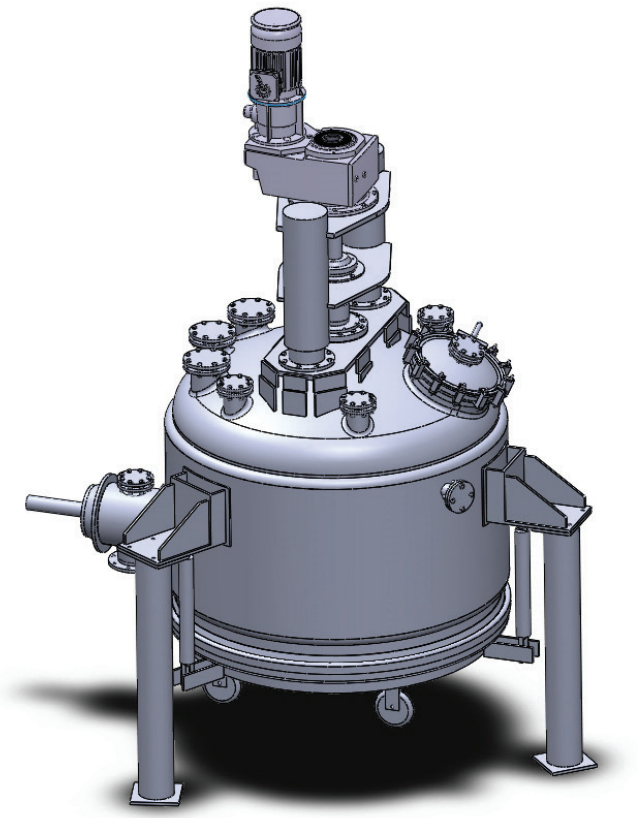


Fig. 1 ANFD model view

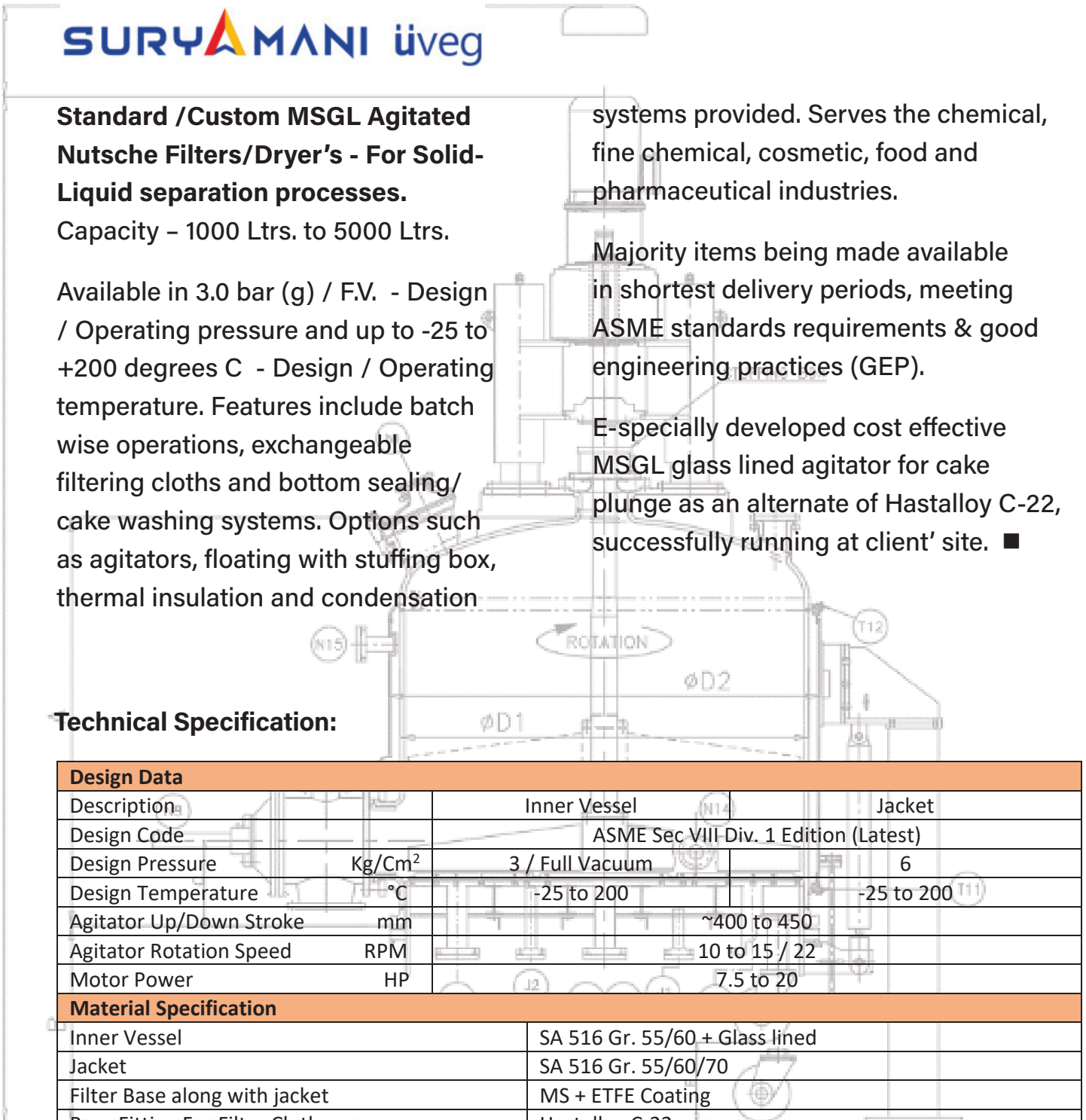
SURYAMANI üveg

Standard /Custom MSGL Agitated Nutsche Filters/Dryer's - For Solid-Liquid separation processes.
Capacity – 1000 Ltrs. to 5000 Ltrs.

Available in 3.0 bar (g) / F.V. - Design / Operating pressure and up to -25 to +200 degrees C - Design / Operating temperature. Features include batch wise operations, exchangeable filtering cloths and bottom sealing/ cake washing systems. Options such as agitators, floating with stuffing box, thermal insulation and condensation systems provided. Serves the chemical, fine chemical, cosmetic, food and pharmaceutical industries.

Majority items being made available in shortest delivery periods, meeting ASME standards requirements & good engineering practices (GEP).

E-specially developed cost effective MSGL glass lined agitator for cake plunge as an alternate of Hastalloy C-22, successfully running at client' site. ■



Technical Specification:

Design Data			
Description		Inner Vessel	Jacket
Design Code		ASME Sec VIII Div. 1 Edition (Latest)	
Design Pressure	Kg/Cm^2	3 / Full Vacuum	6
Design Temperature	°C	-25 to 200	-25 to 200
Agitator Up/Down Stroke	mm	~400 to 450	
Agitator Rotation Speed	RPM	10 to 15 / 22	
Motor Power	HP	7.5 to 20	

Material Specification	
Inner Vessel	SA 516 Gr. 55/60 + Glass lined
Jacket	SA 516 Gr. 55/60/70
Filter Base along with jacket	MS + ETFE Coating
Base Fitting For Filter Cloth	Hastelloy C-22
Base Fasteners	Hastelloy C-22
Side Discharge Valve	MS + ETFE Coating
Filter Plate	PP / PTFE
Filter Cloth	Polypropylene (10 Microns)
Agitator	Hastelloy C-22 Cladded / Glass Lined
Agitator Blade	Hastelloy C-22 Cladded / Hastelloy C-22 / CS + GL
External Fasteners	IS 1367 CL 4/4.6
Insulation And Cladding (Optional)	32 mm Glass Wool + 50 mm Puff + 3 mm SS-304 Cladding
External Surface Preparation	1) Grit Blasting. 2) Base Coat of Epoxy Primer. 3) Final Coat 0f Epoxy Paint.

SURYAMANI üveg

Details of Dimensions

Capacity			Liters	1000	1200	1500	2000	2500	3000	3500	4000	4500	5000
Full Volume			Liters	1560	1880	2025	2590	3570	3933	4900	5556	5160	5850
Jacket Volume			Liters	105	116	170	165	270	268	265	302	289	332
Jacket Heat Transfer Area			Sq. m	2.7	2.9	4.08	4.8	6.4	6.78	6.9	8.2	8.2	9.05
Filter Area			Sq. m	1.1	1.4	1.8	2.2	2.2	3.02	3	3	4.3	4.3
Maximum Cake Volume			Liters	400	550	750	975	975	1357	1648	1648	2000	2000
Motor Power			HP	7.5	7.5	10	15	15	20	20	20	20	20
R.P.M				22	22	13	12	12	12	12	12	13	13
Geometrical Dimensions		A	mm	750	750	1397	1422	1800	1709	1750	1890	1000	1114
		B	mm	800	800	727	820	820	900	920	920	900	900
		C	mm	375	375	375	375	375	385	385	385	385	385
		D1	mm	1200	1400	1600	1800	1800	2000	2200	2200	2400	2400
		D2	mm	1300	1500	1700	1900	1900	2100	2300	2300	2500	2500
		H	mm	3350	3450	3696	4095	4550	4859	4919	5059	4700	4814
		S	mm	400	400	400	400	400	450	450	450	450	450
		E	mm	350	350	300	300	300	400	400	400	400	400
Process Nozzle Details	M	Agitator nozzle		200	200	200	200	200	250	250	250	250	250
	N1	Manhole/ Handhole		250	250	350x450	350x450	350x450	500 / 350x450	500/ 350x450	500/ 350x450	500/ 350x450	500/ 350x450
	N2	Spare		100	100	80	100	100	100	100/150	100/150	100/150	100/150
	N3	Spare		80	100	80	100	100	100	100/150	100/150	100/150	100/150
	N4	Spare		80	80	100	100	100	100/150	100/150	100/150	100/150	100/150
	N5	Light Glass		-	80	100	100	100	100/150	100/150	100/150	100/150	100/150
	N6	Spare		-	80	100	100	100	100/150	100/150	100/150	100/150	100/150
	N7	Spare		-	100	80	100	100	100	100/150	100/150	100/150	100/150
	N8	Spare		-	-	-	-	-	100	100/150	100/150	100/150	100/150
	N9	Side Outlet		300	300	300	300	300	300	300	300	300	300
	L1	Base Outlet		50	50	50	80	80	80	80	80	80/100	80/100
	L2	Base Outlet		50	50	50	80	80	80	80	80	80/100	80/100
	L3	Base Outlet		50	50	50	80	80	80	80	80	80/100	80/100
	L4	Base Outlet		-	-	-	-	-	-	80	80	80/100	80/100
	N14	Inlet		50	50	50	50	50	80	80	80	80	80
	N15	Outlet		50	50	50	50	50	80	80	80	80	80
	T11	Vent		½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT
	T12	Drain		½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT	½" BSPT
	J1	Base Jacket Inlet		25/40	25/40	40	40	40	40	40	40	40/50	40/50
	J2	Base Jacket Outlet		25/40	25/40	40	40	40	40	40	40	40/50	40/50

General notes:

1. All dimensions are in mm. unless otherwise specified.
2. The dimensions described are for guidelines only. We reserve right to modify due to continuing in innovations technology.

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