IMPROVING THE ENVIRONMENTAL PERFORMANCE OF THE FOUNDRY SECTOR IN KOLHAPUR , MAHARASHTRA

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1. Introduction

Background

To address the issue of severe air pollution that plagues many parts of the country, the Government of India announced the National Clean Air Programme (NCAP) in 2019. NCAP's goal is to reduce the concentration of $PM_{2.5}$ and PM_{10} in non-attainment cities—i.e. cities whose air did not meet the national ambient air quality standards of 2011–15—by 20–30 per cent.[1]

Based on air quality data collected in 2011–15, the Central Pollution Control Board (CPCB) recognized 122 cities under NCAP as these cities did not meet the national ambient air quality standards. Later, ten other cities with population of more than 1 million people were also included in the list. Thus, 132 cities are now identified by NCAP as non-attainment cities. These cities were instructed, in conjunction with their individual State Pollution Control Boards (SPCBs) and the CPCB, to make Clean Air Action Plans.[2]

The state of Maharashtra has the highest number of non-attainment cities (18). Kolhapur is one of the state's non-attainment cities. As per TERI's 2016 Environmental Status Report (ESR) for Kolhapur city, the increasing concentrations of NO_x and PM_{10} levels are cause for concern. This report highlights that apart from vehicular pollution, other sources of air pollution in the city are industries (foundries, sugar industries), stone crushing and quarrying activities, burning of waste and various construction activities.[3]

As per the Kolhapur city Air Pollution Control Action Plan prepared by the CPCB, most of the emissions come from industries (32 per cent), followed by road dust (22 per cent), construction (13 per cent), vehicle (12 per cent), stone crushers (11 per cent) and cooking fuels (10 per cent).[4] It can thus be inferred that industries are the major contributors to PM emissions and foundries are the major air polluting industries in the city falling under the red and orange categories.

Kolhapur is traditionally an agro-based economy. With industrialization in the region, however, demand for oil engines and agricultural implements grew over the years, leading to the emergence of the foundry industry around the 1960s. Today Kolhapur is a leading foundry cluster, renowned for manufacturing quality castings (especially automobile castings).

Escalating population growth, rapid industrialization and uneven urbanization has increased air pollution in the city and put the city in the spotlight. While doing the ground survey in different Maharashtra Industrial Development Corporations (MIDCs) of Kolhapur, CSE's team captured various sources of air pollution such as emissions from industries, burning of industrial waste, dry leaves, and fugitive emissions from the movement of heavy vehicles (see *Photograph 1: Sources of air pollution in Kolhapur*).

Photograph 1: Sources of air pollution in Kolhapur

1a. Industrial emissions

1b. Burning of waste

1c. Burning dry leaves

1d. Fugitive emissions due to poor road conditions

1e. Industries burning outside their premises


1f.Dumping of waste in open areas

Source: CSE

Prominent features of Kolhapur Industrial Area

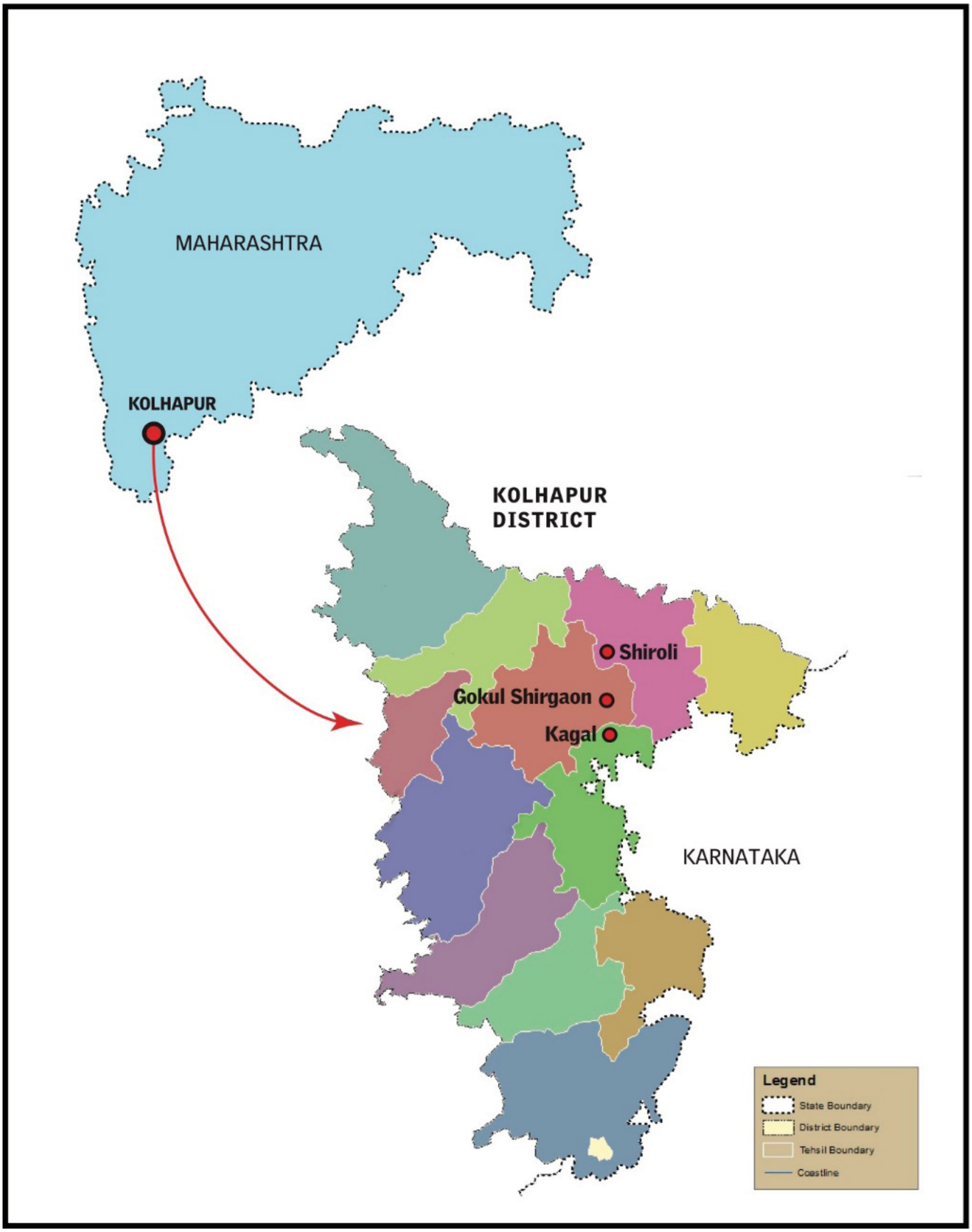
Kolhapur city lies in southwest Maharashtra and shares its eastern and southern border with the state of Karnataka. It is one of the fastest-growing cities in Maharashtra and a centre for many energy-intensive industries spanning various sectors. Automotive, foundries, engineering spares, sugar industries and textile mills are the major industries in the city.

There are nine industrial estates in Kolhapur, of which three—Gokul Shirgaon MIDC, Shiroli MIDC and Kagal 5-Star MIDC—are MIDCs and six—including Ichalkaranji Industrial Estate, Jaisingpur Industrial Area, Laxmi Industrial Area, Hatkanagale Industrial Area, Kolhapur City, and Sangli (Miraj and Palus) are corporate industrial estates. Several large-scale Indian companies such as Kirloskar Oil Engines, Vardhman Textiles, Raymond Textiles, Menon Group and Maurya Group have established presence in the city.

According to the Census of World Casting Production, the total production of casting in the world in 2019 was around 110 million tonne while in India production was around 11.49 million tonne (accounting 10 per cent of the total world's production).

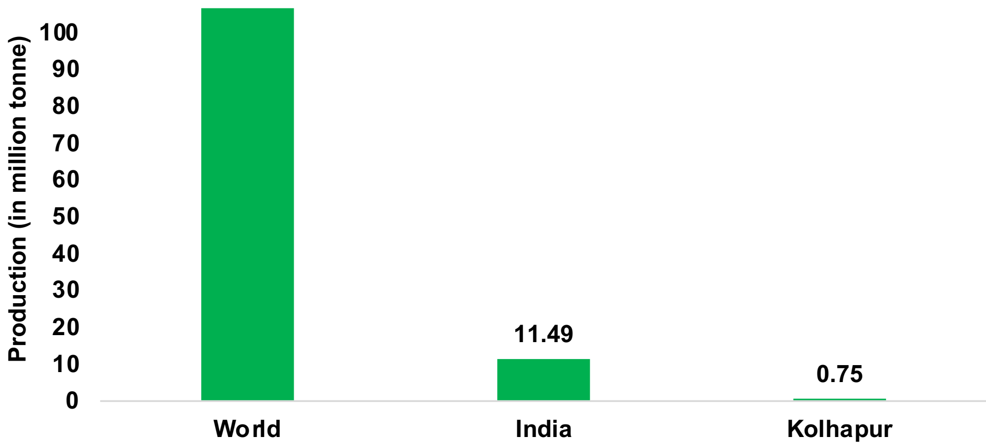
The total production of the Kolhapur foundry industry is estimated to be 0.75 million tonne per annum, as per the data shared by the Kolhapur Foundry Association. This accounts for about 7 per cent of India's total casting production.

Map 1: Major MIDCs with foundries in Kolhapur



Source: CSE

Graph 1: Casting production (in million tonne)



Source: Census of World Casting Production and Kolhapur Foundry Association

According to CSE's analysis of data provided by the Kolhapur regional office, there are approximately 272 foundries—73 in Gokul Shirgaon MIDC, 123 in Shiroli MIDC and around 76 in Kagal 5 Star MIDC—in three MIDCs of Kolhapur. These industries fall under the red and orange categories.

Table 1: Number and categories of foundries in Kolhapur

MIDC	Category	Large Scale	Medium Scale	Small Scale	Total by Category
Shiroli	Red	4	7	103	114
	Orange	2	1	6	9
	Total	***6***	***8***	***109***	***123***
Gokul Shirgaon	Red	3	0	58	61
	Orange	2	0	10	12
	Total	***5***	***0***	***68***	***73***
Kagal	Red	15	1	37	53
	Orange	9	3	11	23
	Total	***24***	***4***	***48***	***76***
Grand Total		35	12	225	272

Source: Data collected from Maharashtra Pollution Control Board

In the small-scale category 88 per cent of the foundries falls under the red category (see *Table 1: Number and categories of foundries in Kolhapur*). Red category industries are highly polluting and have a pollution index of more than 60.

The Kolhapur foundry cluster is well-known in India for automobile castings. There are around 272 foundries in the city, most of which are small scale and falls under the red category. The cluster contributes to 7 per cent of India's casting production and simultaneously has a significant contribution in air pollution. The sector has fugitive emissions from raw material handling, casting, knocking-out shakeouts, fettling operations, and point-source emissions from stack. The sector grapples with the issue of non-working of air pollution control devices, poor utilization of slag and sand, usage of polluting fuels, and poor housekeeping practices.

To understand the environmental performance of the sector, CSE decided to conduct a detailed study on foundries. This report attempts to highlight the air pollution issues of the foundry sector that arise from fuel usage along with the technology and process in use in the units. The report highlights the good operating practices in the Kolhapur foundry cluster and makes recommendations to curb air pollution, reduce GHG emissions and bring down the carbon footprint of the sector.

2. Findings of the survey

The CSE team visited around 50 foundries in three different Municipal Industrial Development Corporations (MIDCs) of Kolhapur. Around 24 foundry units were visited in Shiroli MIDC, 22 in Gokul Shirgaon MIDC and four in Kagal 5 Star MIDC. This chapter highlights the findings of the field survey and discusses the indicators used to assess the environmental performance of the foundry sector in Kolhapur city.

The survey was broadly intended to understand the type of furnaces used, type of air pollution control devices (APCDs) installed, frequency of maintenance of APCDs, housekeeping in the foundries and other such relevant indicators. The various parameters considered to assess the environmental performance of the foundry are discussed in detail in the following:

Indicators for highlighting environmental performance of a foundry

Furnaces used in foundries

In the process of casting metal, different types of furnaces are used to melt metal into liquid form to cast into moulds. These furnaces use a specific technology and fuel to run and generate greenhouse gases after the combustion of fuel. In short, furnaces are the heart of foundries.

Cupola furnaces

Cupola furnaces are conventional furnaces used in foundries to melt metal. Usually used by small-scale industries, they consume coke as a fuel. The size of the cupola is expressed in diameters and is in the range of 0.5–4 metre. The furnace is easy to operate, requires little maintenance, and it is cheaper than other furnaces. In the furnace, upon the combustion of coke, metal is melted and carbon dioxide, heat and slag are generated. In the case of conventional cupolas, the specific energy consumption value is high.

During the survey, the CSE team found that the percentage of cupola furnaces in Kolhapur was less than induction furnaces.

Cupola furnaces are of the following types:

Single-blast cupola furnace: In this furnace, air is supplied through the blower and passes through a blast pipe. This type of conventional furnace is used most by small- and medium-scale industries.

In the process of melting, heat is released during the combustion of coke. Carbon dioxide (CO_2) and carbon monoxide (CO) are also released in the process through the following reactions:

$C + O_2 = CO_2$ exothermic (heat generated) 1

$CO_2 + C = 2CO$ endothermic (heat absorbed) 2

In the case of a single-blast cupola furnace, the generation of carbon monoxide is not suppressed and both coke consumption and pollution are higher than in divided-blast cupolas.

Photograph 2: Single-blast cupola furnace

Source: CSE

Divided-blast cupola furnace: Also known as twin-blast cupola furnace because the furnace has two air tuyeres. Simply, air entering the furnace is divided into two parts between the top and bottom rows of tuyeres. The spacing between the two tuyeres is around 1 metre, which considerably reduces the formation of carbon monoxide.[5]

The combustion of coke takes place in the absence of oxygen at the level of the lower tuyere (located near the combustion area). Due to a deficiency of oxygen, a substantial quantity of carbon monoxide (CO) is formed. As the hot gases rise, CO is formed due to the carbon loss reaction, i.e. $CO_2 + C = 2CO$. Therefore, the main motive of introducing the second pipe is to burn this CO to CO_2 so that calorific value of carbon can be balanced.

After the introduction of the second pipe, the amount of CO generated at the top becomes zero. To check the efficiency of the divided-blast cupola (DBC) furnace, the levels of carbon monoxide can be measured at the top of the furnace. The lesser the value of CO, the more efficient is the DBC furnace.

The two rows of pipes—through which air is distributed equally—are 900 mm–1 m apart. The pressure and volume of each pipe's air supply can be separately controlled by butterfly valves mounted at the blast pipes and can be measured by installing manometers and volume flow meters separately. The stack height of a DBC furnace is around 16 feet while the stack height of a conventional single-blast type cupola furnace is around 5–8 feet.

DBC furnaces have several advantages over single-blast cupola furnaces, including:
a. Coke consumption is reduced by 18–20 per cent; and
b. Pollution load is reduced by approximately 30 per cent.

Photograph 3: Divided-blast cupola furnace

3a. DBC with wet scrubber

3b. Divided blast cupola furnace

Source: CSE

Induction furnaces: Induction-based furnaces use electromagnetic induction technology. AC current is supplied to a primary coil that establishes a magnetic field around the coil. The variable magnetic flux created in turn induces an electromotive force that melts the metal.

An inductor, i.e. cooling coil, transfers the energy into the molten material. The water-cooled inductor is located outside an electrically non-conductive crucible. The melted scrap charge, which generates metallurgical smoke due to oxidation, has solid particles as well as gaseous pollutants. The steel melting scrap charge may have dust and rust which on heating disintegrates from metal.

In addition, some refractory lining may also contribute to the solid pollutants. Thus, solid pollutants will consist of suspended particulate matter of iron oxide, alumina, silica, magnesia, calcium oxide and alkali oxides.[6]

The gaseous pollutants consist of CO, CO_2 and a small proportion of SO_2. In case scrap consists of galvanized parts, a small percentage of volatilized zinc can be found in gases. In an ideal case, to melt 1 tonne of iron at 1,500°C, around 396 kWh of electrical energy is required. But in an induction furnace, due to numerous losses, the specific energy consumption increases to above 500 kWh.[7]

Photograph 4: Induction furnace with a hood installed in foundry

Source: CSE

The CSE study found that in Gokul Shirgaon MIDC, 9 per cent of the surveyed units had conventional cupola furnaces, 27 per cent had divided blast cupola furnace and remaining 64 per cent surveyed units have induction furnaces.

In the case of Shiroli MIDC, it was found that 8 per cent of the surveyed units had single-blast cupolas, 21 per cent had divided-blast cupolas and the remaining 71 per cent had induction furnaces.

Kagal 5 Star MIDC is the new industrial area where new companies have established their foundries and are using induction furnaces for their operation.

It can be inferred from the survey that most of the units have induction furnaces. In the case of cupolas, most of the units have shifted to divided-blast cupola; very few industries use single-blast cupola furnaces for melting metal.

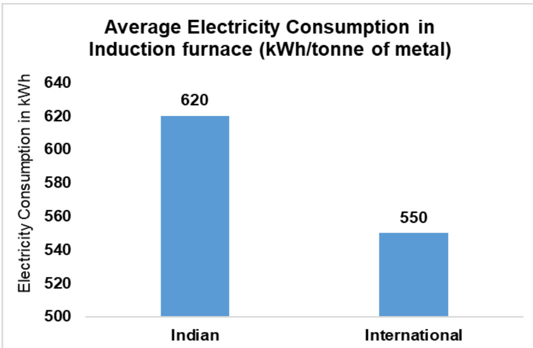
Energy consumption in foundries

It is of paramount importance to understand energy utilization and consumption patterns in foundries. Understanding the energy consumption pattern will help identify areas where energy is wasted and where there is scope for improvement. Most energy consumption (around 85–90 per cent) takes places in the melting process, followed by sand preparation and mould preparation. Energy consumption is not a matter of concern just for Indian foundries but has also been seen as a challenge at the global level.

Average energy usage in national and international foundries

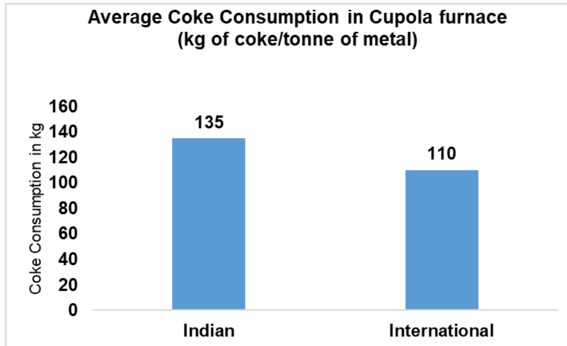
- **Cupola furnace:** The average coke consumption in a cupola furnace is 110 kg of coke/tonne of metal for international foundries, while it is around 135 kg of coke/tonne of metal in Indian foundries.
- **Induction furnace:** The average electricity consumption in an induction furnace is 550 kilowatt hour (kWh)/tonne of metal for international foundries while it is around 620 kWh/tonne of metal in Indian foundries.

Graph 2: Average electricity consumption in induction furnace



Source: Tata e-fee article[8]

Graph 3: Average coke consumption in cupola furnace



According to the CSE study, 50 per cent of the surveyed cupola units in Gokul Shirgaon MIDC had an average coke consumption up to 100 kg per tonne of metal melt, which is better than the Indian as well as international average coke consumption and 14 per cent of the surveyed induction furnace units had specific energy consumption of up to 600 kWh per tonne of metal melt.

In the case of Shiroli MIDC, 29 per cent of the surveyed cupola units had an average coke consumption of up to 100 kg per tonne of metal melt—which is better than the Indian as well as the international average coke consumption—and 47 per cent of the surveyed induction furnace units have specific energy consumption of up to 600 kWh per tonne of metal melt.

In Kagal 5 Star MIDC, none of the surveyed induction furnace units achieved a specific energy consumption of up to 600 kWh per tonne of metal melt.

Sand reutilization

Sand is used in foundries in huge quantities to produce castings. Sand casting is widely used because it can withstand high temperatures and is not very expensive. In many foundries, burnt sand is seen to be discarded as a waste product, causing environmental problems such as air and groundwater pollution because of its improper disposal.

The sand required for operation in industries should be angular. This type of sand is found on riverbanks, floodplains, riverbeds, lakes and seashores. The demand for sand is so high across the country that we are overexploiting it. There are recurrent cases in the National Green Tribunal (NGT) about illegal sand mining that clearly highlight the seriousness of the problem. The need of the hour is to understand that sand is a crucial natural resource and should be used sustainably. Huge savings can be achieved by reusing sand as it will reduce the need for new sand, reduce dumping costs and reduce the cost of labour required for dumping.

Kolhapur Industrial Area has two sand reclamation units installed at Gokul Shirgaon and Shiroli, where some industries send their sand for recycling and later buy it from the reclamation plants and reuse it in the process. Information about these sand reclamation units has been detailed in Chapter 3 of this report.

The CSE survey found that there are also private players in the market for recycling sand and reusing it in foundries. Despite this, huge mountains of burnt sand can be seen in Shiroli and Gokul Shirgaon MIDCs, clearly highlighting that many industries are still not connected to sand reclamation plants and are dumping sand as waste in open spaces.

Photograph 5: Burnt sand from foundries dumped in open grounds

5a. Burnt sand dumped in open spaces

5b. Burnt sand is dumped and choking drains

Source: CSE

The CSE survey found that in Gokul Shirgaon MIDC, 27 per cent surveyed units were discarding burnt sand—not reusing it—and dumping it in open grounds. The remaining 73 per cent of surveyed units were reusing it within the industry.

In Shiroli MIDC, it was found that 33 per cent of the surveyed units were not reusing sand but dumping it in open grounds. The remaining 73 per cent of surveyed units were reusing it within the industry. In Kagal 5 Star MIDC, all the surveyed units were recycling sand and reusing it in the process.

Despite two sand reclamation units installed in the city, during the survey it was observed that the burnt foundry sand was discarded on open grounds at many places around the MIDCs (see *Photograph 5)*, indirectly affecting the quality of ambient air, water and soil in the city.

Slag utilization

In the melting process, metal scraps and fluxes (limestone and dolomite) are injected into a furnace along with coke and electricity, depending upon the type of furnace. Upon heating coke or using electricity, scraps are melted and the metal is separated from the composite flux under gravity, leaving slag.

The generation of slag is inevitable during melting in a furnace. Slag generated from furnaces is non-metallic in nature and is a by-product of the foundry industry. It contains silicates, alumina silicates and calcium alumina silicates.

The generation of slag depends upon the type of furnace, type of metal melted and slag cooling method. Slag generated in a cupola furnace is approximately 5–6 per cent of total production, while it is 1–3 per cent in the case of induction furnace. The ultimate utilization of slag in Kolhapur is very poor and it is usually dumped outside the industrial premises.

The CSE study found that in Gokul Shirgaon MIDC, 45 per cent of surveyed units were dumping burnt slag for landfilling, 50 per cent were giving it to local vendors, and only 5 per cent were sending it to cement plants.

In Shiroli MIDC, 50 per cent of the surveyed units were found to be dumping burnt slag for landfilling, and the remaining 50 per cent of units were giving it to local vendors. During the survey, none of the industries said that they are sending slag to cement industries.

In Kagal 5 Star MIDC, 25 per cent of surveyed units were dumping burnt slag for landfilling, and the remaining 75 per cent were giving it to local vendors.

The most valuable usage of slag is in the production of cement and concrete. Slag gets rapidly quenched by submersion in water to yield a fine granulated product, thus reducing the amount of grinding required to make the slag useful in the cement industry.

Photograph 6: Slag disposal from foundries

6a. Slag generated from an induction furnace

6b. Slag dumped outside a factory

6c. Slag dumped inside a factory

6d. Slag dumped behind a factory

Source: CSE

Mechanisms to arrest fugitive emissions

Fugitive emissions from foundries also contribute to air pollution. They are not released through stacks; they are emitted from non-point sources during various processes within foundries. In foundries, fugitive emissions occur in sand preparation, casting, mould preparation, core-making section, metal transfer, knock-out, fettling and material handling. Fugitive emissions must be controlled where they are discharged from any activity.

In Gokul Shirgaon, 86 per cent of the surveyed units did not have any mechanism to arrest fugitive emissions in the foundries. Only 14 per cent of the foundries have mechanism to arrest fugitive emissions.

In Shiroli, 46 per cent of the surveyed units did not have any mechanism to arrest fugitive emissions. The remaining 54 per cent of surveyed units had mechanisms to arrest fugitive emissions.

In Kagal 5 Star MIDC, 25 per cent of the surveyed units did not have any mechanism to arrest fugitive emissions while the remaining 75 per cent did. Most of the units have installed a dust collector system at the sand plant to arrest fugitive emissions in foundry units.

Photograph 7: Fugitive emissions in foundries

7a. Fugitive emissions at shotblasting

7b. Fugitive emissions at an induction furnace

7c. Fugitive emissions at unloading

7d. Fugitive emissions at shakeout

Source: CSE

Air pollution control device installed

Gaseous pollutants from foundries can harm human health and the environment. To control emissions and pollutants, air pollution control devices (APCDs) are essential.

Air pollution control devices are used to prevent various types of air pollutants from entering the environment mainly from industrial stacks. These devices can be classified into the following two general categories:

i. devices that control the amount of particulate matter escaping into the environment, and
ii. devices that control the acidic gas emissions released into the atmosphere.

Generated pollutants are carried by exhaust gases produced during the combustion of fuel. These exhaust gases are then normally passed through APCDs before being released into the atmosphere. The pollutants are removed, destroyed or transformed in the control devices before the discharge of exhaust gas into the atmospheric air.

According to the CSE study, in Gokul Shirgaon MIDC, 73 per cent of the surveyed units had not installed any APCD and 9 per cent had wet scrubbers but without adequate treatment. Only 18 per cent had installed APCDs properly.

In the case of Shiroli MIDC, 71 per cent of the surveyed units had not installed any APCD while 8 per cent had wet scrubbers but without adequate treatment. Only 8 per cent had installed APCDs properly.

In Kagal 5 Star MIDC, 50 per cent of the surveyed units had not installed any APCD while the remaining 50 per cent had.

Photograph 8: APCD installed at foundries

8a. Overflow from wet scrubber tank

8b. Slag stored in a wet scrubber tank

Source: CSE

Maintenance of APCD

Air pollution control devices are explicitly designed to destroy unsafe compounds emitted during the manufacturing process. If the APCDs are not well maintained on a regular basis, industries can generate huge amounts of pollution, affecting the ambient air quality.

APCDs must therefore be kept in good condition to help facilities achieve production targets and achieve emission standards. It is also recommended that industries should install an interlocking system at the APCDs, which halts the working of the furnace during the breakdown of APCDs.

According to the CSE study, in Gokul Shirgaon MIDC, only 23 per cent of the foundry units carried out maintenance of APCDs on a monthly basis. The remaining 73 per cent of the surveyed units did not do any maintenance.

In Shiroli MIDC, only 21 per cent of the foundry units carried out maintenance of APCDs on a monthly basis, 4 per cent of surveyed units on a half-yearly basis and remaining 75 per cent of the surveyed units did not do any maintenance.

In Kagal 5 Star MIDC, 50 per cent of the surveyed units carried out maintenance of APCDs on a monthly basis while the remaining 50 per cent of the surveyed units did not do any maintenance.

Photograph 9: Air pollution control devices (APCDs) at foundries

9a. Fume extraction system at a foundry

9b. Wet scrubber installed at a foundry

Source: CSE

Housekeeping practices

Good housekeeping helps smoothen material movement inside a unit, keeps the workplace tidy and efficient, and helps reduce fugitive dust. It also helps reduce waste generation and saves energy. Keeping foundries free of mess also reduces the risk of accidents and damage to stock or equipment, and maintains a smooth flow of work.

During the survey, housekeeping in foundries of Kolhapur was not found to be up to the mark. Most foundries stored their raw materials, such as coke and sand, in open spaces, and small-scale foundries did not have regular housekeeping plans. In addition, the waste generated was not properly disposed of. There was no proper bifurcation of space for raw material and finished material in the industries. Water was found to be continuously overflowing from the wet scrubber tank. Vehicles coming to unload raw materials were found to be creating substantial amounts of dust and the industries were so small that they did not have separate entry and exit points. The CSE team observed a lot of dust emissions inside the foundries.

The ground survey found that large-scale industries had a mechanism to clean foundries while this was absent in small-scale foundries. Since most of the foundries in Kolhapur are small scale and do not have a good housekeeping practice, detailed housekeeping guidelines need to be developed for the sector.

As per CSE's study, in Gokul Shirgaon MIDC, 23 per cent of the surveyed units did their housekeeping activities daily, 45 per cent did weekly housekeeping, 23 per cent did housekeeping on a monthly basis and the remaining 9 per cent did housekeeping on a half-yearly basis.

In Shiroli MIDC, 71 per cent of the surveyed units did their housekeeping activities daily, 17 per cent surveyed units on a weekly basis and 13 per cent on a monthly basis. In Kagal 5 Star MIDC, all the surveyed units did house-keeping daily (see *Photograph 10*).

Photographs 10: Poor housekeeping in foundries

10a. Broken moulds dumped outside a foundry

10b. Broken stack at a chimney

10c. Poor entrance at a foundry

10d. Slag dumped in corners

10e. Raw material kept in open space

10f. Burnt sand dumped inside a foundry

10g. Dumping of industrial waste outside a factory unit

10h. Storage of coke in an open space

Source: CSE

Internal and external energy audits

The Indian manufacturing industry is the second largest in the world. As per data from the Foundry Informatics Centre, there are about 4,500 foundries in India. The sector is highly energy intensive. Around 85–90 per cent of the energy is consumed in the melting process, followed by sand preparation and core making.

The Specific Energy Consumption (SEC) values give a fair idea about the energy usage pattern in the foundry units. The higher the SEC value, the more is the energy consumption in the foundry unit. Efforts should be made to reduce the specific energy consumption values by opting for best operating practices prevailing in the sector.

Energy audit is a fact-finding exercise. It helps foundries understand how energy is utilized or consumed in a unit, i.e. it helps identify areas where energy is being wasted and where there is a scope to save energy.

Energy audit exercises help identify the several opportunities for energy conservation. For example, using a lid-based mechanism in induction furnaces helps reduce energy losses; installing energy-efficient furnaces helps reduce specific energy consumption; using charge material in adequate amounts helps reduce slag generation and other losses, etc.

The CSE ground survey found that most of the foundry units had not conducted energy audits. Even though Kolhapur is a well-known foundry cluster, with a large number of foundry units, the industries have not opted for energy audit practices. The survey found that around 84 per cent of the foundry units were small scale, and most of them were not aware of the concept of energy audit. The large-scale industries in the cluster had conducted energy audits, but their number was very limited.

Energy consumption is not only a matter of concern for Indian foundries but also for global foundries. Energy audits should be conducted internally as well as externally by the third parties to get a real picture of the system.

As per CSE's study, in Gokul Shirgaon MIDC, only 5 per cent of the surveyed units had conducted energy audits. The remaining 95 per cent surveyed units had not conducted an energy audit.

In Shiroli MIDC, only 17 per cent of the surveyed units had conducted energy audits, while the remaining 83 per cent of surveyed units had not. In Kagal 5 Star MIDC, only 50 per cent of the surveyed units had conducted energy audits.

Figure 1: Survey findings from foundries in Gokul Shirgaon MIDC, Kolhapur

Figure 2: Survey findings from foundries in Shiroli MIDC, Kolhapur

Figure 3: Survey findings from foundries in Kagal 5 Star MIDC, Kolhapur

Figure 4: Major takeaways from the field survey

1. • The majority of the foundries have installed induction furnaces and have specific energy consumption of more than 600 kwh per tonne of metal melt.

2. • As per the MPCB data analysed by the CSE team, around 84 per cent of the foundries were found to be small scale and fall under the red category.

3. • Despite there being two sand reclamation units in the city, private players in the market for recyling sand, and industries themselves recycling sand, huge heaps of burnt sand are seen at dumpyards and on roadsides.

4. • Utilization and management of slag is poor. Most of the foundry units dump it for the purpose of landfilling and selling it to local vendors.

5. • As per the CSE survey, in Gokul Shirgaon and Shiroli around 70 per cent of the units have not installed air pollution control devices.

6. • Energy audits have been conducted only in a very few number of units, that too only in some large-scale units. Small-scale industries are not even aware of the concept.

Table 2: Major takeaway from case studies

Case study	Major takeaways
Case study 1: Shakuntala Steel Location: Gokul Shirgaon MIDC, Kolhapur	1. The specific energy consumption is ~ 550 kWh to melt 1 tonne of metal. 2. Bag house filter at the sand reclamation plant with 250 bags, and at the shot blasting unit with 70 bags to control fugitive emissions. 3. The sand reclamation unit was installed in 2016 and uses around 70 per cent of the reclaimed sand daily in the process. 4. Of the total production, approximately 2 per cent (of slag is generated (around 10 tonnes) and sent to brick manufacturers..
Case study 2: Shri Ram Foundry Location: Shiroli MIDC, Kolhapur	1. The specific energy consumption is ~ 600 kWh to melt 1 tonne of metal. 2. Hood has been installed at the furnaces, dust collector has been installed at the sand reclamation plant, bag filter at the shot blasting unit as well as the knock-out operations. 3. Reclaims around 95 per cent of the sand and the remaining 5 per cent of the sand is sent to the sand reclamation unit in Shiroli. 4. Of the total production, around 1.5 per cent slag is generated. As the unit uses good-quality scrap, the generation of slag is not much. 5. Unit conducted an energy audit in 2018.
Case study 3: Parikh Metacast Private Limited Location: Kagal 5 Star MIDC, Kolhapur	1. The specific energy consumption is ~ 700 kWh to melt 1 tonne of metal. 2. A fume extraction system has been installed for all four induction furnaces, and a dust collector system has been installed for the sand reclamation plant and shot-blasting machine. 3. The unit has installed a sand reclamation unit of capacity 9 tonne per hour and reclaims around 70 per cent of the sand. 4. Approximately 3–4 per cent of the total production is slag generated. As the unit used good-quality scrap, the generation of slag is not much.

3. Good practices in the foundry sector in Kolhapur

Good practices help us identify the pathway that ensures the sector's future reliance on clean, affordable and efficient technological practices.

This chapter discusses some good practices in the foundry sector in Kolhapur across different MIDCs. It highlights live examples of good practices and case studies operating on the ground. The key takeaway would be to understand how such practices can be adopted by other foundries in Kolhapur and other foundry clusters in the country.

CASE STUDY 1

Shakuntala Steels, Gokul Shirgaon MIDC, Kolhapur

Shakuntala Steels, located in Gokul Shirgaon MIDC, Kolhapur, manufactures ferrous grade alloy castings and wear-resistant castings. It began manufacturing steel castings in 2015 and exports the product to the UK, Europe, the Middle East and other Asian countries.

The unit has installed two induction furnaces of capacity of 1 tonne per hour. Both these furnaces remain in operation throughout the day. The unit has a production capacity of approximately around 400–500 tonne per month.

Specific energy consumption

The foundry unit has installed an efficient hood-based system at both the furnaces. The specific energy consumption to melt 1 tonne of molten metal is around 550 kWh. The foundry unit has a separate meter for its induction furnace and machine shop. The meter is connected to the Maharashtra State Electricity Board.

Slag generation

Of the total production, approximately 2 per cent slag (around 10 tonne) is generated and sent to brick manufacturers.

Sand generation

The foundry unit requires 13 tonne of sand per day to produce castings—4 tonne of fresh sand and 9 tonne of reclaimed sand is used per day. This highlights that the foundry unit conserves sand and by reclaiming it considers it a valuable resource. In 2016, a sand reclamation unit was installed inside the industry, with a capacity of 3 tonne per hour. The unit operates for 24 hours and the cost is around Rs 1,75,00,000 (1 crore 75 lakh).

The sand reclamation unit reclaims around 90 per cent of the sand, and the remaining 10 per cent is discarded. Around 1 tonne of sand is discarded daily and sent in trolleys for landfilling. The vendor charges Rs 350 for each trolley.

APCD installed

The foundry has installed a bag house filter at the sand reclamation plant, with around 250 bags. In addition, bag filters have also been installed at the shot blasting unit to control fugitive emissions and it has around 70 filters.

Miscellaneous

The foundry unit has a display board at the entrance with the name of the unit and type of product manufactured. It also has an efficient LED-based lighting system to conserve energy. It stores raw materials, finished products and waste generated in a closed space. In addition, the foundry unit has a cemented road and does housekeeping activities daily to ensure streamlined flow of materials.

The physical and chemical properties of the products are checked by the units. Micro boxes are first produced and testing done on them, and after getting the desirable test results, a larger amount of metal is melted.

The unit has installed a Spectro Max spectrometer and an advanced spectrometer to check the carbon content in the products. For physical testing they have machines such as the universal testing machine. In addition, the unit has a system for non-destructive testing and magnetic particle testing.

Photographs 11: Examples of good practices at Shakuntala Steels

11a. Storage of raw material in a closed space

11b. Sensors to monitor temperature of molten metal

11c. Dust extraction system installed at unit

11d. Sample of castings kept at the unit for testing

11e. Induction furnace installed at the unit

11f. Induction furnace installed at the unit

Source: CSE

CASE STUDY 2

Shri Ram Foundry, Shiroli MIDC Kolhapur

Shri Ram Foundry Steels, located in Shiroli MIDC, Kolhapur, manufactures grey cast iron components for automotive and engineering applications. The manufacturing capacity of the unit includes grey iron castings up to Grade 30 and up to 80 kg weight. The unit has installed two induction furnaces of capacity of 750 kg and 500 kg respectively. Both these furnaces remain in operation throughout the day. The unit has a production capacity of approximately around 1,500 tonne per month.

Specific energy consumption

The foundry unit has installed an efficient hood-based system at both the furnaces. The specific energy consumption for melting 1 tonne of molten metal is around 600 kWh.

Slag generation

Approximately 1.5 per cent of the total production—around 22.5 tonne—is slag generated. It is given to a local vendor. Slag generation here is less as compared to other foundry units because the unit uses good quality raw material and scrap.

Sand generation

The Shri Ram Foundry unit has installed a sand recycling plant of capacity 1 tonne per day. It operates for 24 hours, and 24–25 tonne of sand is recycled every day. The foundry reclaims around 95 per cent of the sand. The remaining 5 per cent of burnt sand is sent to a sand reclamation unit in Shiroli. The unit takes around 30 per cent of core sand from the Shiroli Reclamation Plant.

APCD installed

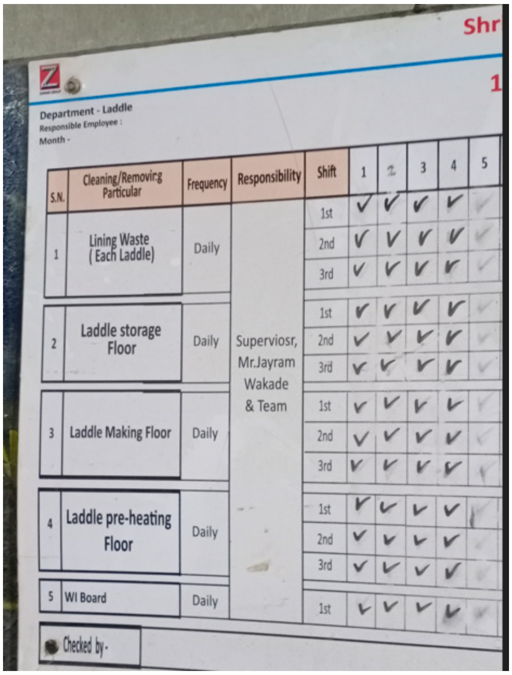
The foundry has installed a dust collector at the sand reclamation plant and bag filter at the shotblasting unit as well as the knock out operations. The maintenance of APCDs is done monthly by the foundry unit.

Miscellaneous

The foundry unit has a display board at the entrance, with the name of the unit and type of product manufactured displayed. It also has an efficient LED-based lighting system to conserve energy. The unit stores raw materials, finished products and waste generated in a closed space. In addition, it has a cemented road and does housekeeping activities daily to ensure a streamlined flow of materials. The unit has developed a plan for regular housekeeping.

The unit conducted an energy audit in 2018. It has also installed an LED lighting system to conserve energy. The foundry unit has a cemented road inside.

Photographs 12: Examples of good practices at Shri Ram Foundry, Shiroli



12a. Department-wise cleaning mechanism at the unit

12b. Hood installed at the induction furnace

12c. Temperature sensor installed at the furnace

12d. Raw material (scrap) kept in a closed space

Source: CSE

CASE STUDY 3

Parikh Metacast Private Limited, Kagal 5 Star MIDC

Parikh Metacast Private Limited is a sister concern of 24-year-old Parikh Metaliks Private Limited. It manufactures ferrous grade alloy castings, which are used in thermal power plants, ship building, automobiles, tool rooms, planetary gearboxes, pumps and valves etc. It exports its products to USA, Qatar, Dubai and Japan.

The unit has four induction furnaces of capacity 5 tonne per hour, 3 tonne per hour, 1 tonne per hour and 750 kg per hour respectively installed, and a production capacity of approximately around 220–250 tonne per month.

Specific energy consumption

The foundry unit has an efficient hood-based system installed at all the furnaces for collecting the fumes before discharging the emission through the stack. The specific energy consumption for melting 1 tonne of metal is around 700–720 kWh.

Slag generation

Approximately 3–4 per cent of the total production—around 8–10 MT of slag per month for production of 220 million tonne (MT)—is slag generated. The slag is sold to the local vendors. The unit uses good quality of scrap because of which the generation of slag is not much as compared to other industries.

Sand generation

The unit has installed a sand reclamation unit of capacity 9 tonne per hour (tph) of Omega make. The sand reclamation unit has a knockout machine, vibratory feeder, mechanical attrition, cooler classifier and pressure vessel. The vibratory feeder feeds sand into the attrition; the attrition unit makes the lumps finer and transfers them to the cooler classifier. The sand is then made normal and passed on to a pressure vessel from where it is transferred to storage hoppers.

Around 60–70 per cent of sand is reclaimed from the reclamation unit. A 100 per cent reclamation is of no use for the unit as for manufacturing a new casting the unit needs to use fresh sand. The remaining 30–40 per cent of sand after the knocking operation is given to construction sites for either landfilling or used for plastering at construction sites after processing.

The unit has also installed a dust collector system behind the reclamation unit to remove dust from the sand. The dust collected from the dust collector system is sold to a vendor who processes it and uses it for brick manufacturing.

APCD installed

The unit has installed a fume extraction system for all four furnaces, and installed a dust collector system for the sand reclamation plant and shot-blasting machine.

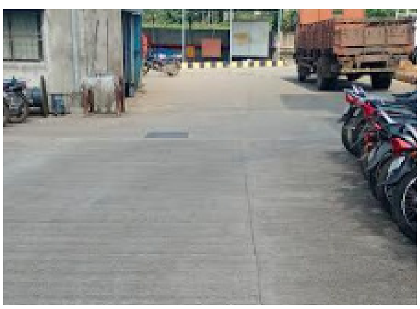
Miscellaneous

The foundry unit has a board at the entrance, with the name of the unit and type of product manufactured displayed. It also has an efficient LED-based lighting system to conserve energy. It stores raw materials, finished products and waste generated in a closed space. In addition, it has a cemented road and does the housekeeping activities daily to ensure a streamlined flow of materials. The physical and chemical properties of the products are checked by the unit in the lab facility available inside the industrial premises. The unit is also planning to install solar panels on the rooftop for the auxiliary side load inside the unit.

Photograph 13: Examples of good practices at Parikh Metacast, Kagal 5 Star MIDC

13a. Bag filter installed at the unit

13b. Machine for material testing



13c. Separate entry and exit points with cemented roads

13d. System to control temperature and chemical properties

Source: CSE

Sand reclamation units

Sand is a valuable mineral resource. After water, it is the most used resource globally and has a major role in providing ecosystem services, essential infrastructure for economic development and livelihoods within communities as well as maintaining biodiversity. Given our dependency on it, sand must be recognized as a strategic resource and its extraction and use need to be rethought.[9]

The foundry sector uses thousands of tonnes of sand for mould making and casting of products. Industries are seen often not recycling or reusing sand but discarding it in open spaces. To recycle sand, a sand reclamation unit can be installed in the foundry clusters.

The resin on used sand is removed by well-engineered combustion technology and crushed. The segregated sand is heated to burn the resin and the sand is recycled again. Heat generated from resin burning can be recovered to preheat the sand as well as for the combustion air.

There is a need to recycle sand as fresh sand is available in limited amounts just like any other natural resource, and sand prices are escalating rapidly. In addition, recycling of sand will also help lower the disposal and transportation costs of sand as the number of reclamation cycles increase.

The Kolhapur foundry cluster has two sand reclamation units, installed at Gokul Shirgaon and Shiroli, where industries send their burnt sand for recycling and later reuse it in the process of casting inside the foundry. The sand reclamation project was initiated in Kolhapur with two basic objectives. The primary objective was to create environmental awareness among the foundries and the secondary was to conserve sand.

Gokul Shirgaon Sand Reclamation Unit

A detailed study for the project was initiated in 2006–07 and the operation of the reclamation unit was started in 2017. The total investment was around Rs 13.5 crore, around 75 per cent of which was provided by the Central government, 10 per cent was given by the state government, and the remaining 15 per cent was given by the industries. In addition, around six to seven foundry units have also invested in this project.

The sand reclamation unit is managed by the Kolhapur Engineering and Foundry Cluster and Gokul Shirgaon Manufacturers Association (GOSHIMA).

Capacity of the reclamation unit

The capacity of the unit is around 3,000 tonne per month. It generates around 10–15 per cent of dust. This means that around 2,550 tonne of sand is reclaimed and 450 tonne of dust is generated. The dust generated is used for making bricks, cement and concrete bricks. The unit runs for around for almost 23 hours a day.

Industries that have invested in the reclamation unit are the only ones benefiting from it and using reclaimed sand. Industries have booked the monthly capacities of the sand reclamation unit on a prior basis (see *Table 3: Capacities for sand reclamation booked by units*).

Table 3: Capacities for sand reclamation booked by units

Name of unit	Capacity booked (tonne per month)
Ghatge Patil	1,500
Jadhav Industries	500
Caspro Industries	150–200
Other industries	350

Working mechanism at Gokul Shirgaon Sand Reclamation Plant

In the feeder, 60 per cent green sand and 40 per cent core sand is mixed and the sand is passed through the magnetic separator to separate the remaining lumps of castings. After this sand is passed through the dryer to remove its moisture content. The sand is then crushed and passed through conveyor belts. It is stored in hoppers and passes through an auger conveyor system to a thermal furnace, which runs on liquefied petroleum gas (LPG) and has a temperature of around 680°C. The sand passes through the thermal furnace and a vibro-feeder. It is then cooled, and the temperature decreases to around 150°C.

In the Mechanical Machine Reclaim (MMR) unit, polishing and coating from the sand—of chemicals like bentonite—are removed. The sand then passes through the fluidized bed combustor in which dust particles are removed and it goes forward. Screening takes place and different grades of sand are received.

The selling cost of reclaimed sand is around Rs 2–3 per kg and the reclamation unit uses LPG and electricity as fuel (see *Table 4: Types of fuel used in the reclamation unit*).

Figure 5: Working mechanism of sand reclamation plant

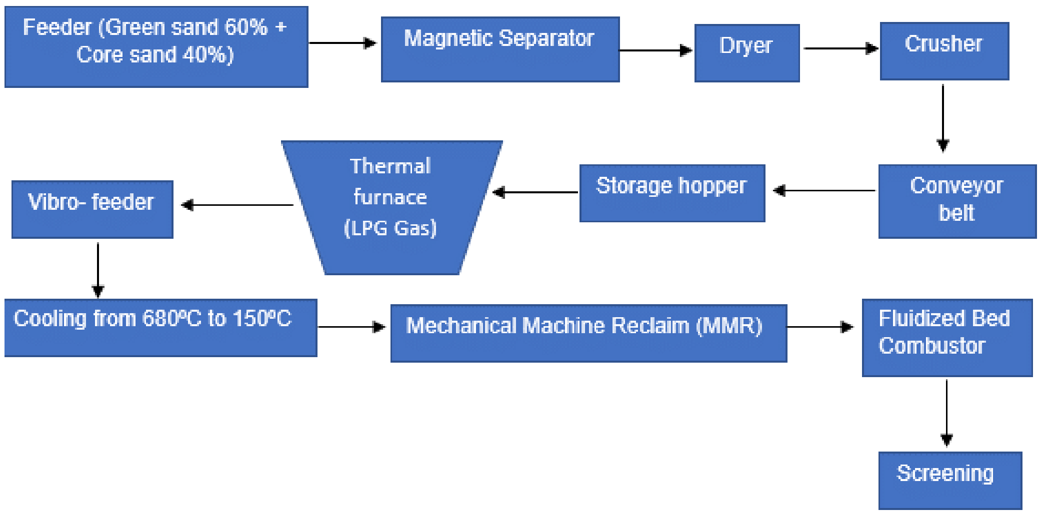


Table 4: Type of fuel used in sand reclamation unit

Fuel	Quantity of fuel used	Cost in INR
LPG	10 kg per tonne of sand reclaimed	85 per kg
Electricity	65–70 kWh per tonne of sand reclaimed	10–11 per kWh

The reclamation unit has a sand-testing lab where tests such as sieve analysis, acid demand value, moisture content, gas determination and loss on ignition are done. The lab conducts test on around 10–12 samples every day and maintains proper records.

Photograph 14: Gokul Shirgaon Sand Reclamation Plant

14a. Entrance of the Gokul Shirgaon sand reclamation unit

14b. Sand-testing lab

14c. Hoppers for storing sand

14d. Thermal furnace

SOURCE: CSE

Shiroli Sand Reclamation Unit

The Shiroli Sand Reclamation Unit was installed in 2017 with a total investment of around Rs 14 crore. The pattern of investment by different stakeholders is the same as in the Gokul Shirgaon unit, i.e. around 75 per cent of the investment was provided by the Central government, 10 per cent by the state government, and the remaining 15 per cent by the foundry industries. In this unit, around 50 foundry units have also invested in this project. Most of the parts of the unit were imported from China while the rest of the unit was manufactured by local vendors. The working mechanism of the unit is same as the Gokul Shirgaon Sand Reclamation Unit. The sand reclamation unit is managed by the Kolhapur Engineering and Foundry Cluster and its subsidiary Shiroli Manufacturing Association.

Capacity of the reclamation unit

The capacity of the unit is around 120 tonne per day. It runs for almost 24 hours, reclaims around 85–90 per cent of sand and generates around 10–15 per cent of dust. The dust generated is used to make bricks, cement and concrete bricks.

Type of fuel used in sand reclamation unit

The Shiroli Sand Reclamation Unit has started using piped natural gas (PNG) as the pipeline network is well laid out in the industrial area. The unit uses now PNG instead of biogas as a fuel in the thermal furnace.

The following are the reasons for shifting from biogas to PNG:

1. There is 24-hour availability of PNG;
2. PNG has more calorific value than the biogas; and
3. The cost of PNG is less than of biogas.

Table 5: Type, quantity and cost of fuel used in sand reclamation unit in Shiroli

Fuel	Quantity of fuel used	Cost (in Rs)
LPG	8–11 kg per tonne of sand reclaimed	79 per kg
Biogas	10 kg per tonne of sand reclaimed	63 per kg
Electricity	33–42 kWh per tonne of sand reclaimed	10–11 per kWh
PNG	8–11 kg per tonne of sand reclaimed	49–51 per kg

Photograph 15: Gokul Shirgaon Sand Reclamation Plant

15a. Entrance of the sand reclamation unit

15b. Industries dumping burnt sand at the reclamation unit

15c. Pipeline for PNG at thermal furnace

15d. Two sets of cascades for biogas storage

15e. Burnt sand processed at the sand reclamation unit

15f. Sand after reclamation

Source: CSE

RISING DEMAND FOR SAND: NEEDS RESOURCE GOVERNANCE

Sand has been declared a "minor mineral" under Section 3(e) of the Mines and Minerals (Development and Regulation) Act, 1957 (MMDR Act). The states are advised to keep a track on illegal mining practices.[10] Despite sand being a minor mineral resource, there are thousands of cases about illegal sand mining every day.

Sand is a valuable mineral resource and plays a pivotal role in delivering ecosystem services, providing livelihoods and helping maintain biodiversity. But in India, it is often treated like a commodity and is used in the construction sector, cosmetic industry, foundry sector etc. The surge in demand has made it a scarce commodity. In the year April 2022, the UN Environmental Programme, warning of a looming sand crisis, said, "Sand is the second most exploited natural resource in the world after water."[11]

Several cases against illegal sand mining across the country
Illegal sand mining is a pan-India problem. It is prevalent in different riverbeds across the country, including the Sutlej in Punjab, Yamuna in Delhi, Ganga in Haridwar, Urmil and Betwa in Bundelkhand, Chambal and Narmada in Madhya Pradesh, Godavari and Krishna in Andhra Pradesh, and Vaitarna and Cauvery in Tamil Nadu.

According to data from the Ministry of Mines, the state of Maharashtra recorded the highest number of cases of illegal sand mining in the country—around 26,628—in 2017, followed by Uttar Pradesh, Karnataka and Madhya Pradesh.[12]

New sand mining policy for Maharashtra
In December 2022, Revenue Minister Radha Krishna Vikhe Patil announced in the State Assembly that there would be a new sand mining policy that would be out for Maharashtra before the end of the budget session. The main objective to release the new policy was to curb sand theft, extraction of sand by private players and illegal mining.

On April 5, 2023, the Maharashtra Cabinet declared a new sand policy for the state. The highlights of the policy are: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Sand mining policy will be unveiled soon in Maharashtra: Min

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1. The state has capped the price of sand at Rs 600 per brass (Rs 133 per tonne) for a year to make it more affordable, and there will be no more auctions. This will help to crack down the illegal sand mining activities.

2. The government will appoint a contractor at the district level to extract sand and deposit it in a depot at one place, and everyone will get sand at the same price. Extraction of sand will be demand driven.

3. The government will float tenders for sand extraction, transportation and construction of sand depots. Once the sand is extracted it will be sold through its depots through an online process. This will involve government in the sale of sand.


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Maharashtra cabinet clears sand mining policy; no more auctions, price capped for a year

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4. A committee will be formed under the tehsildar at the district and taluka levels to monitor sand extraction near rivers.

5. The new policy highlights the concept of geofencing of the area from riverbed to sand depot. The vehicles used for transporting sand will have a specific colour.

6. CCTV cameras will be placed near sand depots and weigh bridges used to weigh sand.

The foundry sector consumes huge amounts of sand for mould making and casting. Foundry clusters are often found to be dumping burnt sand in open areas.

The Kolhapur foundry cluster has two sand reclamation plants. Despite this, many foundries (mainly small scale) do not send sand to reclamation units but use fresh sand for the process. There is an urgent need for the resource efficiency and circularity.

4. Conclusion and recommendations

The CSE survey of foundry clusters in Kolhapur highlights that the specific energy consumption values in most foundry units is high, and utilization and management of slag is poor. More than half of the units surveyed by the CSE team have not installed any air pollution control devices (APCDs), and the frequency of maintenance of units that have installed APCDs is not up to the mark.

In addition, sand, a natural resource, is highly exploited in the city. Despite sand reclamation units installed in the city, huge heaps of the burnt sand can be seen on roadsides and at dump yards. In addition, most of the foundries have poor housekeeping practices. For example, raw material is stored in open spaces, road entrances at foundries are improper and there are no designated places to store finished products.

This clearly illustrates that the environmental performance of the foundries is poor, especially in small-scale foundries. This results in high levels of emissions, thereby impacting the ambient air quality of Kolhapur city.

What needs to be done to reduce emissions from foundries?

Most of the foundries use inefficient induction furnaces with higher specific energy consumption for melting, no mechanism to arrest fugitive emissions, and no internal or external energy audits conducted to keep track of specific energy consumption. With such high impacts, these industries cannot be allowed to operate in the current fashion under the pretext of being small-scale industries.

To operate in an environmentally sustainable manner, this sector requires stringent guidelines along with strict implementation on the ground. This should be accompanied by regular monitoring by the Maharashtra Pollution Control Board (MPCB). This together will help make the industry more environment-friendly.

Hence, with the objective to improve the environmental practices of foundries, CSE recommends the following actions:

Indicator	Recommendation for industries	Recommendation for MPCB
1. Type of furnace	• According to the Petroleum and Natural Gas Regulatory Board (PNGRB) plan, Kolhapur city got piped natural gas (PNG) in 2018. Foundries in Kolhapur should prepare a "phase-out plan" to shift to PNG. **Cupola-based foundries** • Single-blast cupola foundries should use low ash metallurgical (LAM) coke as a fuel in cupola-based foundries as it has low sulphur content (< 0.6 per cent) and low ash content (<11 per cent). Alternatively, they should shift to divided-blast cupola furnaces or explore the possibility of shifting to piped natural gas (PNG). **Induction-based foundries** • Foundries should replace inefficient induction-based furnaces with energy-efficient insulated gate bipolar transistor (IGBT) furnaces. With IGBT furnaces, specific energy consumption values of about 550 kWh per tonne of molten metal can be achieved. • Induction-based foundries should install an efficient fume extraction system, lid-based mechanism, swivelling hood, spark arrestor, bag filter or any other suitable dust catcher and secondary fume extraction system with adequate side suction to prevent fugitive emissions during charging. The suction system should be adequate to control fugitive emissions. • Foundries should install separate electric meters for furnaces and for other domestic consumption in the unit.	• MPCB should strictly ensure that coal-based foundries shift to piped natural gas (PNG) and meanwhile take a step to mandate the use of low-ash metallurgical coke as a fuel in cupola and divided-blast cupola-based foundries. • MPCB should prepare a guideline on best operating practices. This will help the foundries run efficiently and reduce their specific energy consumption and pollution load in the long run.
2. Reuse of sand for moulding	• Foundry units (even small scale ones) should recycle the maximum amount of sand and send burnt sand to the nearest sand reclamation unit or to private players. • The leftover sand after the reclamation process should be used in the concrete mix or in brick making.	• MPCB should ask foundries to develop a mechanism for 100 per cent utilization of sand. • MPCB should mandate industries to share details about the amount of sand used, recycled and discarded in the consent document. Industries should share information about the mechanism to use burnt sand.
3. Slag generation in foundries and the possibility of its utilization	• Foundry units should be in direct contact with the cement industries and give their slag to them. If industries have space constraints and cannot store slag, Maharashtra Industrial Development Corporation should allot a site/area where industries should send their slag and from there cement industries or other construction-based industries should collect the slag.	• MPCB should mandate that the foundry units quantify their slag generation. The board should also ensure that none of the units discard the slag as "solid waste". They should come up with regulations so that units manage slag as an item of value in a controlled manner.

Indicator	Recommendation for industries	Recommendation for MPCB
4. Maintenance of APCD	• Foundries should get maintenance of their APCDs done regularly (once in three months at least) by a third party and record and document it. • *In wet systems:* Industries should properly treat wastewater generated from their wet scrubbers and maintain effluent quality standards laid down by CPCB. They should at least install a pH correction unit along with a settling tank before discharging the wastewater. • *In dry systems:* Industries that have installed APCDs such as bag filters or cyclones should collect dust. They should extract metals like zinc and lead from the dust. • Foundries should keep track of filter/bag leakages and undertake regular maintenance activities.	• MPCB should ask industries to keep the record of maintenance of APCDs. • MPCB should ensure that effective efforts are taken by the industry in the future to treat the wastewater coming from wet scrubbers. • MPCB should ensure that the dust generated from the dry extraction system is properly managed and the information is documented by the industry and reported to MPCB.
5. Install APCDs	• Foundries shall comply with Section 21 (5) of the Air Act and install APCDs. Existing APCDs shall be altered or replaced with the direction of the State Board, and APCDs should be kept in good running condition. • Industries should document and record all the information related to APCDs such as type of APCD, running hours, etc. • Industries should install an interlocking system in APCDs that halts the working of the furnace during breakdown of APCDs.	• MPCB should ensure that the industries meet air-related compliances according to Section 21 (5) of the Air Act. • All the information related to APCDs should be well documented and shared with the MPCB regularly. If any discrepancy is found in the document, MPCB should ensure that the industry bears the consequences and ensure that it does not happen again.
6. Housekeeping in foundries	The industry should ensure proper housekeeping practices are followed within the premises by: • Keeping floors clean and regularly cleaning foundries; • Handling the trash generated effectively as per norms; • Monitoring stacks on a regular basis and conducting regular maintenance; and • Ensuring that the outside entry area of the unit has a concrete road instead of earthen roads which generate a lot of fugitive emissions and dust.	• MPCB should prepare a guideline on good housekeeping practices in the foundry sector and make it part of consent document. • MPCB should strictly ensure that the industry carries out effective housekeeping within the premises. If the status of housekeeping is not found as per standards, strict actions should be taken against the industry.
7. Energy audit in foundries	• Industries should do an energy audit at least once in two years to keep track of specific energy consumption values. • Internal as well as external audit by third parties should be conducted to reduce wastage of energy.	• To get a no-objection certificate, MPCB should make it compulsory for foundries to submit to the board their energy audit report made by third-party vendors.
8. General compliance	The industry should submit compliance reports on a regular basis to MPCB. The report shall include information related to: • Compliance with air quality norms; • Compliance with solid waste norms; and • Compliance with water consumption and wastewater discharge norms.	MPCB should ensure that consent to establish and/or operate includes the following: • Energy consumption; • Type of fuel used in furnace; • Status of APCDs and their maintenance schedule; • Raw material consumption and solid waste generation; • Detailed layout plan of industry; • Water consumption; and • Quantity of water consumption and wastewater discharge.

References

1. MOEFCC 2019, Government launches National Clean Air Programme; https://moef.gov.in/wp-content/uploads/2020/09/Government-launches-National-Clean-Air-Programme-NCAP-10-01-2019.pdf (accessed on March 10, 2023).

2. NCAP Tracker, https://ncaptracker.in/ncap/ (accessed on March 11, 2023).

3. TERI 2016. Environmental status Report of Kolhapur city; https://www.teriin.org/sites/default/files/2018-02/2016MC02%20%20%20Kolahpur%20ESR%202015-16%20%28English%29_0.pdf (accessed on March 10, 2023).

4. Maharashtra Pollution Control Board. Kolhapur City Air Pollution Control Action Plan; https://cpcb.nic.in/Actionplan/Kolhapur.pdf (accessed on March 11, 2023).

5. Anon. 2017. Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India; https://beeindia.gov.in/sites/default/files/BOP-Belgaum.pdf (accessed on March 13, 2023).

6. Anon. 2012. Cupola Padho aur Karo. CUPOLA. final.pdf (fmc.org.in) (accessed on March 14, 2023).

7. Satyendra 2013. Induction Furnace and Steel Making, Ispat Guru. Accessed at Induction Furnace and Steelmaking—Ispat Guru (accessed on March 21, 2023).

8. Tata Metaliks; https://www.tatametaliks.com/static-files/pdf/tata-eFee-article%20(with%20Registered%20Mark).pdf (accessed on March 15, 2023).

9. UN News. Use sand resources 'wisely' or disk development fallout—UNEP Report April 2022; https://news.un.org/en/story/2022/04/1116972#:~:-text=After%20water%2C%20sand%20is%20the,metres%20high%20around%20planet%20Earth (accessed on March 16, 2023).

10. Mines and Minerals (Development and Regulation) Act, 1957.

11. https://mines.gov.in/writereaddata/UploadFile/MMDR%20Act,1957.pdf (accessed on March 21, 2023).

12. UNEP, 2022. Our use of sand brings us “up against the wall”; https://www.unep.org/news-and-stories/press-release/our-use-sand-brings-us-against-wall-says-unep-report (accessed on March 21, 2023).

13. Gupta Shivani 2020. The bloody world of India’s illegal sand mining: At least 193 killed since January 2019; https://en.gaonconnection.com/the-bloody-world-of-indias-illegal-sand-mining-at-least-193-killed-since-jan-2019/#:~:text=Maharashtra%2C%20Uttar%20Pradesh%2C%20Madhya%20Pradesh,the%20most%20number%20of%20cases (accessed on March 26, 2023).

Kolhapur has about 272 foundries, most of which are small scale. Around 88 per cent of the small-scale foundries fall under the red category. Most of the foundries do not have air pollution control devices, dump slag in landfills, have poor housekeeping practices, and have not conducted energy audits.

This report attempts to highlight the air pollution issues of the foundry sector that arise from fuel usage, along with the technology and process in use in the units. It highlights the good operating practices in the Kolhapur foundry cluster and gives recommendations to curb air pollution, reduce GHG emissions and bring down the carbon footprint of the sector.

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