DST-AMRITA
TECHNOLOGY
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CENTRE

WASTE MANAGEMENT TECHNOLOGIES – THEME – EFFECTIVE RECYCLING OF SCRAP AND CCUS

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Waste Management Technologies – Theme – Effective Recycling of Scrap and CCUS

BACKGROUND

Foundries are one of the oldest industries surviving in the world today. As per IIF data, there are nearly 7,000 foundries across India. The Indian foundry industry is ranked second globally with a production of 10 million tonne per annum. It is catering to the automotive, tractor, power train, railways, energy and engineering sectors in domestic as well as overseas markets. Directly and indirectly, India's foundry industry provides employment to nearly 20 lakh people. Exports of Indian foundries is around $3.1 billion. Gujarat has the lion's share of 30% in total production of foundries across the country.

India's Opportunities and Challenges

China dominates foundry industry with 40% share and India follows with 18% market share. As per one of the news articles the US and European industries are pulling out of China, the opportunity for Indian foundry cluster is huge.

The foundry market in India is expected to grow by $12.23 billion during 2021-2025 progressing at a CAGR of over 10%, according to an article in Business Wire. About 85% are small units, 10% are medium sized and 5% are large, organized foundries in India. The Indian foundry industry employs about five hundred thousand people directly and about fifteen hundred thousand people indirectly. Most foundries, especially the small, organized foundries in India are labour intensive where operations and handling are manual.

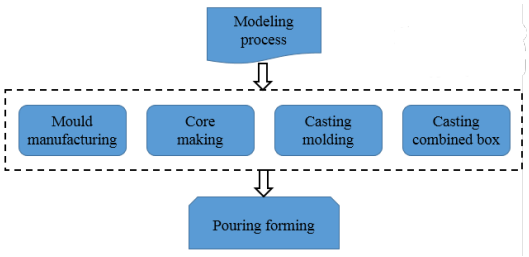
Foundries in India need to invest and increase production capacity. Most of the foundry players in India are small or medium, and only a few quality conscious castings manufacturers have taken efforts to invest and upgrade their technological facilities. China is the most important threat to India as far as castings are concerned, simply due to cheap labour. Indian foundries should be energy efficient and upgrade their work force. Also, with an increasing awareness about environmental issues, one major challenge in the foundry industry is stricter laws that prohibit pollution. The tightening of government regulations on the release of waste produced by foundries in the environment is leading to increased investment in waste recycling process and technologies. While this is a welcome step, it increases the overheads on the Indian foundries.

Requirement

- Solution for recycling and reusing the of the waste sand coming out of the foundries. As of now the sand cannot be reused as it would not give desired results
- Technology to remove the unwanted metal parts on the castings and effective disposal of the scarp metals coming out during the fettling process and segregating the same so that it is not mixed with the other scrap materials.
- Effective and affordable technology to capture, store and reuse carbon emitting out of industries and vehicle emissions, for greener and cleaner tomorrow

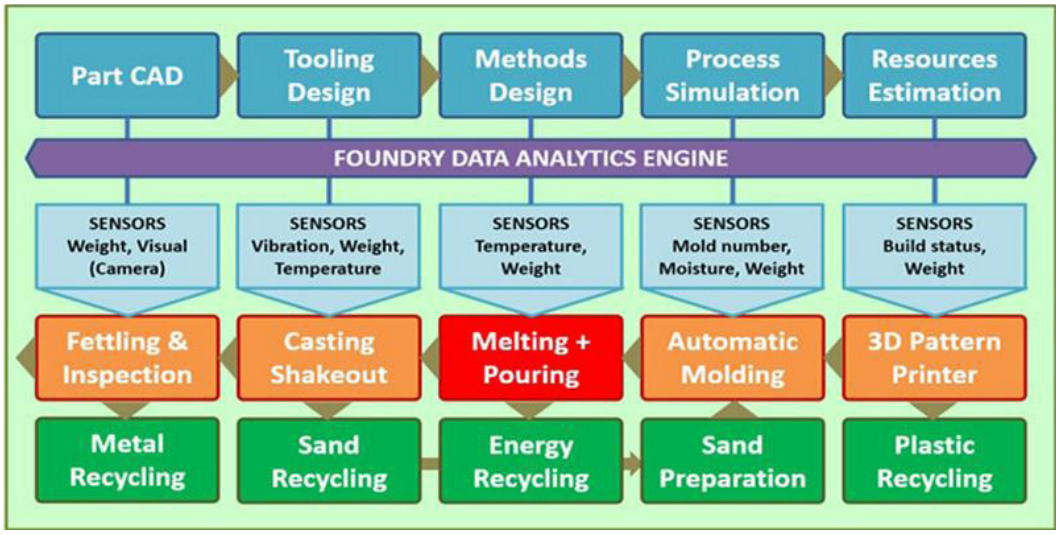
SMART FOUNDRY

Since the inception of the industry, some of the key infrastructural shifts in the early 1990s that led to the rapid growth of the foundry segment. The traditional model of a foundry is as shown in the block diagram below.



Traditional Foundry Model

SMART manufacturing or Industry 4.0 leverages information & communications technologies to democratize production and make it more sustainable. India, with its large base of SMEs, human resources and IT infrastructure can adopt this paradigm to meet challenges of employability, employment, and entrepreneurship. Relevant technologies like 3D CAD, process simulation, 3D printing, rapid tooling, and process data analytics can be readily applied to metal casting - the mother industry that feeds all other sectors.

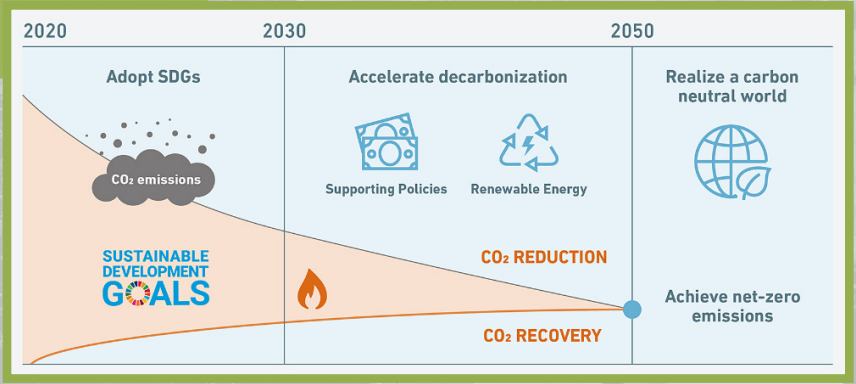


SMART Foundry Model (Source: smartfoundry2020.in)

Carbon Capture Utilization and Storage (CCUS)

There is lot of carbon emission from the industries and emission from vehicles. This is causing air pollution and quality of breathable air has worsened in the cities. While there is immediate need to reduce the carbon emission from the industries and vehicles, another way is to capture the emitted carbon, storing and reusing the same to produce carbon related products. As of now the technology to Capture and Storing, Reusing the carbon is very expensive. This has triggered the need for being more resource-efficient and sustainable manufacturing a priority than ever.

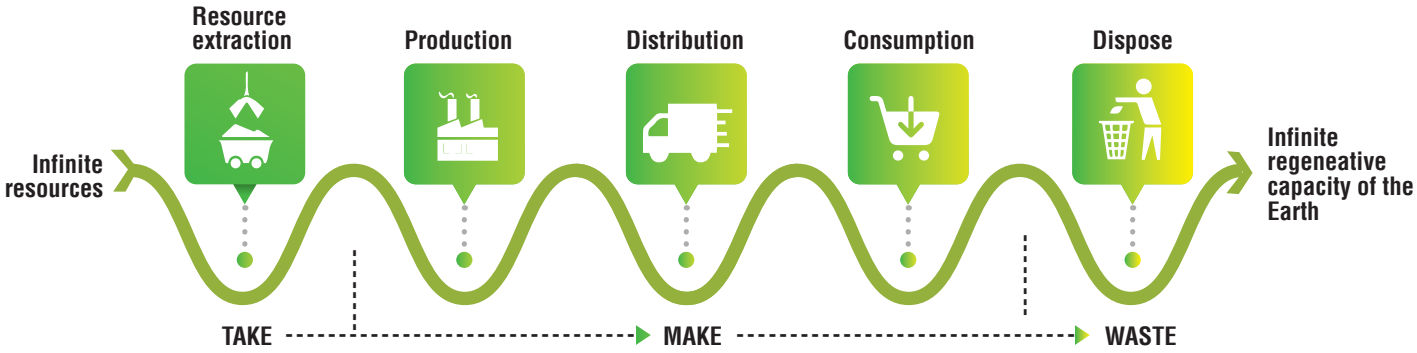
Both technological innovations and continuous optimization of existing process flows are essential to ensure resource-savings and future competitiveness, especially in small and medium-sized businesses. The sustainable development goals have set its clear mission to achieve net-zero emissions by 2050 and it has set a clear road map in achieving the same a indicated below.



Road Map to Achieve Net Zero Emission

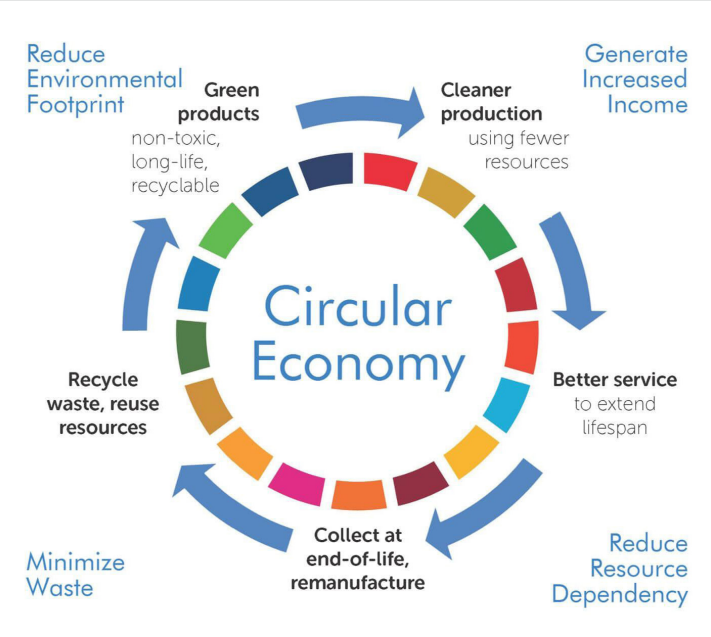
Understanding the importance of achieving net-zero emission, a new technological development is essential to considerably reduce manufacturing costs and at the same time contributes significantly to environmental protection by a substantial decrease of CO2 emissions is the need of the hour. With India

Circular Economy



In the linear economy, raw natural resources are taken, transformed into products and get disposed of. On the opposite, a circular economy model aims to close the gap between the production and the natural ecosystems' cycles – on which humans ultimately depend upon.

The World Economic Forum's Definition of Circular Economy "A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems, and business models."



One of the main ingredients required for foundry is the silica sand. Foundry Sand that can no longer be used in the foundry process is available for beneficial reuse. Foundries can install sand reclamation systems that screen the metal and debris out of the sand so that a good, clean product is available for reuse in a variety of applications and industries. Below are some of the areas in which foundry sand can be utilised

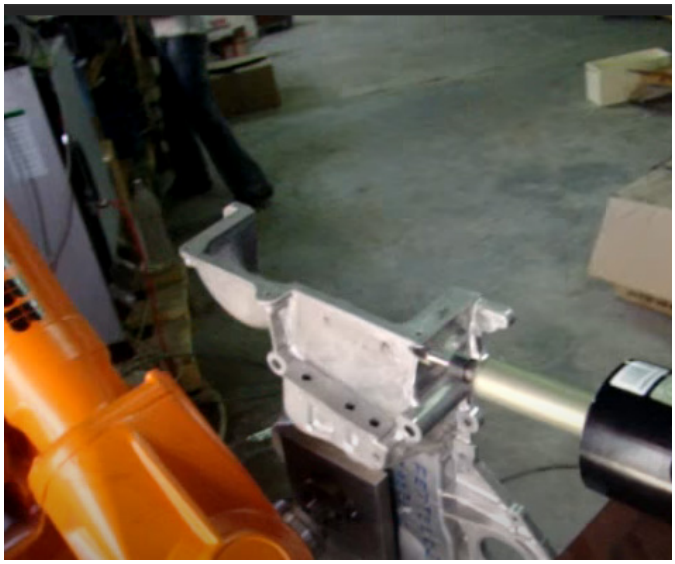
- Construction Fill / Road Subbase
- Flowable Fill
- Grouts and Mortars
- Potting and Specialty Soils
- Cement Manufacturing
- Precast Concrete Products
- Highway Barriers
- Pipe Bedding
- Asphalt
- Cemetery Vaults
- Brick and Pavers
- Landfill Daily Cove

Though newer technologies have come there still the problem of adapting to the changes and disposal or reusing of the industrial waste. Currently in India, the reclamation or reuse of the foundry sand is very low. After the use the sand is dumped laced with chemicals in the old wells or near to the water bodies or open lands. This is causing ground water poisoning and depletion of soil fertility. For E.g. Approximately there is about 3000 tons waste is being dumped in Coimbatore alone. Thus, prompting to find and adopt a solution for recycling and reusing the of the waste sand coming out of the foundries is the need of the hour.

The Micro, Small and Medium enterprise cannot indigenously install such sand recycling units due to various challenges such as high cost, economics of scale, difficulty to market the recycled sand. As 95% of the India's foundries are small and medium enterprise Thus, a consortium of the small and medium foundries can be formed will eliminate the challenges faced and gain increased profit by positioning and marketing the reclaimed sand in a relevant way. As of now very few and big industries may be using this technology and MSME are yet to catch up in India. For example, Tata Steels launched value added product of it LD Slag into Tata Aggreto and Tata Nirman for applications in road, fly ash brick and clinker making. However, this is not possible for a small and medium scale enterprises, the consortium or clusters formed by MSME can be the game changer.

Automation of Fettling

After the casting is completed, the fettling process is done to remove the unwanted metals from the casting which currently being dumped as the waste. The excess parts such as die's parting lines, runners, risers, sprue, chills etc are unavoidable in casting process, but needs to be cut and removed when final product is to be made ready. The process is currently manual and labor intensive, which is an occupational hazard for the people and time consuming. Even after this process, the unwanted materials will still be on the castings due to the human error.



Another problem which is imminent is these wastes are collected by the scrap dealers and dumped indiscriminately all over the place, after removing the metal parts from the waste. The same metal is being mixed with other scarp material and resold to the Foundries for processing and this is causing lot of wastage as the castings are developing during the process and large quantity of fine dust is produced as which causes health hazards. Currently most of the Indian MSME's are using manual fettling process. Hence, there is a huge scope for cost effective automation for the MSME foundries. An indigenously built automation process will help Indian foundries to achieve exponential growth and contribute to the economy

Can Technology address these outcomes?

- Recovery of the material up to 95% - 98%.
- Recycling of the waste material up to 90%.
- Reusing of the waste sand in the foundries there by reducing the excavation of sand from the seashores.
- Silica sand is a natural resource and with the reuse of the sand in the Foundries, can it be conserved.
- Reduction in fuel consumption since the sand is transported from far off places to the industries.
- Improvement of health of the people as the ground water contamination can be reduced or stopped.
- Safe & clean working environment for the workmen – which is dust and pollution free.
- Reduction /elimination of the occupation hazards.

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