CHRONICLING PROCESS INDUSTRY INNOVATIONS SINCE 1966

VOL.58 | ISSUE 3 | MARCH 2023

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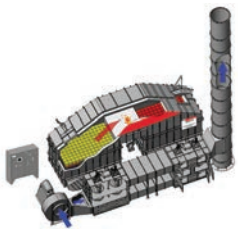

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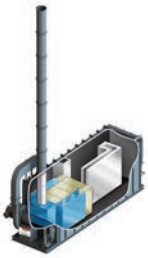

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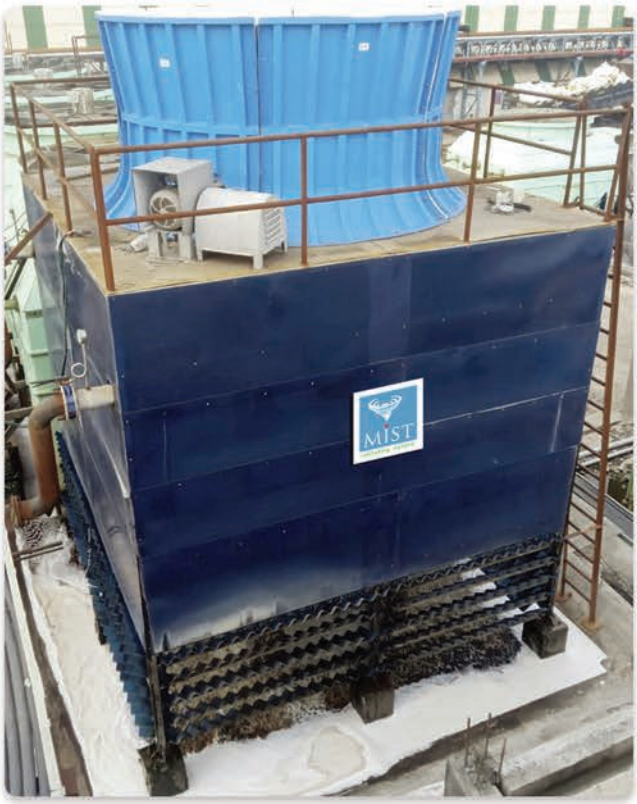

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Government stands committed to reduce India's emission level of Green House Gases

Shri Ashwini Kumar Choubey, Minister of State for Environment, Forest and Climate Change

New Delhi, India: Minister of State for Environment, Forest and Climate Change, Shri Ashwini Kumar Choubey in a written reply to a question in Rajya Sabha informed that Government of India stands committed and has taken a number of steps to reduce India's emission level of Green House Gases. The five elements enunciated by India at COP26 in Glasgow have been appropriately incorporated in enhanced Nationally Determined Contributions (NDCs) under Paris Agreement and Long-term Low Carbon Development Strategies towards net zero emissions by 2070, in accordance with the principles of equity and Common But Differentiated Responsibilities and Respective Capabilities (CBDR-RC) in light of different National Circumstances.

India's National Action Plan for Climate Change (NAPCC) provides the overarching policy framework for climate change mitigation and adaptation through its National Missions in specific areas of solar energy, energy efficiency, water, sustainable, agriculture, health, Himalayan ecosystem, sustainable habitat, green India and strategic knowledge for climate change. The NAPCC represents multipronged, long term and integrated strategies for achieving key goals in the context of climate change. In line with NAPCC, thirty-four states and union territories have prepared their respective State Action Plans on Climate Change.

The Government has taken several measures to promote renewable energy in the country and the sector in India is experiencing a period of rapid expansion, buoyed by strong government focus and policy support. The National Green Hydrogen Mission has been approved with an aim to make India a global hub for production, utilization and export of Green Hydrogen and its derivatives.

Green economy, one of the top seven priorities (Saptarishi) of the Union Budget 2023-24

New Delhi, India: Minister of State for Environment, Forest and Climate Change, Shri Ashwini Kumar Choubey in a written reply to a question in Lok Sabha informed that the Government has started Lifestyle for Environment (LiFE) movement with a view to sensitize all stakeholders, including the public at large, about the need for mindful utilization instead of mindless consumption of resources. A comprehensive and non-exhaustive list of 75 individual environment-friendly actions (LiFE actions) across 7 categories has been identified for nudging individuals, communities and institutions as a part of this movement.

In the written reply it was stated that the five elements enunciated by India at COP26 in Glasgow in November 2021 have been appropriately incorporated in enhanced Nationally Determined Contribution (NDC) under Paris Agreement and Long-term Low Carbon Development Strategies towards net zero emissions by 2070, in accordance with the principles of equity and Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC) in light of National Circumstances.

The update to NDC submitted to UNFCCC in August 2022 includes India's commitment to reduce Emissions Intensity of its GDP by 45 percent by 2030, from 2005 level; achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030, with the help of transfer of technology and low-cost international finance including from Green Climate Fund; and put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation, including through a mass movement for 'LIFE'– 'Lifestyle for Environment' as a key to combating climate change.

Nuclear power saved 41 million tonnes of CO2 emissions in year 2020- 21

New Delhi, India: Union Minister of State, PMO, Personnel, Public Grievances, Pensions, Minister of State (Independent Charge) Science & Technology, M/o Earth Sciences; MoS, Atomic Energy and Space, Dr Jitendra Singh said that presently (2020-21) nuclear power is saving 41 million tonnes of CO2 emissions annually, compared to the emissions that would be generated by equivalent electricity generation from coal

based thermal power plants.

In a written reply to a question in Lok Sabha, Dr Jitendra Singh said that as part of Low Carbon Development of Electricity Systems consistent with Enhanced Development benefits, Government is exploring a significantly greater role for nuclear power. He added that nuclear power currently provides 3% of electricity generation. Sufficient production and share of nuclear power is essential for ensuring country's energy security. Current policy targets a three-fold rise in nuclear installed capacity by 2032.

The Minister highlighted that nuclear energy can be considered for delivering base load power free of intermittency in place of energy from fossil fuels. DAE considers nuclear energy as a significant component of its non-fossil fuel power generation capacity and will continue to pursue research and innovation in this sector.

Dr Jitendra Singh further pointed out that the present installed nuclear power capacity is set to increase from 6780 MW to 22480 MW by 2031 on progressive completion of projects under construction and accorded sanction. He added that in the next three years, capacity addition of 5300 MW is planned on completion of KAPP 3&4 (2X700 MW), RAPP 7&8 (2X700 MW), KKNPP 3&4 (2X1000 MW) and PFBR (500 MW).

Startups & innovation ecosystem are engines of growth for any country

New Delhi, India: Startups and the entire innovation ecosystem are the engines of growth for any country, the Minister of State in the Ministry of Commerce and Industry, Shri Som Parkash said in reply to a parliamentary question today. Recognizing this aspect, the Government launched Startup India initiative on 16th January 2016 with an aim to build a stronger ecosystem for nurturing India's startup culture that would further drive our economic growth, support entrepreneurship, and enable large-scale employment opportunities.

Sustained Government efforts in this direction have resulted in increasing the number of recognised startups from 442 in 2016 to 92,683 in 2023 (as on 28th February 2023).

Startups have actively contributed to Government's flagship programs such as Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Smart Cities Mission, Swachh Bharat Mission, National Heritage City Development and Augmentation Yojana (HRIDAY scheme) to improve urban infrastructure and service provision.

Furthermore, DPIIT has recognised startups which are spread across 56 diversified sectors. More than 15% of these startups are in sectors such as Agriculture, Healthcare & Lifesciences, Automotive, Telecommunication & Networking, Computer Vision, etc. Over 7,000 recognised startups are in sectors like Construction, House-hold Services, Logistics, Real Estate and Transportation and Storage contributing towards urban concerns.

Carbon stock in India increases by 79.4 million tonnes

New Delhi, India: Quantum of carbon sequestration by a tree depend on various ecological and physical factors including trees species. As per India State of the Forest Report (ISFR) 2021, total carbon stock in forest is estimated as 7,204 million tonnes which include 529.47 million tonnes of carbon stock in plantation/ Trees Outside Forest. There is an increase of 79.4 million tonnes in carbon stock of the country as compared to the last assessment of 2019. The annual increase is 39.7 million tonnes, which is 145.6 million tonnes CO2eq.

India is a party to the United Nations Framework Convention on Climate Change (UNFCCC). A Nationally Designated Authority for Implementation of Article 6 of Paris Agreement (NDAIAPA) has been notified which has a mandate for approval of projects under Article 6 of the Paris Agreement for carbon trading. Also, an Indian Carbon Market (ICM) is envisaged which will inter-alia have an offset mechanism. Under the offset mechanism, carbon credits may be generated and sold by the entities including farmers and Gram Panchayats.

Government mandates use of cleaner fuels like PNG in industrial and commercial applications to curb air pollution in Delhi NCR

New Delhi, India: The Commission for Air Quality Management (CAQM) in NCR and Adjoining Areas has notified a list of approved fuels to be used by industries in NCR. Of a total of about 7,760 fuel-based industries presently operating in NCR, 4082 industries have opted for running their operations with PNG and the balance are now running on biomass-based fuels / fuels other than PNG including coal. Only about 320 industrial units across entire NCR have temporarily ceased their operations on their own, beyond 31.12.2022, till they also migrate to cleaner fuels as per the approved fuel list.

With a view to abate air pollution in the Delhi-NCR region, shifting of industrial and commercial applications to cleaner mode of fuels like PNG etc. has been a priority of the Central Government and State Government in the NCR. Coal being the most heavily polluting fuel, it been decided to phase out its use from entire NCR in industrial, domestic and miscellaneous applications (barring use of low Sulphur coal only in thermal power plants), towards aiming for an overall improved air quality in the region. Accordingly, the Commission for Air Quality Management (CAQM) in NCR and Adjoining Areas has finalized a policy to curb 'air pollution menace occurring every year in Delhi and National Capital Region'. The policy inter-alia contains approved fuel list for the Delhi-NCR whereby heavily polluting fossil fuels like coal etc. have been proposed to be banned w.e.f. 01.01.2023 in the entire NCR.

The Government has launched National Clean Air Programme (NCAP) as a long-term, time-bound programme to reduce air pollution in a comprehensive manner with target to achieve up to 40% reduction in PM10 concentration level by the year 2025-2026 w.r.t. baseline of 2017-18. City specific clean air action plans under NCAP have been prepared and rolled out for implementation in these 131 non-attainment/million plus cities by the concerned stakeholders including State Governments. The specific clean air action plans target the city specific air polluting sources viz. vehicular emission, road dust, biomass/ crop/ garbage/ MSW burning, construction activities, industrial emission and other city specific sources etc.

GREEN HYDROGEN MISSION - Expected to reduce ₹ 1 lakh crore worth of fossil fuel imports and nearly 50 MMT per annum of CO2 emissions by 2030

New Delhi, India: On 4th January 2023, the Union Cabinet approved the National Green Hydrogen Mission with an outlay of ₹ 19,744 crore from FY 2023-24 to FY 2029-30. The overarching objective of the Mission is to make India a global hub for production, usage and export of Green Hydrogen and its derivatives.

The following components have been announced as part of the Mission: Facilitating demand creation through exports and domestic utilization; Strategic Interventions for Green Hydrogen Transition (SIGHT) programme, which includes incentives for manufacturing of electrolysers and production of green hydrogen; Pilot Projects for steel, mobility, shipping etc.; Development of Green Hydrogen Hubs; Support for infrastructure development; Establishing a robust framework of regulations and standards; Research & Development programme; Skill development programme; and Public awareness and outreach programme.

The expected outcomes of the Mission, by 2030, are as follows:

- India's Green Hydrogen production capacity is likely to reach 5 MMT per annum, contributing to reduction in dependence on import of fossil fuels. Achievement of Mission targets is expected to reduce a cumulative ₹ 1 lakh crore worth of fossil fuel imports by 2030.
- Nearly 50 MMT per annum of CO2 emissions are expected to be averted through production and use of the targeted quantum of Green Hydrogen.

Solar Waste Treatment under E-Waste (Management) Rules, 2022

New Delhi, India: The Ministry of Environment, Forest and Climate Change has notified the E-Waste (Management) Rules, 2022 on 2nd November 2022. Management of solar PV modules panels/ cells has been added in Chapter V of the said rules. As per these rules, every manufacturer and producer of solar photo-voltaic modules or panels or cells shall:

Ensure registration on the portal; Store solar photo-voltaic modules or panels or cells waste generated up to the year 2034-2035 as per the guidelines laid down by the Central Pollution Control Board in this regard; File annual returns in the laid down form on the portal on or before the end of the year to which the return relates up to year 2034-2035; Ensure that the processing of the waste other than solar photo-voltaic modules or panels or cells shall be done as per the applicable rules or guidelines for the time being in force; Ensure that the inventory of solar photo-voltaic modules or panels or cells shall be put in place distinctly on portal; and comply with standard operating procedure and guidelines laid down by the Central Pollution Control Board in this regard.

Further, Recycler of solar photo-voltaic modules or panels or cells shall be mandated for recovery of material as laid down by the Central Pollution Control Board in this regard.

Extended Producer Responsibility guidelines mandate sustainable plastic packaging to reduce plastic footprint

New Delhi, India: Identified single use plastic items, which have low utility and high littering potential, have already been prohibited, with effect from 1st July 2022, vide Plastic Waste Management Amendment Rules, 2021 notified on 12th August 2021, across the country. The notification also prohibits manufacture, import, stocking, distribution, sale and use of plastic carry bags having thickness less than seventy-five microns with effect from 30th September 2021, and having thickness less than thickness of one hundred and twenty microns with effect from the 31st December, 2022. Regular enforcement drives have been undertaken to implement ban on identified single use plastic items and on plastic carry bags having thickness less than one hundred twenty microns. Action have been taken on the deviations, which include seizure of banned single use plastic items and levy of penalty.

Steps have been taken by concerned central ministries and state governments towards implementation of ban identified single use plastic items. Private enterprises are manufacturing eco-alternatives. Around 150 manufacturers and startups manufacturing eco-alternatives to banned single use plastic items from across the country participated in the National Expo on eco-alternatives to banned single use plastics items and Conference of Startups -2022 held in Chennai on 26-27th September 2022. Further, 201 Manufacturers/Sellers of compostable plastics have been certified by CPCB and the list is available on the website of CPCB.

G20 Seminar on Strengthening Research and Promoting Innovation through richer Collaboration held at Amritsar

Amritsar, Punjab: India's G20 Presidency took centre stage at Khalsa College, Amritsar, where IIT Ropar under Ministry of Education hosted a seminar on 'Strengthening Research and Promoting Innovation through Richer Collaboration.' The event brought together delegates from the G20 Education Working Group to discuss the future of work and innovation, with a focus on building bridges across nations for equitable development.

Prof. Rajeev Ahuja, Director of IIT Ropar, welcomed the participants and highlighted India's opportunity to establish itself as a leader in research and innovation globally. Sh. K. Sanjay Murthy, Secretary, Higher Education attended the event and emphasized on the importance of collaboration in research for achieving Sustainable Development. Prof. Govind Rangarajan, Director, IISC shared enlightening thoughts on interdependency of domains and interdisciplinary action for solving problems. He also highlighted India's frugal innovations, which have the potential to solve problems of the developed world, and the need to acknowledge and use grassroots innovation.

The seminar focused on bridging the gap between government-academia-industry linkages for designing solutions for addressing global challenges. There is a need for bringing multidisciplinary in education. The discussion reached a consensus that Research Collaboration is need of the hour and countries/Institutions need to break silos to promote translational research for achieving the sustainable development goals just as they did during the Covid 19 pandemic. There's also a need to establish frameworks for sharing research data and outputs. G20 countries should also work towards establishing a common framework for effective use of emerging and disruptive technologies to address global challenges.

Anupam Rasayan signs Letter of Intent worth $120 Million (₹984 crores) with one of the Leading Japanese Chemical Company

Anand Desai, MD, Anupam Rasayan

Surat, Gujrat: Anupam Rasayan, one of India's leading custom synthesis & speciality chemical players, has signed Letter of Intent worth revenue of $120 Mn (₹984 crores) for next 6 years with one of the leading Japanese Chemical company to supply new age advance intermediate for life science active ingredient. This product will be manufactured in our existing as well as upcoming multipurpose manufacturing facilities.

Speaking about the contract, Anand Desai, Managing Director of Anupam Rasayan, said, "We are excited to announce that we will be primary supplier globally for this new age high value advance intermediate to the Japanese customer. We are happy to add yet another marquee Japanese multinational in our customer portfolio. Sales realisation for this molecule will be one of the highest for the company. This molecule is based on fluorination chemistry which further validates our strategy of expansion in fluorination.

This product is being manufactured for the first time in India and it is in line with the government's make in India policy. This LOI demonstrates our technical capability to work on niche molecule along with Japanese customers and strengthens our revenue growth visibility in the coming years."

Power Foundation and Climate Policy Initiative India Pvt. Ltd. sign MoU to advance Sustainable Development in Power Sector

New Delhi, India: Power Foundation and Climate Policy Initiative India Pvt. Ltd. (CPI) have signed a Memorandum of Understanding (MoU) to work together to support India's transition towards a cleaner energy future. The agreement was signed on March 15, 2023, in New Delhi in a ceremony held in the presence of Director General of Power Foundation, Shri Sanjiv Nandan Sahai.

The MoU was signed by Dr Sambit Basu,

Director (Programs) & Chief Energy Economist, Power Foundation, and Shri Dhruba Purkayastha, Director, Climate Policy Initiative India Pvt. Ltd. Speaking on the occasion, Dr Basu said, "As India works to fulfill its global climate change commitments, collaborations like this one between CPI and Power Foundation are crucial. By working together to promote sustainable development in the power sector, we can build a cleaner, more resilient energy system for the future."

Shri Purkayastha said, "We are excited to partner with Power Foundation to drive sustainable development in India's power sector. Through our collaboration, we hope to promote the adoption of distributed renewable energy and develop sustainable financing mechanisms to support India's energy transition."

Under the MoU, Power Foundation and CPI will work together to promote distributed renewable energy, capacity building of relevant stakeholders, supporting India's energy transition, and managing transition-related risks. This MoU intends to provide an overarching framework under which collaborations and partnerships may be developed between the two organizations in the areas of sustainable development of the power sector.

Aramco and Linde Engineering to develop ammonia cracking technology

Dhahran, Saudi Arabia: Aramco, one of the world's leading integrated energy and chemicals companies, and Linde Engineering, a global leader in the production and processing of gases, announced that they have signed an agreement to jointly develop a new ammonia cracking technology. The collaboration between the two companies will combine Linde Engineering and Aramco's experience and capabilities in industrial research and development, lower-carbon hydrogen, and ammonia cracking technology.

A potential differentiator of this new technology is the ammonia cracking catalyst, jointly developed by Aramco and the King Abdullah University of Science and Technology (KAUST), which will be evaluated against other catalysts.

Through this agreement, Aramco, and Linde Engineering plan to build a demonstration plant in northern Germany to showcase this new ammonia cracking technology. Linde Engineering intends to offer this ammonia cracking technology to current and new customers, creating new commercial opportunities within the global lower-carbon energy supply chain. The emerging lower-carbon ammonia business may prove to be key in bridging the gap between a country's domestic renewable energy production capacity and total energy demand.

The Big 9 drivers: Accelerating Growth through a Carbon Intelligent & Resilient capacity

While global overcapacities and leverage in the steel industry have adversely affected profitability and sustainability, opportunities In India remain strong.

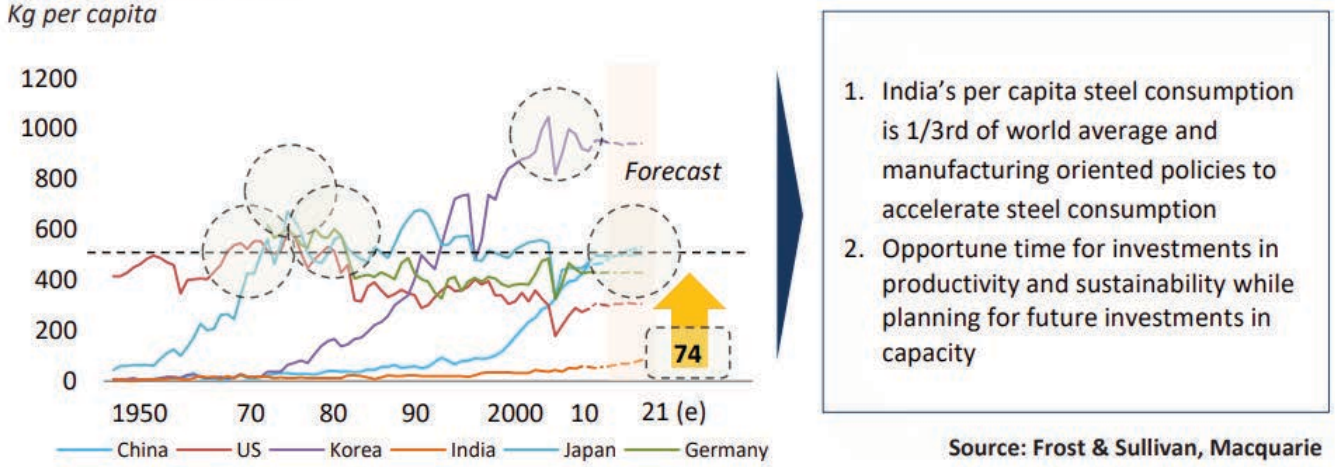
The baseline

The global steel industry: The steel industry has been struggling with pricing stress amid shifts in demand and consumption patterns and changing environmental norms.

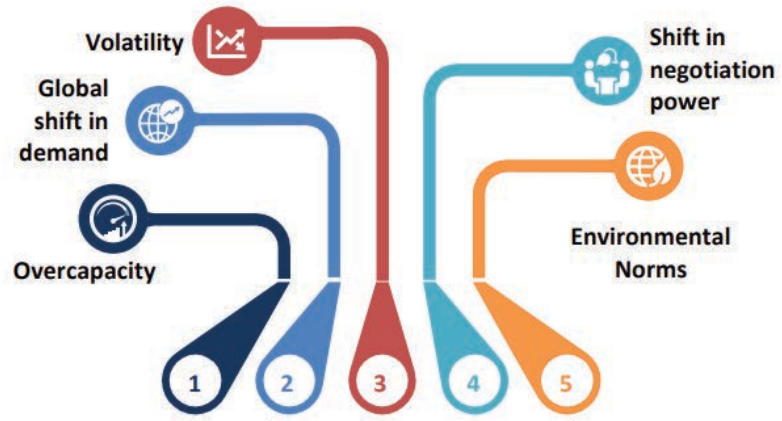
"Five megatrends" have made the environment especially challenging:

Global steelmaking capacity is showing an upward trend over the past decade (see figure 2). This has created challenges in supply demand scenarios and price-based competition in commodity markets. With renewed focus on "Net Zero" it is increasingly important for steel players operating with variable process route to be competitive focusing on sustained growth outcomes.

Fig 1: Global steel consumption (kg/ capita)



Source: Frost & Sullivan, Macquarie



Global & Indian Steel Scenario: Correlation between GDP growth and steel use

The absence of China from the world export market and higher import of steel from China are significant factors that could ensure steel prices remain strong. In contrast, domestic players' demand-supply instability in the global market presents an export opportunity.

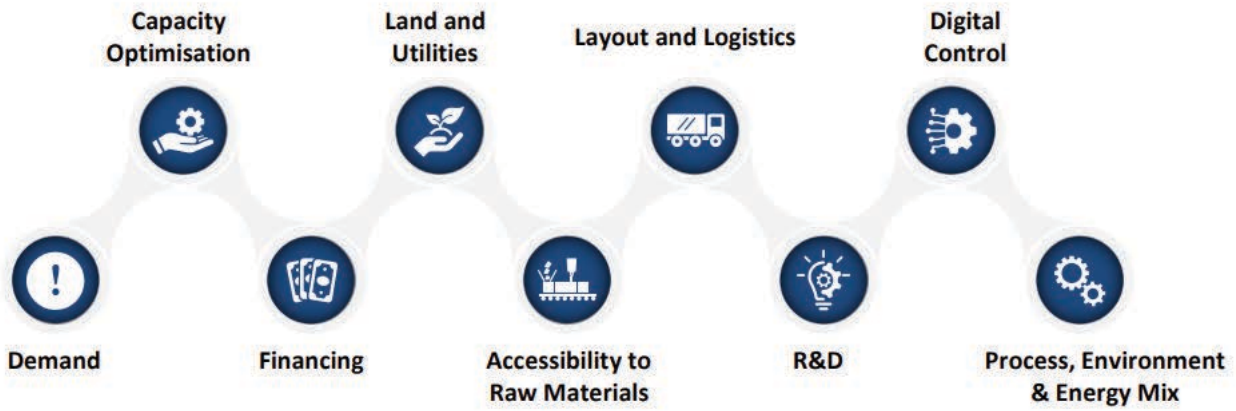
India's steel industry

An up-cycle in steel prices is expected to continue in FY 22, with stimulus packages unveiled by various countries keeping demand for steel high.

India has raw materials cost advantage with iron ore and domestic coal reserves. The cost curve will decrease with raw materials, logistics, productivity, and energy improvements. The steel industry will grow in close correlation with overall economic growth.

As we progress and given that the steel industry is on the cusp of rapid transformation, Frost & Sullivan has identified nine enablers for India to create a globally competitive steel industry.

Ensuring domestic demand through "Make in India" and the rise in steel prices enabled the Indian steel sector to remain an attractive destination for global investments with low-cost resources to increase capacity utilization and effectively



The Big 9: Drivers of Growth

meet the rising demand.

We expect an upward trend in the capital expenditure for plants incorporating private-public steelmakers in India. Alternative financing methods and hedging costs reduction may help make the financing options more competitive for future expansions, ensuring cost leadership.

The earnings for steelmakers took a hit because of supply-demand instability and liquidity issues.

An analysis of India's large integrated steelmakers with the small-medium-size players represent that the small-medium- size steelmakers are more prone to volatility in input costs since raw material cost covers 55% of their revenue as opposed to 40% for integrated steelmakers.

Comparing Indian steel producers with global best-in-class peers highlights a 70 percent lag in R&D spending as a percent of revenue, a 38 percent lag in CO2 emissions per ton of crude steel, and a 5 percent lag in process yield.

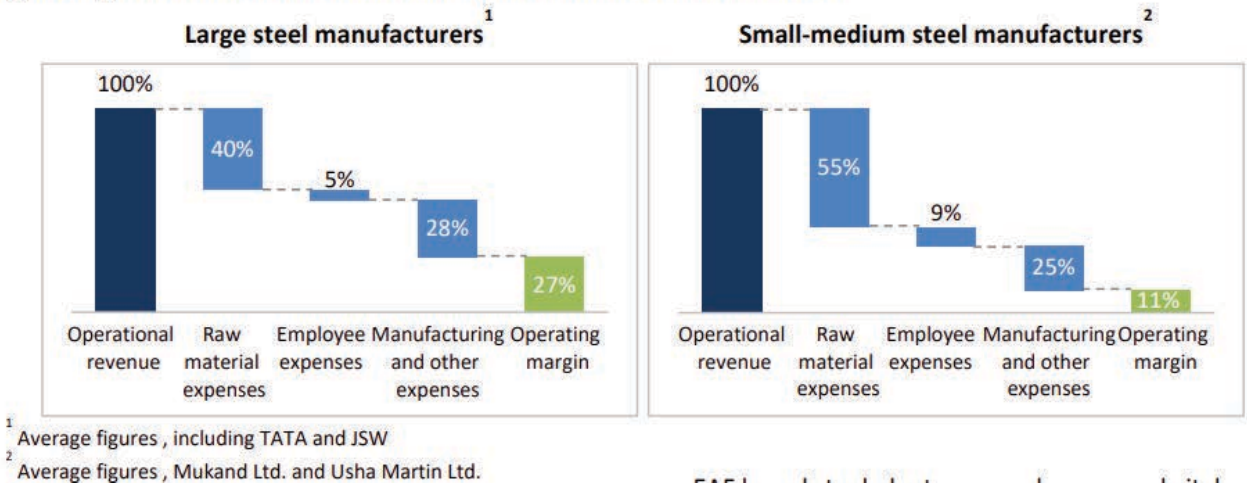
EAF based steel plants can explore several vital opportunities to further improve the cost, quality, and flexibility of operations based on price dynamics and product goals with a charged mix like pig iron, HBI, DRI, and scrap recycling to promote the concept of circular economy.

Our analysis indicates that in 2022, more focus will be on green hydrogen-based steel production. Scrap recycling utilizing a mini-mill will play a critical role in reducing the total emission footprint.

Accelerating India's growth trajectory in 2022 and beyond

India has the opportunity to lead in

Fig 5: Large steel manufacturers & Small and medium steel manufacturers



[1] Average figures , including TATA and JSW
[2] Average figures , Mukand Ltd. and Usha Martin Ltd.

2022 by focusing on the following key imperatives:

- India's growing economic development necessitates a top-tier steel industry to reinforce our development to 8-9 percent, with steel capacity reaching about 124 MT in FY 22. This is considering the Union Budget for 2021-22 with a sharp 35% y-o-y increase in allocation of CAPEX at ₹5.6 lakh crore. Lately, production cuts and lowering demands from China is reducing overcapacities.
- As the industry grows, the steelmakers are looking at realigning their focus from capacity to engineer intelligent, resilient, and environmentally friendly capabilities for the future with the flexibility to combine direct reduction, Blast furnace, arc furnace, and BOF technologies. This will increase the ability to add incremental capacities at lower lifecycle costs. Additionally, the flexibility to complement clean coal energy sources like coal gasification can make steel at a lower carbon footprint and sustained profitability, minimizing risk.
- Availability and volatility of raw material prices will continue to destabilize margins. While India has an advantage in iron-ore & coal – the proper sourcing, raw material blending, M&As combined with flexible capacity can push up the EBITDA/ ton. Flexibility in raw material inputs, process innovation, and sourcing strategy will continue to play a critical role in 2022.
- India has particular challenges concerning the productivity of the plants. A significant part of our blast furnaces run around 2 t/m3/day productivity compared to over 2.8 t/m3/day in the benchmarked operations. We emit around 1.8-2.0 t of Co2/ton of steel. It is expected to focus more on operations, energy, and carbon efficiency to gain a competitive advantage.
- Rail and road logistics is the primary mode of transportation In India. Logistics cost for bulk movement in India is 2.5X times more than other developed nations. Continued investments in rail, slurry pipelines, and coastal infrastructure to reduce logistics costs by about $30-$40/ton.
- As the industry grows in 2022, our assessments show that flexible plant configuration, multi-modular logistics, efficient utilization of natural resources, efficiency, and digital control can further increase the steel industry's EBITDA/ton by more than $50-$60.
- We have the chance to lead by harnessing the power of flexibility,

technology, growth, and innovation. The overall industry looks uneven due to its cyclical nature. However, steelmakers have tremendous opportunities with a sustained focus on growth imperatives. The shift from commodity steel to value-added and carbon-efficient products integrates the technical, economic, logistical, and digital dimensions of steel making model to ensure the healthy levers of profitability realizing the steel mission of 2030-31 ■

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Putting the 'U' in CCUS

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Carbon capture, utilization and storage (CCUS) has been a topic of interest for nearly two decades and has gained prominence with the advent of the race to net-zero. While CCS technologies are quite mature, few advancements have been made in CCU. It can be argued that CCU has been in practice when CO_2 is used for enhanced oil or gas recovery. But such a form of CCU is not always practical, for example when the CO_2 emission source is far away from a potential sink or when a storage basin or sink is very limited as is the case in India. In such a situation, a viable CCU alternative is to convert CO2 into useful products like methanol or mineralization like sodium bicarbonate, calcium carbonate and magnesium carbonate. Technology development for such conversion routes is quite advanced and ready for large-scale deployment although with limited installed references in operation. Nevertheless, these are promising routes for a country like India, where CO_2 emissions are largely in the interior sections.

Methanol Route

The CO_2 to methanol route is straightforward and quite similar to the conventional steam methane reforming syngas to methanol route as the type of catalyst and operating pressure and synthesis temperature conditions are alike. Subtle differences do exist with respect to pretreatment of the CO_2 to remove impurities, heat of reaction, compression of CO_2 and hydrogen and the types of machinery, but these can be addressed in a detailed feasibility study. All process technology licensors for syngas to methanol have the technology for CO_2 to methanol as well. The essential role of CO_2 as an intermediate in the catalytic process of methanol production was established in the 1990s. At about the same time, initial works on the synthesis of methanol from CO_2 and hydrogen were developed by technology licensors and catalyst manufacturers that have established the feasibility of such a process. Although conclusive, these initial works have attracted only recent interest. However, the CO_2 addition to the synthesis gas produced by steam reforming has been in practice to adjust the synthesis gas quality in some plants, with CO_2 being imported from a nearby ammonia plant or captured from the reformer flue gas. One of the advantages of the CO_2/H_2 based synthesis is a reduced level of byproducts compared to the traditional syngas route. Even if the modern catalysts are highly selective towards methanol, a small amount of higher alcohols, oxygenates and hydrocarbon are produced. Their production is favored by high temperature and a high CO to H_2 ratio and thus higher in syngas-based synthesis. Even though CO_2 conversion is slower compared to CO - based synthesis under similar conditions, it can be considered as a viable option. Despite the numerous academic works on alternative catalyst formulations, the Cu/ZnO supported on Al_2O_3 catalyst used for syngas-based synthesis so far remains the catalyst of choice for the CO_2 to methanol synthesis.

Hydrogen used for the CO_2 to methanol synthesis can be green H_2, blue H_2 or grey H_2. Using green H_2 entails a higher initial investment for the generation of renewable power and water electrolysis. A phased investment first would involve using blue H_2 or grey H_2 for the synthesis and then switching to green H_2 after a few years when the initial investment is paid out. Proximity to existing hydrogen generators and reliable supplies are key to profitability.

CCU is not practical if the CO_2 emission source is far away from a potential sink. A viable alternative is to convert CO_2 into useful products like methanol or mineralization e.g. $NaHCO_3$, $CaCO_3$ or MgCO3. Technology development for such conversion routes is quite advanced and ready for large-scale deployment although with limited installed references in operation.

Mineralization

Mineralization of CO_2 to produce sodium bicarbonate, calcium carbonate and magnesium carbonate is another promising route.

Production of sodium carbonate/ bicarbonate using CO_2 from another mineral source like calcium carbonate has been a proven process for more than a century but is quite energy intensive. An economically viable and emerging alternative is capturing CO_2 from existing plants, purifying and then reacting with sodium carbonate slurry. Sodium bicarbonate demand is continuously growing thanks to the food and pharmaceutical industries.

Other mineral feedstocks that can be used for reacting with CO_2 are concrete waste, cement plant bypass or other similar materials that are generally rich in calcium silicate and calcium oxide. This route produces aggregates that are very useful for building construction. Several mineralization technologies exist, some of which have installed industrial scale references and some at pilot or demonstration scale references.

Each technology is dependent on the type of feedstock in that some are more reactive to CO_2 and may not need additional ingredients while the less reactive ones may need more ingredients. Therefore, all technologies require a test phase with appropriate samples to evaluate the most reactive ones. The promising feedstocks are those that have stable quality and adequate quantity at an affordable cost.

As important as the technology and feedstock, so is the source location in proximity to the CCU facility and the end user's market. In a well negotiated contract, the mineral feedstock should be made available cost free to the CCU facility as the feedstock supplier would bear the disposal cost. In India, solid wastes rich in calcium silicate/oxide are available from concrete waste, cement and steel plants. So the mineralization route also can be quite promising for CO_2 utilization.

Overcoming Limitations

Although the CCS is technologically mature, it has certain inherent limitations for implementation, including the need for pipeline infrastructure, the collection of emissions from various locations, a geologically proven storage for 25 to 30 years, project and operations risk management and more.

Likewise, CCU also has drawbacks!

The availability of mineral feedstocks, hydrogen and the need for a concentrated CO_2 stream of at least 90 percent is readily available from most chemical, petrochemical and gas processing facilities that contain CO_2 from a non-combustion source. The flue gas stream from post combustion, typically from power plants and other combustion sources, contains a low 4 to 6 percent concentration of CO_2, which requires a high capital cost and an energy intensive process to separate the CO_2 and bring it to a level suitable for use. Hence as a first step for a demonstration scale facility, CO_2 from non-combustion sources can be captured for the methanol or mineralization process.

Although the CCS is technologically mature, it has certain inherent limitations for implementation, including the need for pipeline infrastructure, the collection of emissions from various locations, a geologically proven storage for 25 to 30 years, project and operations risk management and more.

Nevertheless, utilization of CO_2 to produce chemicals is technically and economically feasible and more importantly a viable route when storage options are limited or do not exist. This is particularly applicable for India with its vast resources and ample opportunities. Hydrogen and mineral feedstock sourcing strategy, plant location and a commercial supply framework are three main factors that will drive the project economics. A market survey to evaluate supply and demand and sound master planning are fundamental prerequisites for a successful CCU venture. The use of CO2 to produce methanol and carbonates eventually will be a beneficial model for a circular carbon economy . ■

Alleima inaugurates a new manufacturing facility in Mehsana Mill in Gujarat, India

Alleima, a global manufacturer and supplier of advanced stainless steels, special alloys, and heating systems, will inaugurate its new Hydraulic and Instrumentation tubing factory on March 15, 2023, at its Mehsana Mill in Gujarat, western India. The investment that Alleima made in 2021 has now concluded and is part of a larger growth initiative that Alleima started in 2017. The new factory will meet the increasing demand for locally manufactured products in India.

In 1983, Alleima established its first operation in Pune, India. Since then, the company's activities in the country have expanded. Today, India is one of Alleima's key geographical areas, and the Mehsana manufacturing facility has since grown in importance. Having been successively expanded and modernized, the factory has increased production and availability of high quality seamless stainless steel and high alloy tubes to strengthen service in the region. Now, the inauguration of the important investment will finally take place.

"As part of our strategy to invest capacity and capability in growth markets, the new Hydraulic and Instrumentation tubing manufacturing facility will enable us to serve our customers locally with premium products in India. The investment aims to capture growth opportunities in the Chemical and Petrochemical segment. There is also a change towards increased natural gas in the energy mix and a shift towards alternative clean fuels, which present further growth opportunities. The Mehsana Mill is an important facility in our journey towards strengthening our footprint in Asia" says Göran Björkman, President and CEO at Alleima.

The first phase of this growth initiative first started in 2017. It was completed in 2020 when Alleima added a new cold finishing tube manufacturing line mainly for heat exchanger tubing and other demanding industrial applications. This time, the investment has been divided into two parts, a new Hydraulic and Instrumentation tubing factory, and a Heat Exchanger (HX) cold finish Tube Capacity that will be fully completed and

operational in 2023.

"For the past few years, we have been focusing on boosting capacity, adding new products, and constantly improving our capabilities to meet the highest global quality standards and customer specifications. The new factory will expand the Hydraulic and Instrumentation Tube capacity to meet the growing market for infrastructure around natural gas. This move will also enable the transition towards cleaner alternative fuels and meet the increased demand from growth in the Chemical and Petrochemical segment in India," says Sharath Satish, President, Business Unit Tube APAC, Alleima, and continues.

"We look forward to ramping up our production to cater to the increasing demand for locally manufactured products in India while aligning with the Government of India's "Make in India" and "Atma Nirbhar Bharat" program for Self-Reliance. Through this investment, we also look forward to enabling further export and swifter delivery times to customers across the region." ■

Mist Evaporation System For Zero Liquid Discharge: An Environment Friendly Solution For Liquid Waste Disposal

Makarand A. Chitale, the Director (Technical) of Mist Ressonance Engineering, explains the essence of Mist Evaporation System technology, and how MREPL has executed a system to adopt Zero Liquid Discharge Policy to safeguard nature.

We all know that Industrialization is very much essential for our economy and growth of the society. However, it is also necessary to keep balance of nature & maintain a pollution-free environment. Hence, A few years ago, Government of India declared Zero Liquid Discharge Policy for process industries. This means that any process industry, which is using water as its auxiliary must consume or reuse the water in its process. Any form of liquid which can pollute our rivers/water source should not be discharged outside the premises.

This mandate forced the process industries to use the conventionally known Zero Liquid Discharge Technologies, which use large Multiple Effect Evaporators that consume high amount of steam/ coal. Their capital expenditure is also very high & at the same time their OPEX is also enormously high. So it was not possible for the small/medium sized industries to adopt this technology. Many industries still throw the dirty effluent water/ RO reject to open water sources/rivers thus polluting precious water or harm aqueous life.

Hence it was necessary to find a technology which will be affordable to all size of industries and environment friendly.

MREPL is glad to announce that they have developed Mist Evaporation System

(Natural evaporator) for Zero Liquid Discharge of RO Reject / Effluent, which use minimum utilities like steam/coal/ electricity. Effluent/RO reject is naturally evaporated by their unique patented technology of Mist creation with or without help of waste heat available in the plant. This helps the industry to adopt this system at minimal OPEX compared to conventional system & even its first investment is about 50% or less in comparison to MEE.

In the year 2016, MREPL received the prestigious "G. S. PARKHE INDUSTRIAL MERIT AWARD" given by MCCIA for Innovation in Entrepreneurship. The Award was received for our Technology of Mist Creation & its application in Zero Liquid Discharge of RO Reject / Effluent.

Since then the system has been successfully implemented at many process industries.

Technology of Mist Evaporation System

Mist Evaporation System is a high efficiency system, which works on our Mist Cooling Technology which induces water to intensive atomization i.e. water particles are subdivided to around 5 microns. The atomized particles shoot out of MIST-CREATOR NOZZLES at immense speed and rise to a height of 6 meters above the nozzles.

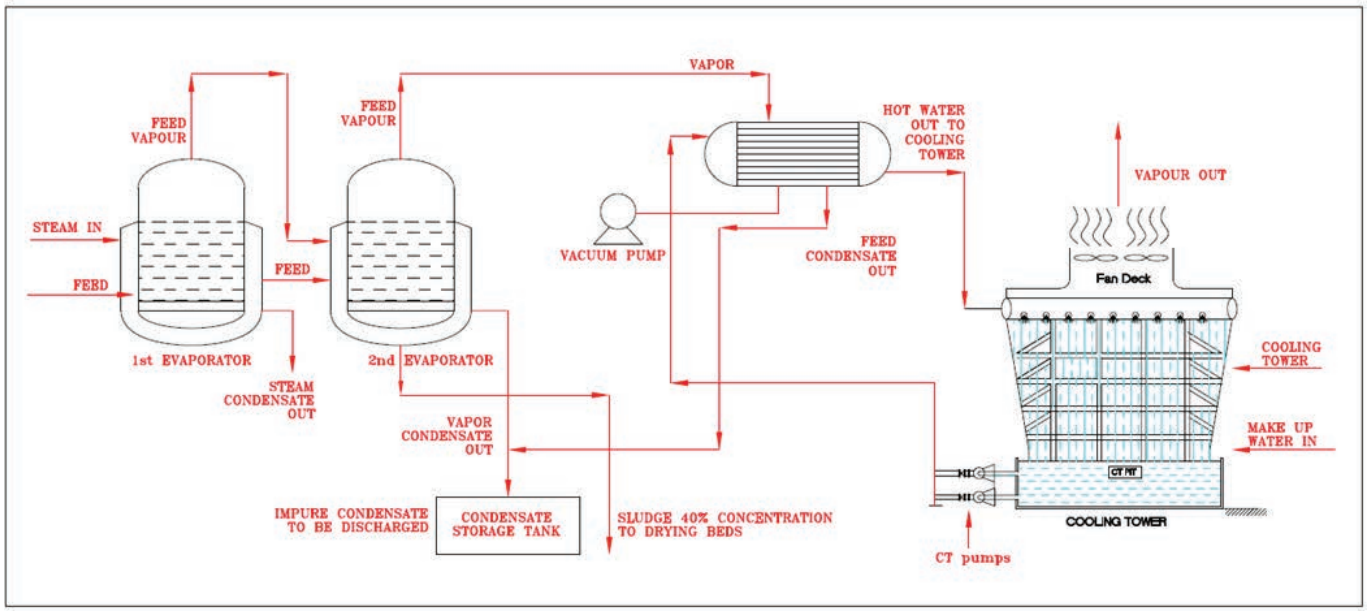
This ensures extensively large surface area for a longer interval and at high velocity providing a mist formation. Surface evaporation is very fast, faster than the time needed to reach equilibrium. This ensures faster evaporation of water and the effluent water starts concentrating.

It is very important to note here that, this evaporation is carried out inside a closed chamber in most cases & hence pure water vapor goes away from top through Mist Eliminators thus achieving Zero Liquid Discharge.

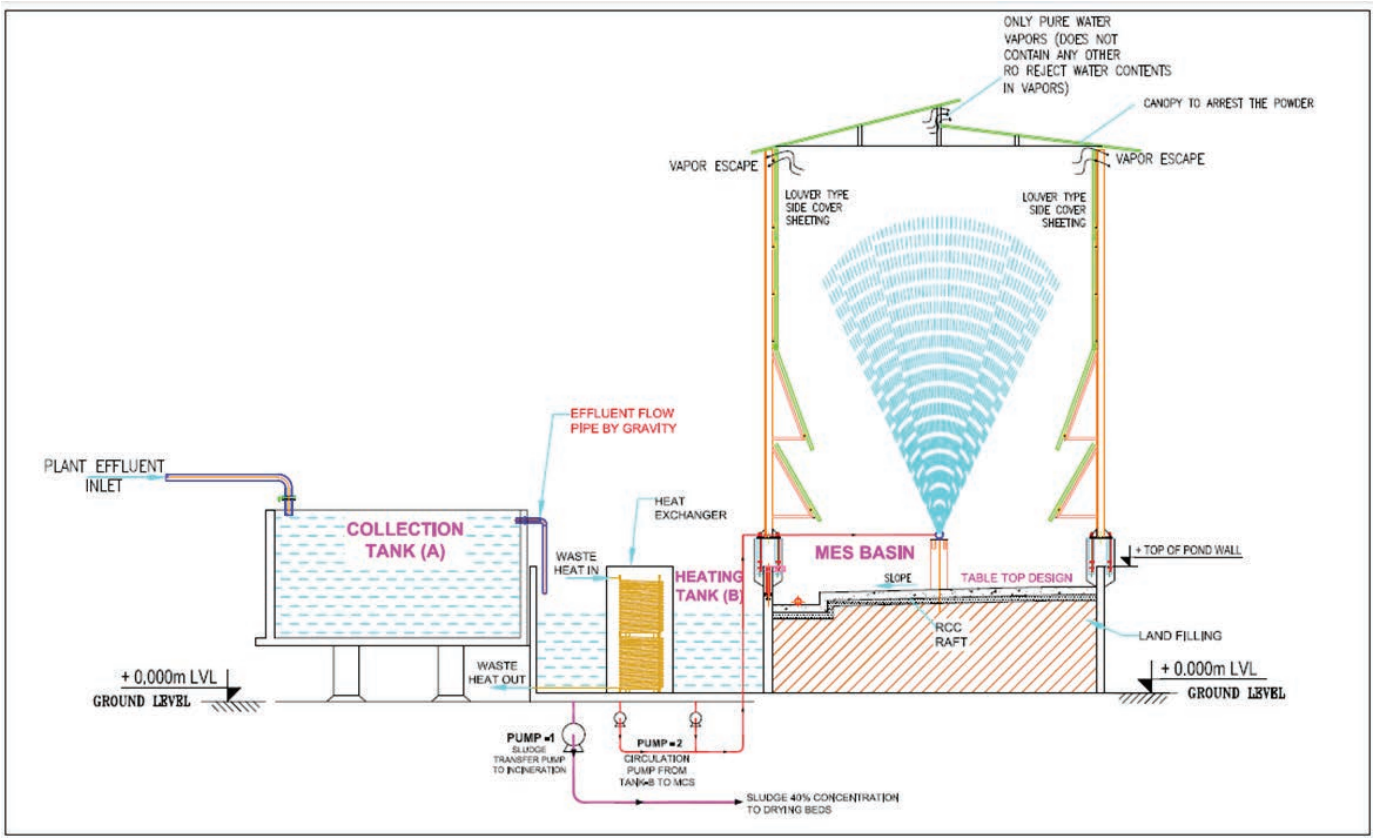
Mist creator nozzles operate with a choke-less design as mist formation is achieved when water comes out in whirling motion through its bore of size more than 16 mm in diameter. Hence, MES can easily handle RO/Effluent water of TDS up to 40% concentration without any choking.

Mist Evaporation Effect

As effluent water passes through Mist Evaporation System at very high velocity due to our patented nozzle design, it atomizes the water particles to fine mist to the size of 5 micron. As these fine mist particle come in contact of large air surface area, they tend to absorb heat available in ambient air and hence evaporate instantaneously to a large



Schematic Drawing For Conventional Multiple Effect Evaporator (Mee) System



Schematic Drawing For Mist Evaporation System For ZLD

Sr. No.	Description	Conventional MEE System	MES with natural evaporation – without using any heat source	MES with waste heat source viz. Hot air, hot water, flash steam, flue gas etc.	Mist Evaporation System with live steam as heat source throughout the year
1	Capacity (KLPD)	10	10	10	10
2	Salient features a) Water Consumption b) Waste Water Generation c) Civil Work d) Maintenance	a) Make up required for CT b) Impure 50˚C condensate generated is to be disposed. c) Heavy due to static and dynamic load d) Very high	a) No Make up required b) No excess /impure condensate generated. c) Simple due to table top construction with static load. d) Negligible	a) No Make up required b) No excess /impure condensate generated. c) Simple due to table top construction with static load. d) Less	a) No Make up required b) No excess /impure condensate generated. c) Simple due to table top construction with static load. d) Less
3	Operational Cost/KLPD	Rs. 1000/KLPD	Rs. 100/KLPD	Rs. 80/KLPD	Rs. 500/KLPD
4	Saving on OPEX	Nil	Rs. 900/KLPD	Rs. 920/KLPD	Rs. 500/KLPD
5	Initial Cost	High	Low	Low	Low
6	Plot size	3 m²/KLPD	10 m²/KLPD	6 m²/KLPD	6 m²/KLPD

Mes V/S Conventional Multiple Effect Evaporators With Various Options

extent. We have observed this natural evaporation is appx. 18% in a day (Annual Average). This is additional evaporation due to natural mist evaporation effect combined with solar evaporation. This natural evaporation reduces actual heat required in heating tank.

Mist Evaporation System For Zero Liquid Discharge

Mist Evaporation System combines our unique Mist Cooling Technology with ambient Heat/ Solar plate effect to achieve Zero Discharge of Effluent / RO Reject. This unique system also can use waste heat available at the plant to heat the effluent on one side & evaporation is achieved through Mist Evaporation Tower on second side to achieve Zero Liquid Discharge with minimum use of energy.

Salient Features Of MES Over Conventional Systems (MEE/MVCM)

- Minimal OPEX due to Natural Evaporation.
- Lower CAPEX.

- Entire operation happens inside a closed chamber only allowing pure water vapour to escape thus acting as a Natural evaporator.
- Negligible maintenance due to choke less design of nozzles.
- Vacuum and cooling system is not required.
- No make-up water required.
- MES achieves complete zero liquid discharge as the process does not produce impure condensate which is generated by conventional MEE which is to be disposed.
- Easy to operate.

Comparative Diagram Of Conventional Mee System & Mist Evaporation System For Zero Liquid Discharge

Types Of Mist Evaporation System (Mes)

Open Type MES

Where area is available, MREPL can guarantee complete Natural evaporation of effluent/RO reject by our high efficiency Mist Creation System installed in Open basin.

Totally Enclosed MES For Salt Concentration/ Zero Liquid Discharge

MES is closed from all sides up to 7 meter height by louvers and by canopy/mist eliminators at the top. Entire operation happens inside a closed chamber with top covered with Canopy/ Mist Evaporators. This allows only pure water vapour to escape from top & avoid carryover of any

mist particle or impurities and also arrest entry of rain water.

This Technology Will Now Help Any Size Of Industry To Adopt Zero Liquid Discharge Policy Easily And Preserve Nature. ■

Author

Makarand A. Chitale
Director
Mist Ressonance Engg Pvt Ltd

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Emission Abatement with Oxidation

As is the case with many industrial manufacturing operations, emissions are best destroyed through the use of oxidation technologies. How destruction occurs and to what level and efficiency is often determined by the process conditions. Very few industries use custom oxidizer solutions like the Chemical Processing Industry. This article covers some of the technologies and techniques being applied to the wide variety of chemical processing applications

Today, most manufacturers worldwide in the Chemical Processing Industry (CPI), are required to be compliant with regulations like the United States' National Emission Standard for Hazardous Air Pollutants (NESHAP) for chemical manufacturing. Similar regulations are being adapted worldwide as environmental initiatives gain popularity. The primary off-gas emissions from this industry include Volatile Organic Compounds (VOCs) as well as Hazardous Air Pollutants (HAPs). VOCs are defined as any organic chemical compound that contains the element carbon, excluding carbon monoxide (CO), carbon dioxide (CO2), carbonic acid, carbonates, metallic carbides, and methane. HAPs are a VOC with additional harmful properties. When left untreated, these emissions degrade in the presence of sunlight and contribute to low-lying ozone or smog. VOCs and HAPs are also known to cause respiratory ailments, heart conditions, birth defects, nervous system damage and cancer in humans.

Starting in the early 1970's, the idea of oxidation for emission abatement was developed due to the awareness of the harmful effects of VOCs and HAPs. New pollution control regulations were soon to follow. Proper oxidation converts hydrocarbons to CO2 and water (H20) vapor. There are three conditions that must

be met in order for oxidation to occur. They are often referred to as the three "T's", temperature, time, and turbulence. Based on the VOCs that need to be destroyed, there is an elevated temperature that must be reached before the compounds can be oxidized. The time relates to how long a compound needs to be at temperature in order for it to be oxidized. Lastly, turbulence is a fixed condition built into the equipment design that ensures a proper mixture of VOCs and oxygen for combustion. Specific compounds and desired destruction rate efficiency determine temperature and residence time.

Process emissions from batch and continuous chemical manufacturing applications can vary greatly in volume and composition. Some of the sources of VOCs and HAPs in the Chemical Processing Industry Include:

- Phenol Production
- Ethylene Oxide – Sterilization
- Formaldehyde Production
- Organic Chemical Manufacturing
- PA (Phthalic Anhydride) Production
- PTA (Pure Terephthalic Acid) Production
- PET (Polyethylene Terephthalate) Production
- Polypropylene Production (PP)
- Low Density Polyethylene (LDPE) Production
- Monoethylene Glycol (MEG) Production
- Synthetic Rubber Production (PBR/ SBR)
- Engineered Plastic Production (ABS)
- Specialty Chemicals

With so many applications and sources of off-gasses, there is a wide variety of abatement technologies being applied in the CPI. Depending on the process conditions, chemical processors have used technologies such as flares, vapor combustors, catalytic and thermal oxidizers. Catalytic and regenerative thermal oxidizers (RTO) have been the most widely applied emission abatement technologies.

Catalytic oxidation

A popular choice in the CPI and has been used extensively for many years. Employing catalyst into the oxidation process allows the compounds to break apart at lower temperatures and reduces the supplemental fuel requirements of the system. In operation, VOC and HAP laden process gas is either pushed or pulled into a metal heat exchanger inside of the oxidizer via a system fan. The contaminated airstream is progressively heated while traveling through the heat exchanger towards the combustion chamber. At the burner, the process gas is raised to the catalyst operating temperature. As the heated gas passes

through the catalyst, an exothermic (heat releasing) reaction takes place, and the pollutants are converted to carbon dioxide, water vapor and heat. There are two major categories of oxidation catalyst: Precious Metal (noble metal: platinum, palladium, rhodium, iridium) and Base Metal (manganese dioxide, copper oxide, chromium oxide). The different catalyst substrates include pellets (beads, spheres) and monolith (ceramic / stainless steel).

Once oxidized across the catalyst, the hot purified air passes through the opposite side of the heat exchanger and releases thermal energy to preheat the incoming air. The heat exchanger reduces the auxiliary fuel requirement, thus saving operating cost and allowing self-sustaining operation with no auxiliary fuel usage at lower explosive limits (LEL) of 8-12%. Finally, the cooler, purified air is exhausted to the atmosphere through the system stack. Typically, the reactor and internal heat exchanger are fully welded, leak – tested, and constructed of stainless steel with high-density insulation.

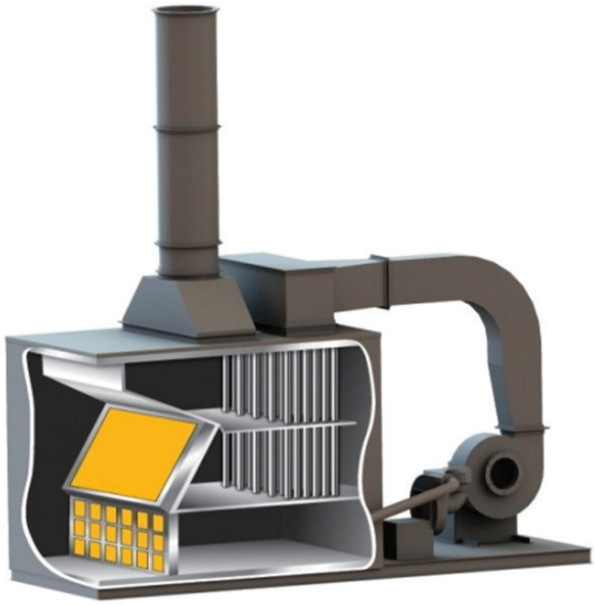

Figure1: Standard Catalytic Oxidizer

Theoretically, catalytic oxidizers have a long-life span, and they can operate for many years if routine maintenance is continued. However, on most catalytic oxidizers, catalyst deactivation can begin within 3-8 years. Deactivation occurs due to constant and sometimes specific chemical exposure. Mercury, lead, and cadmium are major contributors to deactivation. Other factors contributing to the decrease in catalytic activity are accumulation of inorganic scale, phosphorous (lube oils), dirt, and sintering that causes larger crystals to agglomerate from catalyst particles and catalyst substrate. Depending on the application, catalyst could be replaced more than once over the unit's lifespan. Catalyst testing and catalyst rejuvenation services are often required to prolong oxidizer efficiency and ensure minimal downtime.

The Regenerative Thermal Oxidizer (RTO)

A widely used and popular choice for emission abatement in the CPI. Its popularity derives from the oxidizer's ability to reuse up to 97% of its thermal energy, and its high destruction rate efficiency. A typical airflow range on an RTO is between 3,000 SCFM (4,731.3 Nm3/hr) – 70,000 SCFM (110,397 Nm3/hr) on

a single unit. On a multiple unit system, it can start at 70,000 SCFM all the way up to 500,000 SCFM (788,550 Nm3/hr).

Solvent laden process air is either pushed or pulled into the inlet manifold of the oxidizer via a system fan. Flow control or poppet valves then direct this gas into energy recovery chambers where it is preheated. The process gas and contaminants are progressively heated in the ceramic media beds as they move toward the combustion chamber. There are three different types of heat recovery media that can be found in an RTO design: random packing, extruded honeycomb monolith and multi-layered media. Depending on the application, a combination of these media types may be used to optimize efficiency or deal with particulate.

Once oxidized in the combustion chamber, the hot purified air releases thermal energy as it passes through the media bed in the outlet flow direction. The outlet bed is heated, and the gas is cooled so that the outlet gas temperature is only slightly higher than the process inlet temperature. Poppet valves alternate the airflow direction into the media beds to maximize energy recovery within the oxidizer. The high energy recovery within these oxidizers reduces the auxiliary fuel requirement and saves operating costs. The regenerative thermal oxidizer technology consistently achieves destruction efficiencies over 99%. Self-

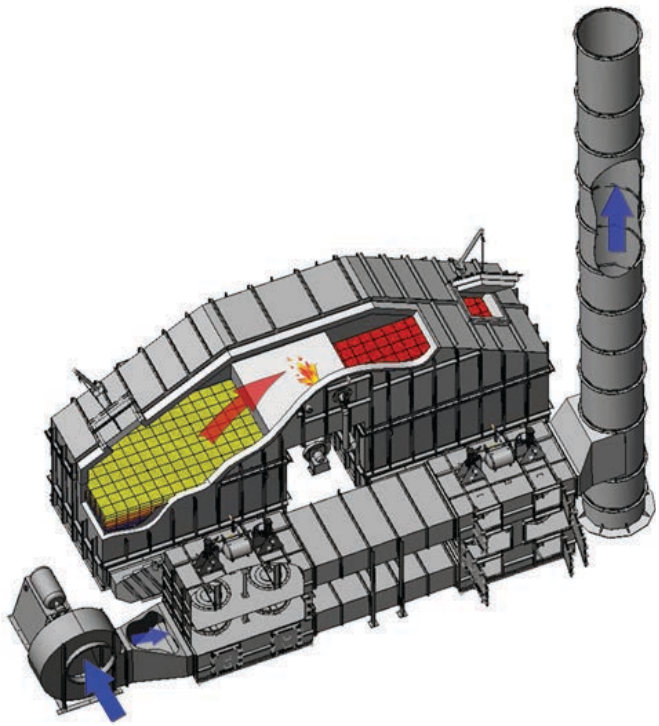

Figure 2: H ow air flows and heat is transferred within a Regenerative Thermal Oxidizer (RTO)

sustaining operation, with no auxiliary fuel usage, routinely occurs under low emission loading conditions (3% LEL or greater).

Over the past decade, RTOs have been increasingly applied in the CPI as technological advances have increased its' applicability. Newer designs handle a wider range of emission constituents, concentrations, and loadings. This allows the RTO, when it best fits the needs of the application, to be used on more chemical process exhausts than before. RTOs can now be used on CPI processes where the catalytic oxidizer or flare were once the only option. It differs from the catalytic, recuperative, and direct-fired

oxidizer technologies in that destruction is achieved with little to no auxiliary fuel required once the RTO is brought to temperature.

Advances in the RTO design include a Hot Gas Bypass (HGB), which allows the device to process highly concentrated streams while preventing potential damage to the heat recovery media. Another development to the RTO is Supplemental Fuel Injection (SFI). This redundant fuel delivery system lowers operating costs by reducing the use of burner combustion blowers. During system operation, the oxidizer system burners are disabled, and natural gas is injected at the RTO inlet as necessary to maintain chamber temperature. This provides a secondary benefit and ultralow NOx emissions with flameless operation.

Scalability is another aspect of the RTO that makes these systems popular with CPI processors. This allows companies the opportunity for future plant expansion and process line additions without needing to install a new oxidizer. In addition, RTOs generally need fewer replacement parts, and with an annual preventative maintenance plan, can have a lifespan well over 15 years.

Process emissions from batch and continuous chemical manufacturing applications can vary greatly in volume and composition. In addition, green business practices don't always coincide with energy reduction strategies, which is often the case with emission abatement products. Therefore, it is important to consult with a professional to ensure the correct abatement technology for your process conditions, budget constraints, energy demands and compliance objectives. Very few processes are identical, and not one specific technological choice can be applied to all applications. ■

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COMPANY INFORMATION

Anguil Environmental Systems Pvt Ltd located at Vadodara, Gujarat is an Indian Subsidiary of Anguil Environmental Systems, Inc USA. Incorporated in the year 2020, Anguil entered India market with an aim to provide its world class solutions to control air and water pollution. For more information on company, its technologies, products, and application markets, please visit www.anguil.com or write to us at info@anguil.com

Glass Filter Media with AOP Techniques for Removal of Microplastics from Domestic Wastewater

Nikunj B. Shah, Dr. Kiran D. Patil, Dr. Shilpa P. Kodolikar and Niraj S. Topare from Dr. Vishwanath Karad MIT World Peace University, in this case study talk about the vehement importance of dealing with microplastics, the danger they possess to the environment and effluent treatments of removing them.

The built-up of microplastics quantities found in the environment have stressed the urgency to identify, develop and deploy scenarios in which municipal wastewater treatment plants (MWWTPs) limit the release of urban microplastics into the environment. Microplastics have been found almost everywhere on earth, from Antarctic ice sheets to the stomachs of seabirds, to our own faces. Microplastics are particles smaller than 5 mm, consisting of tiny plastic granulates or fibers. Due to the chemical composition of plastics, these particles are resistant to degradation. Their small size makes them easily accessible to a vast range of organisms and transferable along the food chain.

This results in the accumulation of potentially hazardous effects on both organisms and humans alike, causing alternations in chromosomes leading to obesity, infertility, and cancer. Microplastics mainly originate from sources such as synthetic fibers, automobile tire wear, household dust, and the deterioration of plastic surfaces in the domestic wastewater. Due to the lack of certainty about microplastics and their derivatives functioning in effluents from the secondary treatment plant and

transport processes, an ongoing debate exists about the microplastic buildup in the discharged effluents.

Nonetheless, MWWTPs are found to be significant sources of microplastic leakage into the environment. Due to the sheer volume of continuous discharge into the aquatic environment, the final effluent acts as an exit route for microplastics. With increasing stress on the availability of fresh water and changes in statutory policy by various central and state governments, the subject of water treatment, utilization and reuse have gained significant importance. Due to the classification of water in various categories (e.g. freshwater, industrial effluent, domestic effluent, greywater), various parameters are ascertained, and they are fixed on the basis of the source of the water and physio-chemical water constituents. The values of the parameter as per the chemical and biological analysis report of the water are tested and the method of treatment is finalized in most of the studies. In the current stage of the treatment – all the domestic effluent treatment plants are designed till secondary treatment which ends with are biological process. There is no tertiary treatment in place in more than 99% of the treatment plants in India only do the treatment till the secondary stage. The effluent stream is mostly released in open water bodies like canals, rivers or any other area. The domestic standards for effluent treatment as per CPCB and NGT guidelines are the reference points for permitting the water discharge in the open water body.

Advanced Oxidation Processes (AOPs)

Over the last few decades, advanced oxidation processes (AOPs) have received a lot of attention in wastewater treatment research and development. It is known as oxidation technologies that use the hydroxyl radical (▪OH), examples include cavitation, photocatalytic oxidation, Fenton's chemistry, and ozonation. These processes have successfully been used to remove or degrade toxic pollutants or used to pretreated insoluble pollutants that can be treated by biological methods. It is widely accepted that an efficacious practices are largely depends on generating reactive free radicals, of which the most important one is the hydroxyl radical (▪OH).

Design and Development of System

The system consists of an inlet tank for raw water or influent storage. The system is designed with due consideration of the fact that the effluent of the secondary effluent plant is the influent for the system. This influent is fed to the disc filter unit using a feeding pump. The removal of suspended solids, impurities will be taking place in the disc filter. An online static

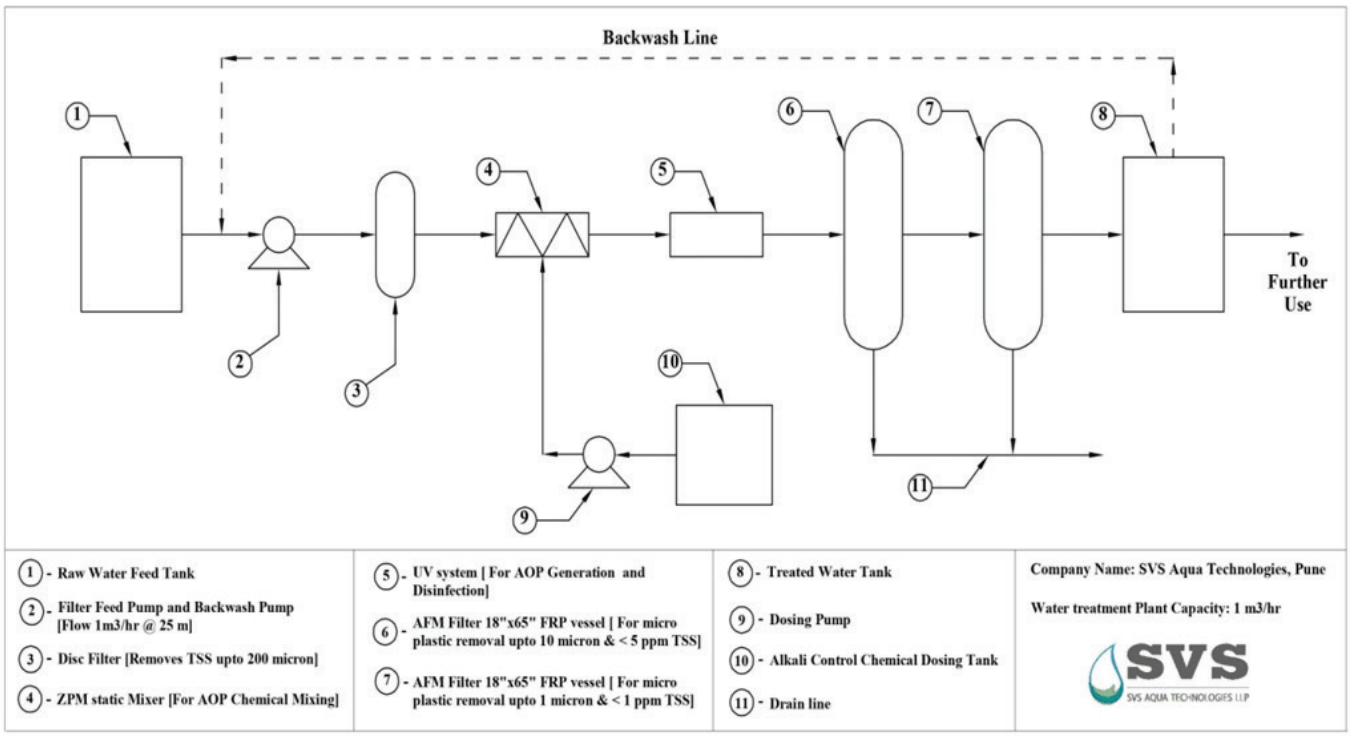

Figure 1: Process Flow Diagram for Water Treatment Filtration Plant (Capacity: 1m3/hr)

mixture is considered to break the homogenized suspension or a colloidal suspension and induce charge and increase ORP by grounding the static mixture helping in physical separation. It will also be used as an Injection point for the chemical, for generating hydroxyl radical. Hence chemical dose will be uniformly mixed inside the static mixer.

This is followed by a UV chamber with an intensity of 200 mj/cm2. This UV intensity is capable of generating the OH- radicals intended for the chemical destruction of the plastic byproducts as per the literature and previous work. The OH- radical COD will be destructed into biodegradable BOD and will come out in suspension from the dissolved form further removed by filtration. This will also aid up the microbial reduction of the colony-forming units which is another concern while microplastics removal. Subsequent to the UV chamber dual glass filter vessel setup is considered for the filtration of the UV-treated effluent stream. The selected vessels are 18-inch x 65- inch in size. The vessel filtration velocity is considered at 10 m3/m2/hr. The glass media selected is different in the two vessels. One vessel contains a hydrophilic medium, and in the second vessel it is a hydrophobic medium. Accordingly,

Figure 2: Glass media filtration and AOP technique based tertiary effluent plant for micro-plastics removal (Actual site image)

with the different types of impurities in water, both media on standalone or in series or in parallel will give the removal of microplastics based priority VOCs and SVOCs. Figure 1 shows the process flow diagram of the water treatment filtration plant (Capacity: 1m3/hr) and Figure 2 shows the images of the actual setup.

Highlights of the Work

The setup designed will have significant applications in testing the use of AOP accompanied glass media-based filtration for the removal of most emerging water pollutants; microplastics and their priority derivatives SVOCs and VOCs.

As most of the domestic effluent treatments do not consider the tertiary treatment of the wastewater, the proposed setup may provide a breakout technique and henceforth reduce the amount of microplastics and their derivatives disposed directly into the nearby water bodies.

The removal mechanism envisaged by filtration and oxidative destruction, as the incoming effluent is an outlet of biological process, so biodegradable BOD and COD both have been removed in the second step. The incoming water has a non-

biodegradable impurity. The studies are intended for the removal of microplastic, MP derivatives, and other priority substances like SVOC, etc. which come in water, due to plastic.

For a conventional sand media, the micro-organisms, attach to the surface of the sand media and secrets polysaccharide glue, forming mudball formation, resulting in channeling during filtration. Hence sand is not a recommended media for STP effluents. Also, the Hydroxyl radical will have a negative impact on the bicarbonate structure of the sand, hence not compatible.

The use of glass media for filtration represents a smart choice. Glass is the most inert and having maximum strength, glass being the most chemically inert, and very high abrasion resistance.

The green-colored glass chosen is carrying chromium ions. The chromium will impart natural zeta potential to glass and also in presence of higher oxygen - chromium acts as a catalyst to generate hydroxyl molecule and aiding in oxidative destruction.

By considering this technology and parameters, efficient technology and system can be designed and implemented for the removal of microplastics from the domestic effluent. ■

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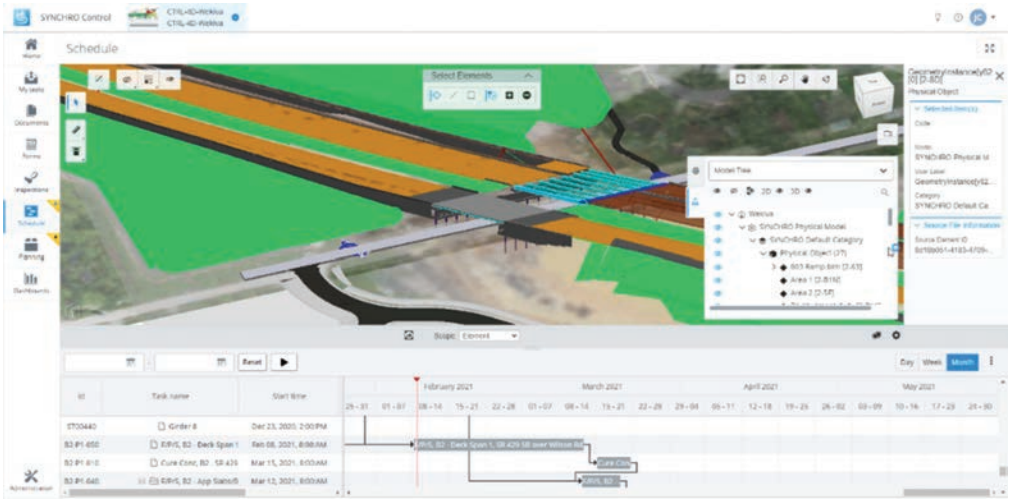
WSB and Bentley Systems Offer New Digital Construction Management Service Based on SYNCHRO



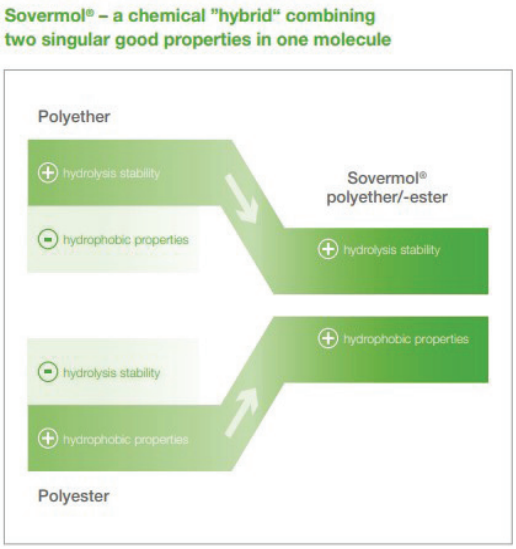
Bentley Systems, the infrastructure engineering software company, today announced a collaboration initiative with WSB to lead civil infrastructure owners and contractors to adopt and use infrastructure digital twins. WSB has launched a new digital construction management solution and advisory service, based on Bentley's SYNCHRO, to help the civil infrastructure market overcome challenges of adopting model-based digital workflows and leveraging the power of construction digital twins. WSB is the first firm to join the Bentley Digital Integrator Program for construction to provide programmatic go-to-market support and knowledge transfer to eligible engineering and project delivery firms and system integrators creating and curating digital twins for their clients' infrastructure assets.

Construction work is too often based on 2D drawings, spreadsheets, and document-based workflows resulting in errors, waste, and rework that cause most projects to be over budget and schedule. Bentley and WSB will lead firms in transforming construction by adopting technology and digital delivery.

"Owners and construction firms realize that new digital workflows are needed to meet infrastructure demands. Applying these digital workflows successfully requires a deep understanding of technology, processes, and data," said Carsten Gerke, senior vice president of strategic partnerships with Bentley Systems. "The Bentley Digital Integrator Program is built around combining technology with subject matter expertise for improved infrastructure. WSB joining the program provides a leapfrog opportunity for all our transportation users."

https://www.bentley.com/software/synchro/

BASF starts Sovermol® production in Mangalore, India



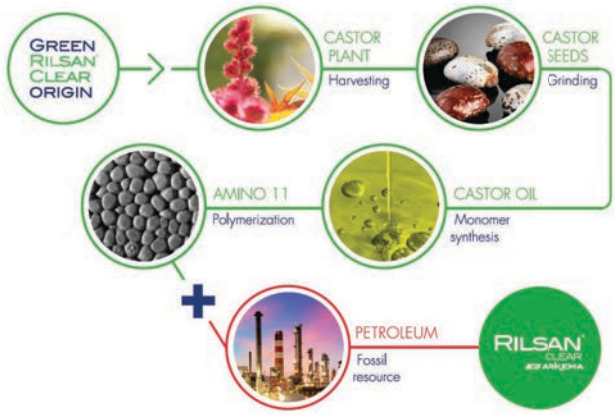
BASF has begun production of its first bio-based polyol, Sovermol®, in Mangalore, India. This product serves the fast-growing demand of eco-friendly products for applications in New Energy Vehicles (NEV), windmills, flooring and protective industrial coatings in Asia Pacific.

Utilizing the existing facilities at BASF's Mangalore site, the Sovermol production facility is now operational after comprehensive planning and construction.

Sourced from renewable materials, Sovermol contains zero volatile organic compounds (VOC). Sovermol products are used to produce sustainable coatings and adhesives for various industries, enabling customers to reduce their carbon footprint and to save resources.

https://www.basf.com/au/en/products/dispersion-resin/paint-coating-industry/sovermol.html

Arkema increases bio-based offer with a new range of mass balance acrylic materials



In a key milestone in the transition to a more renewable and lower carbon economy Arkema launches new range of bio-attributed acrylic monomers and specialty acrylic additives and resins, mass-balance certified under the International Sustainability and Carbon Certification-PLUS (ISCC+) framework. This launch would enable Arkema's customers in in achieving their climate plan goals by reducing their scope 3 greenhouse gas emissions.

These novel performance bio-based segregated solutions are: Rilsan and Pebax Rnew polyamide 11 advanced polymers, Sartomer Sarbio UV-curing resins, Synaqua alkyd emulsions, Crayvallac and Coapur rheology additives, amongst many others.

https://hpp.arkema.com/en/product-families/rilsan-polyamide-11-resins/rilsan-clear/

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