SPONGE IRON INDUSTRY:
THE REGULATORY CHALLENGE

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CHAPTER 1

Indian Sponge Iron Industry

1. Introduction

1.1 An Introduction to the sector

Sponge iron is an intermediate product used for the manufacture of steel. Also referred to as Direct Reduced Iron (DRI) or Hot Briquetted Iron (HBI) in its compacted form, sponge iron is not a new route to steel production. For the production of primary iron, this route is recognized as an alternate route to blast furnace. Sponge iron is fed into the electric furnace for steel production or into foundries for the manufacture of wrought iron.

Commercial production of sponge iron in India commenced in 1980[1]. Sponge Iron India Limited was the first plant to be set up in the country in 1980 in Paloncha district of Andhra Pradesh with a capacity of 0.039 million tonnes per annum (MTPA)[2]. Between 1980 and 1988, the growth of the sector was slow owing to the regulatory bottleneck of restrictive licensing[3]. Only three plants were set up during this period, Orissa Sponge Iron Limited with a capacity of 0.1 MTPA, Ipitata Sponge Iron, capacity 0.09 MTPA and Sunflag Iron Steel Ltd[4]. The first gas based sponge iron plant, with a capacity of 1.52 MTPA, was set up by Essar Steel Limited in Hazira, Gujarat in 1990[5].

Today, India has an installed capacity of 36.7 MTPA of sponge iron[6]. Leading states in sponge iron production are Odisha, Chhattisgarh, West Bengal and Jharkhand. Odisha occupies the top position accounting for 36 per cent of the total coal based capacity in the country followed by Chhattisgarh (27 per cent), West Bengal (14 per cent) and Jharkhand (8 per cent)[7].

1.2 Capacity and production

India is the world's largest producer of sponge iron, accounting for 13 per cent of the global production[8]. Sponge iron is produced using either coal or natural gas. Since coal is available in India, the sector largely depends on coal based sponge iron which contributes about 80 per cent of the total capacity in the country[9].

It is not possible to ascertain the exact number of sponge iron plants in India due to non-reporting by many small scale players (see *Box 1: Number game*)[10]. Based on our analysis, there are 333 sponge iron plants in the country[11]. Of the total capacity, 330 plants are coal-based with a capacity of 29.2 MTPA while three are gas-based with a capacity of about 7.5 MTPA[12]. Among the coal based DRI plants, Jindal Steel is the world's largest[13] with total capacity of 1.37 MTPA[14]. The gas based plants are Essar Steel (Gujarat), Ispat industries (Maharashtra) and Welspun Power (Chhattisgarh). Essar Steel is the world's largest gas-based single location DRI plant with a capacity of 5 MTPA[15]. Ispat Industries has a capacity of 1.6 MTPA[16]

BOX 1: NUMBER GAME

According to the Ministry of Steel, sponge iron capacity in India is 31 MTPA[1]. Based on our analysis of the data received from State Pollution Control Boards (SPCB), the installed capacity of sponge iron in the country is 36.7 MTPA. The Ministry also states that the working plants are 360 and sponge iron production in the country stood at 20 million tonnes in 2008-09[2]. This implies a capacity utilisation of a mere 55 per cent for coal based plants and of about 90 per cent for the gas based ones.

Ministry of Steel quoted a figure of 353 sponge iron plants in India with a capacity of 25 MTPA in a meeting in Beijing[4]. Another source states that the total number of plants in the country is 400[3] and production is about 21 million tonnes[5].

Table 1.1: Size Classification

Scale	Production (MTPA)
Small	≤ 0.033
Medium	0.033 - 0.165
Large	≥ 0.165

Source: *Analysis by CSE.*

and Welspun Power is a small gas based DRI plant with 0.9 MTPA capacity[17].

1.3 Coal-based sponge iron industry

There is no official classification of sponge iron plants in India but they can be divided into small, medium and large scale plants based on production capacity (see *Table 1.1: Size Classification*). Plants with a capacity of 0.033 MTPA can be classified as small while the ones with capacity lying between 0.033 and 0.165 MTPA can be classified as medium. Large plants are the ones with capacity above 0.165 MTPA.

The average sponge iron plant size in India is 0.0886 MTPA implying the dominance of medium scale plants in the country[18]. The average plant size in Chhattisgarh is 0.1026 MTPA and that in Jharkhand is 0.0641 MTPA[19]. Odisha has plants with 0.0971 MTPA capacity on an average while in West Bengal the average capacity of a sponge iron plant is 0.0731 MTPA[20].

In terms of numbers, medium scale plants account for 53 per cent of the total plants in India followed by small scale (34 per cent) (see *Table 1.2: Number of coal based sponge iron plants)*. Large-scale plants account for only 13 per cent of the total. Region wise, maximum number of small-scale plants are located in Chhattisgarh (29 plants) followed by Odisha (26 plants) and Karnataka (24 plants). Medium scale plants of the country are concentrated in Odisha (64 plants) and West Bengal (38 plants).

In terms of capacity, small scale and medium scale plants together account for 58 per cent of the total capacity in the country (see *Table 1.3: Capacity of coal based sponge iron plants)*. The proportion of

Table 1.2: Number of coal based sponge iron plants

State	Number of plants	Small Scale	Medium Scale	Large Scale
Odisha	108	26	64	18
Chhattisgarh	68	29	23	16
West Bengal	57	16	39	2
Karnataka	39	24	14	1
Jharkhand	37	13	23	1
Other States	21	5	12	4
Total	**330**	**113**	**175**	**42**

Source:
1. *Analysis based on data received from SPCBs under the Right to Information Act, 2005.*
2. *Anon, 2006, Survey of the Indian sponge iron industry 2005-06, Joint Plant Committee, Government of India, Kolkata, pg. A1-A4, A18.*
3. *Anon, 2007, Comprehensive Industry Document: Sponge Iron Industry, Central Pollution Control Board, Ministry of Environment and Forests, New Delhi, pg. 14.*

Table 1.3: Capacity of coal based sponge iron plants

State	Total installed capacity (MTPA)	Small Scale (MTPA)	Medium Scale (MTPA)	Large Scale (MTPA)
Odisha	10.5	0.7	5.1	4.7
Chhattisgarh	8.0	0.7	1.7	5.6
West Bengal	4.2	0.5	3.3	0.4
Karnataka	1.8	0.6	1.1	0.2
Jharkhand	2.4	0.3	1.9	0.2
Other States	2.4	0.2	0.8	1.4

Source: 1. *Analysis based on data received from SPCBs under the Right to Information Act, 2005.*
2. *Anon, 2006, Survey of the Indian sponge iron industry 2005-06, Joint Plant Committee, Government of India, Kolkata, pg. A1-A4, A18.*
3. *Anon, 2007, Comprehensive Industry Document: Sponge Iron Industry, Central Pollution Control Board, Ministry of Environment and Forests, New Delhi, pg. 14.*

medium scale plants, in terms of capacity, has been rising and it accounts for 47 per cent followed by large scale (42 per cent). The proportion of small-scale plants is around 10 per cent only.

Even though in terms of number, small scale plants are large; in terms of capacity contribution they fall behind. On the other hand, large scale industries contribute a fat share of the total capacity in the country although only few in numbers.

1.4 Clustered spread

Sponge iron plants are present either as integrated plants, stand-alone ones or present in clusters. The bulk of these plants are located in areas characterised by forests, poverty and marginalized tribal groups[21] (see *Map 1: Sweep of sponge iron and protests*). These are in the vicinity of mining areas with mineral deposits and hence provide easy access to raw materials and other infrastructure like roads, etc.

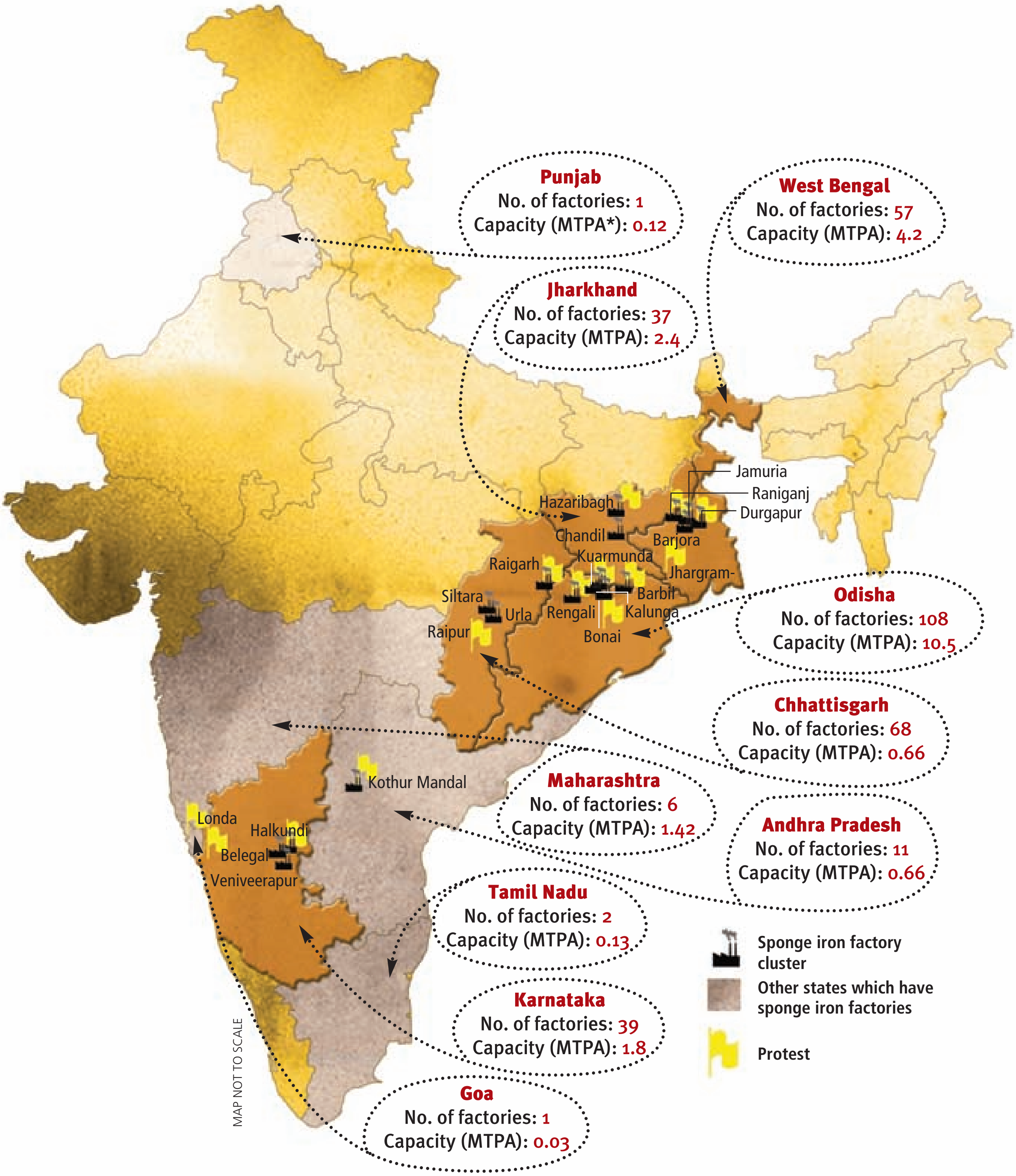
States where agglomeration of sponge iron plants is present are Odisha, Karnataka, Chhattisgarh, Jharkhand and West Bengal. There are 15 identified clusters[22] in India which comprise essentially of small and medium scale plants (see *Table 1.4: Sponge iron clusters in India*). There are about 141 sponge iron plants present in these clusters. Thus, about 43 per cent plants in the country are present in clusters in terms of numbers. The cluster with maximum number of plants is Siltara in Chhattisgarh (32 plants) followed by Kuarmunda in Odisha with 11 plants.

These clusters contribute 36 per cent of the sponge iron capacity in the country. Siltara is the cluster contributing the maximum in terms of capacity (2.95 MTPA), followed by Rengali (1.25 MTPA) and Chandil (0.74 MTPA). Kuarmunda does have the second highest number of plants in the cluster but it contributes only 0.72 MTPA in terms of capacity.

1.5 Growth

A huge amount of coking coal[23] is required for blast furnace and as coking coal is scarce, the alternate route is preferred. Today, sponge iron has become the preferred raw material for steel manufacturers due to uninterrupted domestic availability and relative stability in prices.

Map1: Sweep of sponge iron and protests



**MTPA: Million tonnes per annum*

Source: *Map based on data received from SPCBs under the Right to Information Act, 2005.*

Table 1.4: Sponge iron clusters in India

Clusters	Small	Medium	Large	Capacity (MTPA)
Chhattisgarh				
Siltara	15	11	6	2.95
Urla	5	4	1	0.58
Jharkhand				
Chandil	3	6	1	0.74
Karnataka				
Belegal	4	1	0	0.23
Halkundhi	9	1	0	0.25
Veniveerapur	3	2	0	0.17
Odisha				
Barbil	1	4	2	0.73
Bonai	3	4	0	0.35
Kalunga Industrial Estate (I.E.)	2	8	0	0.65
Kuarmunda	5	5	1	0.72
Rengali	0	2	3	1.25
West Bengal				
Barjora	1	3	1	0.43
Durgapur	1	7	0	0.68
Jamuria Industrial	6	3	0	0.38
Raniganj	1	6	0	0.48
TOTAL	**59**	**67**	**15**	**10.59**

Source: *Analysis based on data received from SPCBs under the Right to Information Act, 2005.*

The sector has grown leaps and bounces since 2002-03 (see *Table 1.5: Sponge iron growth in India*). Capacity has increased by almost 267 per cent from 2003-04 to that in 2008-09. At present, the capacities of plants range from 0.01 MTPA to 1.37 MTPA[24].

Over the past 15 years, sponge iron capacity additions mostly comprised of coal-based plants[25]. In 2008 and 2009[26], 44 sponge iron plants were given environmental clearance (see *Table 1.6: Environmental clearances given to sponge iron plants*). Over these two years, clearance for 14.5 MTPA capacities was given. Region wise, maximum number of environmental clearances was granted in Odisha (15 plants) followed by Chhattisgarh (nine plants), West Bengal (eight plants) and Karnataka (eight plants). In terms of capacity, Odisha took the lead with 7.8 MTPA followed by West Bengal 3.1 MTPA.

Table 1.5: Sponge iron growth in India

Year	Total Capacity (in million tonnes)
1980	0.04
1990 - 91	1.52
2000 - 01	6.97
2001 – 02	7.50
2002 – 03	8.70
2003 – 04	10.00
2004 - 05	12.90
2008 - 09	36.70

Source: *1. http://www.steelworld.com/aper cent20nerve.htm as viewed on February 15, 2010*
2. Anon, 2005-06, Survey of the Indian sponge iron industry, Joint Plant Committee, Kolkata, pg. 18
3. Analysis based on data received from SPCBs under the Right to Information Act, 2005.

Due to an increase in the demand for steel and scarcity of coking coal for the blast furnace route, Indian sponge iron production has been increasing over the last decade. The growth in production from 12.53 MT in 2004-05 to 14.82 MT in 2005-06 was above 18 per cent. The following year witnessed a growth of about

Table 1.6: Environmental clearances given to sponge iron plants

State	No of plants		Capacity (MTPA)	
	2009	2008	2009	2008
Chhattisgarh	4	5	0.7	1.1
Jharkhand	4	–	1.0	–
Karnataka	3	5	0.3	0.5
West Bengal	5	3	2.3	0.8
Odisha	8	7	5.7	2.1
Total	**24**	**20**	**10.0**	**4.5**

Source: 1. *http://enviswb.gov.in/Env_application/GO/index.html*
2. *http://seiaa.kar.nic.in/apprisalcom.htm*
3. *http://seiaacg.org/approve.asp as viewed on February 16, 2010.*

Table 1.7: Sponge iron production

Year	Production (MT)
2004-05	12.53
2005-06	14.82
2006-07	18.34
2007-08	20.37
2008-09	21.09

Source: *Anon, 2010, Annual Report 2009 – 2010, Ministry of Steel, Government of India, New Delhi, pg.14.*

24 per cent. From 2004-05, the production of sponge iron in India has grown by about 68 per cent in 2008-09 (see *Table 1.7: Sponge iron production).*

The contribution of coal based sponge iron to the total production in the country has remained above 60 per cent since 2004-05 (see *Table 1.8: Coal and gas based sponge iron production*). The contribution of coal based sponge iron has been on the rise. From about 8 MT in 2004-05, contributing 63 per cent to the total production, it has grown to about 16 MT in 2008-09, contributing about 74 per cent. The contribution of gas based sponge iron to total production has gradually declined over the years and stands at about 26 per cent today.

The spatial concentration of sponge iron plants in India demonstrates their preference close to sources of raw materials, availability of cheap labour and various subsidies offered by different states (see *Box 2: Reasons for mushrooming of sponge iron industry).*

1.6 Production process

Raw materials used for production of sponge iron through coal route are non coking coal, iron ore and dolomite. Non-coking coal being used should be highly reactive with high fusion temperature but low ash fusion temperature. Dolomite is mainly used as a desulphurising agent.

Table 1.8: Coal and gas based sponge iron production

	2004-05	2005-06	2006-07	2007-08	2008-09
Coal based	7.89	10.28	13.08	14.53	15.57
Gas based	4.64	4.54	5.26	5.84	5.52
Total	**12.53**	**14.82**	**18.34**	**20.37**	**21.09**

Source: *Anon, 2010, Annual Report 2009 – 2010, Ministry of Steel, Government of India, New Delhi, pg.14.*

BOX 2: REASONS FOR MUSHROOMING OF SPONGE IRON INDUSTRY

Key reasons are low capital investment, high profit, subsidies and availability of raw material.

1) **Low pay back and high profit:** is one of the main reasons for mushrooming growth of small and medium scale plants. Installation of a sponge iron plant is not capital intensive and the technology required is fairly standard. A 0.033 MTPA plant requires a capital investment of about ₹7-12 crores with a recovery period of 12-18 months and can generate profits to the tune of ₹60 lakh per month.[1]

2) **Subsidies and tax holidays for industries in different States:** Many states offer tax holidays and incentives in their industrial policy, which has further triggered the growth of this sector:

   According to Chhattisgarh Industrial Policy 2004 –2009, there are direct incentives provided for industrial investment in the form of interest subsidy, infrastructure development/capital investment subsidy, exemption from electricity duty, exemption from stamp duty, exemption from entry tax, allotment of plots at concessional premium in industrial areas, exemption from land diversion fee, reimbursement of project report expenses and quality certification subsidy.[2]

   Odisha's State Industrial Policy 2001, states that all industrial projects will get an interest @ five per cent per annum for a period of five years from the date of start of commercial production on term loans availed from recognised financial institutions/banks. The interest subsidy will be limited to ₹20 lakh in case of small scale plants and ₹10 lakh in case of tiny plants.[3]

3) **Raw Material:** Proximity to raw material such as coal and iron ore.

Refractory lined rotary kiln inclined at 2.5 per cent slope is used for reduction during the process[27]. Coal, iron ore along with dolomite are fed into kiln. There are two zones in the kiln, pre heat zone maintained at about 900-1000 °C and metallization zone at about 1000-1050 °C[28]. In the pre-heat zone moisture is removed and thermal decomposition of coal takes place releasing hydrocarbons and hydrogen. Iron oxide gets oxidised to ferrous oxide.

$$Fe_2O_3 + CO = 2\,FeO + CO_2$$

In the metallization zone the final reduction of ferrous oxide to metallic iron takes place. Most of the carbon dioxide gets converted to carbon monoxide by reacting with the excess fuel. High reactivity coal is preferred in order to make this conversion faster.

$$FeO + CO = Fe + CO_2$$

$$CO_2 + C = 2CO$$

The product is discharged from kiln into the cooler at about 1000 °C. Cooler is a horizontal revolving cylinder where DRI is cooled by spraying water. The cooling water is collected and recycled into the system along with make up water. The product is screened using a magnetic separator. The non-magnetic portion consists of char, spent lime, ash and fine char and the magnetic portion is sponge iron.

The flue gases that are produced from combustion of coal flow in counter current direction followed by solids. They pass through a dust settling chamber (DSC) and pass to an After Burner Chamber (ABC). Here, the unburnt combustibles are burnt by blowing in excess air. The flue gases are then taken to Gas

Conditioning Tower (GCT) where temperature is decreased to 150 °C using water. In some plants, there might be a waste heat recovery system (WHRS) in place. In these plants, the flue gases pass through the WHRS before going to the GCT. Here, heat is extracted from the gases and this heat is used for the process. These then pass through pollution control equipment like ESP, bag filter or a scrubber where dust particles are separated. The gases are let into the atmosphere through a stack.

1.6.1 Types of technology

Technology options for coal based kiln plants are:

- **Krupp Renn:** A carboneous reducing agent is used for this process. The kiln is maintained at about 1230-1260 °C[29]. The rest of the process is the same as described above. Due to a large part of sulphur present in the reducing agent which goes into the product, the economic conversion into steel is difficult using the conventional processes.

- **Krupp – CODIR:** The process requires a flux like ore, oxide pellets, reductant, dolomite or limestone. The kiln temperature is maintained between 950 and 1050 °C[30]. The rest of the process remains the same.

- **SL/RN (Outcompu):** The process uses a flux to remove sulphur from the coal. The kiln temperature is maintained between 900 and 980 °C[31]. Process kilns are equipped with nozzles for injection of air (about 25 per cent) in the pre-heat zone of the kiln. Thus, the pre-heat zone is shortened because of better heat transfer and fuel utilisation.

- **Allis Chalamers Controlled Atmosphere Reactor (ACCAR):** The kiln for the process is equipped with a detailed port system and valves arranged around the circumference for liquid and gases fuel injection. Since either kind of fuel can be used in the kiln, it is looked at as an advantage.

- **DAVY Reduction Corporation (DRC):** The process requires a flux as well. The raw materials are passed through the rotary kiln followed by a pre heat zone and a reducing zone. Tubes are placed along the length of the kiln which supplies combustion air. Maximum reduction zone temperature is 1060 °C and kiln gas temperature is about 1160 °C[32].

- **Customized/Indigenous:** In India, the DRI process is modified in minor ways and is called customized/indigenous. These modifications can just be in terms of feed ratio or length and diameter of the kiln. Some common customized processes in the country are – Jindal, TDR, Sponge Iron India Limited, Orissa Sponge Iron Limited, Popurri Engineering, etc[33].

Rotary hearth and retort processes are widely used all over the world. Some of these are:

- **INMETCO:** The process uses a rotary hearth furnace instead of a rotary kiln. The furnace is separated by air curtains into different zones ñ oxidizing, reducing and natural discharge. Burners above the shallow bed are fired with coal.

- **Salem Direct Reduction:** Uses the rotary hearth furnace as a reduction reactor. The furnace has a stationary roof which is fitted with water cooled arms fixed across one radius. On rotation, the arms move the burden towards a central heat soaking pit.

- **Hoganas:** The process involves charging alternate layers of iron ore, coke breeze and limestone into cylindrical ceramic containers called saggers. The mixture then moves to a tunnel-kiln where it is heated to about 1260 °C[34]. After cooling, the containers are removed and the reduced iron is collected mostly as iron powder.

Gas based processes today account for about 92 per cent of the DRI production in the world[35]. In gas based processes the reduction of iron oxide is carried out by a mixture of carbon monoxide and hydrogen at a temperature of about 750-950 °C[36]. Reformation of natural gas is carried out by partial oxidation of hydrocarbons to produce the reducing gas. The common gas based DRI processes being used in India are:

- **MIDREX:** The main components of the process are a DRI shaft furnace, gas reformer and cooling gas system. The furnace has a refractory lining in the reducing zone. The charge material is fed into the furnace from the top through seal legs and the discharge is also through them from the bottom. Reducing gas enters the furnace from the bottom of the reducing zone. Oxide is reduced to metal by the counter current flow of the reducing gas. DRI is then cooled and screened for removing fines.

- **HYL-III:** The main components of this process are DRI shaft furnace, gas reformer and a gas reheator. The process is similar to MIDREX and employs catalytic steam reforming of natural gas.

A number of other processes are also employed like Nippon Steel Corporation (NSC) process, fluidised bed process, Hot Iron Briquettes (HBI) process, etc. Another process is the smelting reduction process for DRI production. The only smelting reduction process operating on a commercial basis is **COREX**[37]. It is a two stage process where first iron ore is reduced to sponge iron in a furnace using reducing gas (CO and H_2). Reducing gas is supplied by the gasification of coal. In the second step, the reduced iron is melted in the melter-gasifier. Partial combustion of coal provides the heat to melt the iron. The Jindal plant in India uses this technology.

1.6.2 Resource consumption

The sector uses various resources like land, energy, coal, iron ore, dolomite, water, etc. Iron ore requirement is 1.6 tonnes per tonne DRI, coal requirement is 1.3 tonnes per tonne DRI and dolomite is 0.05 tonnes per tonne DRI (see *Table 1.9: Daily raw material requirement for a 0.033 MTPA plant*). At present, total iron ore required for the sponge iron industry stands at 32 million tonnes, coal requirement at 26 million tonnes and dolomite at 1 million tonne[38].

Other inputs include land, energy and water. Land requirement for a sponge iron plant varies with size and ranges from 90 to 212 ha per MTPA[39]. For a typical 0.0165 MTPA plant the approximate requirement of land is around five ha[40].

The sector is recognised as an energy intensive sector. Power consumption for a sponge iron plant depends on the process and the kiln dimensions. SL/RN process exhibits the highest energy consumption of about 22 Giga Joule (GJ) per tonne of sponge iron[41]. For the Krupp-CODIR process, ACCAR process and the HYL-III process, the energy consumption is of the order 16 GJ per tonne of DRI[42]. For MIDREX, the energy consumption stands at about 15 GJ per tonne sponge iron[43]. Some better plants using MIDREX and HYL-III require an energy input of the order of 11 GJ per tonne product[44].

Table 1.9: Daily raw material requirement for a 0.033 MTPA plant

Raw material	Quantity (in tonnes)
Iron ore	160
Coal	130
Dolomite	5

Source: *Analysis based on information from Anon, 2007, Comprehensive Industry Document: Sponge Iron Industry, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 62.*

Water is utilised in three areas in a sponge iron plant viz., cooler, after burning chamber (ABC) and wet scrubber. It is also used for dust suppression. Cooling water requirement is 1.3 cubic meters (m^3) per tonne of sponge iron (see *Table 1.10: Water requirement in a sponge iron plant*). Wet scrubbing utilises about 0.8 m^3 of water per tonne DRI and 0.5 m^3 of water per tonne DRI is required in an ABC[45]. In the ABC, water is sprayed through nozzles to

Table 1.10: Water requirement in a sponge iron plant

Purpose	Water requirement (m^3/tonne DRI)
Cooling	1.32
ABC	0.48
Dust suppression	0.30
Wet scrubber	0.78
Total	**2.88**

Source: *Based on information from Anon, 2007, Comprehensive Industry Document: Sponge Iron Industry, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 74-75.*

control the temperature of the gases. Water requirement for dust suppression is about 0.3 m^3 per tonne sponge iron. Thus, total water requirement for producing one tonne sponge iron is about 2.9 m^3.

2. Sponge iron: Environmental concerns

Sponge iron is a rapidly growing industry in India. Undoubtedly, it has brought economic enrichment to the private entrepreneurs; but at the same time it has also brought the curse of environmental degradation in the form of air pollution, pressure on local resources, degradation of land and adverse health impact.

Air pollution is one of the biggest hazards of these plants. Air pollutants include dust and gaseous pollutants (SO_2 and NO_X). Dust is a bone of contention for the sector. It enters the ambient air from fixed (stacks) or diffused (fugitive emissions) sources (see *Box 3: Air pollution sources in a sponge iron plant).* The kiln, cooler discharge and product house are the potential point sources of emissions. Fugitive dust emissions are also a concern. These are produced during raw material and product handling, loading, unloading, storage, transportation of raw material and product, handling and disposal of char and poor housekeeping.

The situation is worsened due to non installation or non operation of pollution control equipment. Medium and small-scale plants dominate the sector and these do not have sufficient technical competence or the financial capacity to install pollution control equipment or they willfully do not operate them and as a result emit significant quantities of pollutants. Even if they install the pollution control equipment, they don't meet the standard or they don't run it during night.

Another problem with the industry is the high carbon dioxide (CO_2) generation potential. Every 0.033 MTPA of sponge iron production generates about 594-660 tonnes of CO_2 every year[46]. This estimates the total CO_2 generation by the industry in India to be between 0.53-0.59 million tonnes per year[47].

Sponge iron industry is relatively less water intensive but the impact is high as most of the water sourced is ground water. For example, in Jharkhand, 75 per cent of the industries use ground water[48]. Excessive extraction of ground water leads to reduction in the ground water table and affects the availability of water in the surrounding areas.

BOX 3: AIR POLLUTION SOURCES IN A SPONGE IRON PLANT

Point source: from kiln and cooler

Non point source: raw material handling, product discharge system, cooler discharge conveyors, transfer points, junction house, screens, magnetic separators, storage silos, packing and truck loading.

This has been noticed especially in case of Bellary district in Karnataka[49]. Each sponge iron plant operates about 4-5 bore-wells for extracting groundwater. With the increasing number of sponge iron plants in the district, even these plants find it difficult to source groundwater. The Sponge Iron Manufacturer's Association in the district, wants to get the sewage water (after treatment) allocated to them[50]. However, since this sewage water has been a major source of water allocated for agriculture, the irrigation department is deliberating on the proposal. The industry does not discharge huge

Table 2.1: Generation of solid waste

Waste (tonnes/tonne of sponge iron produced)	0.033 MTPA plant	0.165 MTPA plant
Char	0.28 – 0.30	0.28 - 0.32
Dust from settling chamber	0.03 – 0.04	0.20 – 0.24
ESP waste	0.10 – 0.13	0.17 – 0.19
Kiln accretion	0.02 – 0.04	0.015 – 0.02

Source: *Anon, 2004, Description of clean technology for sponge iron plant and development of environmental standards, MECON Limited, Ranchi, pg. 5 - 10.*

Table 2.2: Char disposal practices in different states

State	Dumped (in per cent)	Reused (in per cent)	Sold (in per cent)
Jharkhand	60	26	15
Odisha	100	0	0
West Bengal	100	0	0

Source: *Analysis based on data obtained from SPCBs under the Right to Information Act, 2005.*

amounts of effluents but causes immense pollution as a result of the runoff water during monsoon season which enters the water bodies.

Solid waste generated is in the form of char, dust from the settling chamber, kiln accretion, ESP wastes and gas cleaning plant sludge (see *Table 2.1: Generation of solid waste*). A typical 0.033 MTPA sponge iron plant generates about 29 tonnes of char everyday and its total solid waste load is about 47 tonnes per day.

Char is usually dumped in the factory premises or nearby agricultural fields, reused in a captive power plant or sold. This clearly points to the inability of small scale plants to manage char properly due to non availability of adequate land or resources. In Jharkhand, 60 per cent industries dumped the char, 26 per cent reused it and 15 per cent sold it (see *Table 2.2: Char disposal practices in different states*). All plants in West Bengal and Odisha dumped the char within or outside premises.

3. Social impact of sponge iron industry

These industries emit significant amounts of pollution into the atmosphere from the kiln, raw material handling and dust from the unpaved roads on which the trucks ply. This affects the health of the people residing in the nearby areas. It also affects the livestock and forests in turn affecting the livelihood of the people dependent on these forests, agricultural yield, etc.

3.1 Illegal operations

Low capital investment coupled with high profit margin has encouraged illegal sprouting of sponge iron plants. Illegal sponge iron plants are present in different districts of Odisha like Sundargarh, Keonjhar, Jharsuguda, Angul, Dhenkanal, Cuttack and Jajpur (see *Box 4: Illegal plants in Odisha*). These

BOX 4: ILLEGAL PLANTS IN ODISHA

Odisha has registered the highest number of illegally operating sponge iron plants. The official figures for Odisha claim 108 sponge iron plants in the state[1] but the unofficial figure is as high as 150[2].

affect over 200,000 people with pollution hazards[51]. These plants have somehow managed to start production without obtaining the No Objection Certificate (NOC) from the SPCB. Among the different districts of Odisha, Sundargarh is the worst hit with illegal emergence of sponge iron plants. Even though a Schedule V area, land still continues to be shifted for the illegal plants without approval from the local *gramsabhas* and clearances from the concerned authorities.

Several reports claim illegal mining of iron ore has also intensified manifold in sponge iron dominated states. In Karnataka numerous cases of illegal mining can be found in Hospet and Sandur which supply cheap iron ore to the sponge iron plants in Bellary. In a raid on Bellary Steel in June 2008, the plant failed to produce an invoice for the iron ore purchased[52]. The state lost an estimated Rs 230 crore as these illegal operations put excessive pressure on the roads owing to heavy transport being used to carry the illegally mined ore[53]. Border areas of Odisha and Jharkhand are also a hub for illegal supply of iron ore to several sponge iron plants. A number of crushers have come up in the area to facilitate easy movement of iron ore produced illegally. Illegal mining and smuggling of coal and iron ore is common in Angul, Jharsuguda, Joda and Koida areas of Odisha. The Keonjhar-Pallahara-Angul route has become the safest route for illegal transportation of iron ore and coal[54]. Raniganj in West Bengal is another area where illegal mining of coal is practiced for sponge iron clusters.

3.2 Health impact

Sponge iron plants emit oxides of sulphur and nitrogen and hydrocarbons. These air pollutants are likely to increase the incidence of respiratory tract ailments, e.g., cough, phlegm, chronic bronchitis and also exacerbate asthmatic conditions[55].

Almost two lakh people are adversely affected by sponge iron plants in Odisha[56]. In Chhattisgarh, people residing in Siltara, Urla and Borjhara are suffering from asthma, skin diseases and bronchitis. The regional MLA Devji Patel claims that due to the effect of pollution a lot of people have died and the average age of man has been reduced by 10 years[57]. In Bellary, Janakunte village has is suffering drastically for in the last three to four years, the incidence of asthma has increased in the village[58].

As many as 650 people are employed in a 0.594 MTPA plant while in a smaller plant of 0.0165 MTPA, 45 people are employed[59]. This shows that large numbers of people are involved in the sponge iron manufacturing process exposing themselves to the hazards of the industry. Work zone area around these plants is affected in terms of air pollution. According to CPCB, in 0.198 MTPA plants, SPM levels inside the factory premises were found to be 3.5 times to 18.6 times higher than the standard[60]. Similarly, in a plant with size varying from 0.0495 to 0.099 MTPA, the SPM level range was 1.6 times to 8.4 times higher then the standard[61]. Inhaling this level SPM can lead to drastic health problems. In Bellary, the health of workers from the sponge iron plants is severely affected due to the emission from the plants. Their lungs are destroyed and their life expectancy is low[62]. In case of Odisha, it was observed that in M/s Aryan Steel the AAQ near the labour shed was 462 $\mu g/m^3$, which is within the prescribed limit but harmful for the health of the labourers and this was noted to be the highest value as compared to the readings at other locations inside the industry[63]. Ambient SPM was found to be as high as 1,126 $\mu g/m^3$ incase of M/s B.R Sponge Iron[64]. Such high ambient air quality is bound to impact the health of the workers. In Jharkhand it was found that M/s Chandil Industries had ambient SPM as high as 1,256 $\mu g/m^3$ which is 2.5 times higher than the prescribed limit[65].

A large proportion of school children in the Durgapur-Asansol belt suffer from upper and lower respiratory tract infection[66]. So one can only imagine the condition of the factory workers who are directly exposed to the polluting process for long hours. There are no regular health check ups for the workers in the sponge iron industry[67]. According to *Nagarik Mancha*, an NGO in West Bengal, nearly 7,000 workers engaged in 42 sponge iron plants in the state are suffering from various diseases[68].

3.3 Impact on agriculture

The villages located on the periphery of sponge iron plants have their agricultural fields rendered unproductive with accumulation of dust and emissions on the soil. The quality and quantity of agricultural produce has also been affected. In Banskopa village in West Bengal, close to a 0.132 MTPA plant of Jai Balaji Industries, villagers claimed of decreased agricultural productivity from 800 kg per *bigha* before the plant was set up to 450 kg per *bigha* in the last three years[69]. In Bellary, fields near the sponge iron industries have been wrecked by black soot particles. These fields were brought by the industrialists but the cost paid to the farmers for the land was less than the market rate[70].

There are instances where court cases have been passed with verdicts for compensation. For example, the division bench of Andhra Pradesh High Court passed a verdict directing the sponge iron plants located at Shadnagar area of Mehaboobnagar district to deposit ₹3 crore with the district authorities as a token of compensation for the crop loss suffered by farmers[71].

3.4 Change in livelihood pattern

Farmers become unemployed since fields are devastated or the industrialists buy this land and pay less. The industrialists prefer one-time compensation rather than a periodic one. The farmers get involved in other subsidiary work like masonry or are employed in the industries on contract basis. Also, illegal mining for sponge iron production has caused a drastic shift in the livelihood pattern of the villagers. Farmers lease out their lands for mines and become labourers involved in sorting fines and lumps.

Impact of air pollution from sponge iron plants is seen in the case of non-timber forest produce as well (see *Box 5: Impact on livelihood of people in Chhattisgarh*). In Odisha, Bonai area is famous for collection of various types of NTFP such as *tendu* leaf, *mahua*, *char*, etc. Pollution has severely affected the production of NTFP. The amount that each year local people have lost due to reduction in NTFP is around 10 lakh rupees[72]. Similarly the lac tree, which contributes to the income of local people, is badly affected.

The effect is not just limited to forests. River Brahmani which flows in north and east direction of Bonai town was famous for its small prawn variety which has a good demand in Rourkela. Black dust deposition on the river bed has affected this species. The fishermen of this area are no longer able to catch fishes and are working as daily labourers at Rourkela town[73].

4. Regulations

Being a highly air polluting sector, Ministry of Environment and Forests (MoEF) has classified the sponge iron under the Red category of industries pointing towards the industry's high pollution potential. The emission standards in place for sponge iron plants give separate standards for stack, carbon monoxide and fugitive emissions.

BOX 5: IMPACT ON LIVELIHOOD OF PEOPLE IN CHHATTISGARH

In Chhattisgarh, sponge iron industries have caused reduction in non-forest timber produce (NFTP). *Mahua* flowers and seeds and *tendu* (*bidi*) leaves are the chief forest produce, collected by local people. *Mahua* collectors have raised issues stating deposition of black dust on the flowers and reduction in number of trees due to diversion of more forestlands to industries. Decrease in size of *tendu* leaves is another common complaint.

Impact on sericulture, another important source of livelihood in Chhattisgarh too, is attributed to sponge iron industries. This is because the leaves have dust deposition and the silk worms cannot feed on these leaves affecting the quality (size) of the larva. Increasing non-availability of green pastures for the animals is a problem as forest and grazing lands are shrinking as well as getting covered with industrial pollutants.[1]

Table 4.1: Stack emission standards

Parameter	Coal-based	Gas-based
Particulate Matter (PM in mg/Nm^3)	100	50

Source: *http://envfor.nic.in/legis/ep/414E.pdf as viewed on April 27, 2010.*

Table 4.2: Fugitive emission monitoring locations

Area	Monitoring locations
Raw material handling	Wagon tippler, screen area, transfer points and stock bin area
Crusher	Crushing plant, vibration screen and transfer points
Raw material feed	Feeder and mixing areas and transfer points
Cooler discharge	Discharge area and transfer points
Product processing	Intermediate stock bin area, screening plant, magnetic separation unit, transfer points, discharge area, product separation area and bagging area.

Source: *http://envfor.nic.in/legis/ep/414E.pdf as viewed on April 27, 2010.*

The stack emission standards are different for coal based and gas based sponge iron plants (see *Table 4.1: Stack emission standards*). Particulate matter (PM) standard for coal based plants is 100 mg/Nm^3. In addition, the CO_2 level if monitored is to be maintained at less than 12 per cent. For gas based plants, the PM stack standard is 50 mg/Nm^3. Also, carbon monoxide levels are not to exceed one per cent by volume for both kinds of plants[74].

Minimum stack height for these plants for proper dispersion of sulphur dioxide (SO_2) is set at 30 meters (m) based on SO_2 emissions (in kg/hour)[75]. PM standard for fugitive emissions within the premises is set at 3,000 µg/m^3 for existing plants and 2000 µg/m^3 for new plants at a distance of 10 m from various locations (see *Table 4.2: Fugitive emission monitoring locations*)[76].

The national ambient air quality (NAAQ) standards are applicable for sponge iron plants. The ambient Suspended Particulate Matter (SPM)[77] should be less than 100 µg/m^3. Effluent standards for the industry are also in place (see *Table 4.3: Effluent standards for sponge iron industry*). These specify the pH, total suspended solids (TSS), chemical oxygen demand (COD), etc., for the waste water discharged from these plants. There is no mention of solid waste in the regulations even when it is a major problem for the sector.

In addition to these compulsory standards, there are some optional guidelines that the sector can follow under the charter on Corporate Responsibility for Environmental Protection (CREP). These guidelines state that an electrostatic precipitator (ESP) and other pollution control equipments are to be installed to meet the prescribed emission standards[78]. Air pollution control equipment should be provided with continuous power supply. A dust collection system should also be put in place. CREP suggests that the fugitive emission measurement be done on an eight hourly basis with a high volume sampler[79]. The guidelines recommend making interlocking system mandatory for the sponge iron

Table 4.3: Effluent standards for sponge iron industry

Parameter	Standard (in mg/litre except pH)
pH	5.5 - 9.0
TSS	100
Oil and grease	10
COD	250

Source: *http://envfor.nic.in/legis/ep/414E.pdf as viewed on April 27, 2010.*

plants to keep check on non functionality of pollution control equipment as their non function would imply stopping the process. An interlocking system is essentially an interlinking of the plant operation with the pollution control equipment. It ensures stoppage of feed conveyor, so that feed to the kiln would stop automatically, if safety cap of the rotary kiln is opened or air pollution control system is not in operation[80]. Odisha SPCB decided to adopt interlocking system to combat the ESP non operation[81]. However, sponge iron plants were hesitant to adopt the technology since it would cost around ₹8 lakh per interlocking system[82]. The guidelines also state that since the installation and operation of pollution control equipment is not economically viable for small plants (less than 0.033 MTPA), these plants should not be permitted in future[83].

For effluent, the guidelines mention that efforts are to be made to develop ‘zero discharge’ plants and to reuse water[84]. Storm water drains are to be provided within the plant premises to avoid mixing with effluent[85]. CREP does mention solid waste related guidelines. It recommends that plants with 0.066 MTPA capacities and above should install a Fluidised Bed Combustion (FBC) boiler for power generation[86]. Char mixed with coal or coal rejects is to be used as a fuel in this boiler. There is a suggestion of using a common FBC boiler by sponge iron plants in vicinity or in a cluster. Other options for char utilisation mentioned under CREP are selling to local coal briquette manufacturers, using in brick kilns, etc. There is a clear guideline against disposing the char in agricultural fields. The kiln accretions are suggested to be used in road construction or landfilling. The flue dust generated in air pollution equipment should be recycled or reused appropriately.

Sponge iron plants with capacities more than 0.033 MTPA should install a waste heat recovery boiler (WHRB) for power generation as per the CREP guidelines[87]. Water sprinkling near loading area, enclosed area for crushing, screening and conveying, concrete roads, 15 m wide green belt, etc., are other recommendations under the guidelines. The guidelines state that no new sponge iron plant should be commissioned without installation of proper pollution control equipment. All the kilns are to have a separate stack.

A siting guideline forms a part of CREP. The important aspects of these are:

- The plants should be at a distance of at least one kilometre (km) from residential habitation and ecologically or otherwise sensitive area.
- The plants should be at least half a km from the national and state highways.
- Radial distance between two plants should be five km for plants with 0.165 MTPA capacities.
- If any plant/cluster is located within one km from any residential area/village, they maybe shifted by the SPCB/State government in a phased manner.

5. CSE study

The main objective was to study the impact of sponge iron industry and suggest appropriate measures.

- To study the overall scenario of sponge iron industries in India,
- To study the environmental and social issues associated with sponge iron industries,
- To study regulatory performance and compliance status, and
- To identify the way forward to improve the current scenario.

Inspection reports were received from the State Pollution Control Boards (SPCBs) of four states under the Right to Information Act, 2005. The four states are Chhattisgarh, Jharkhand, Odisha and West Bengal. These reports differed drastically in their reporting format. Also, not all the information was contained in all the inspection reports making the data availability very sporadic. The quality of data available through inspection reports was extremely poor for Chhattisgarh.

A total of 193 sponge iron plants were analysed based on the inspection reports received from SPCBs. Four hundred and twenty four inspection reports (including night inspections) were made available for the plants in the four states from 2005-06 to 2008-09. We had at least one inspection report of each of the plant over this period although multiple reports were present for some.

- **Odisha:** There are 98 plants in Odisha for which inspection reports were made available by the SPCB. 202 inspection reports were analysed over a period of two years (2007-08) and (2008-09). For the year 2007-08, 101 inspections reports were analysed for 75 plants. For the year 2008-09, 101 reports were analysed for 82 plants.

- **Chhattisgarh:** Ninety three inspection reports were analysed for 59 plants over a period of three years, (2006-07), (2007-08) and (2008-09). For 2006-07, 32 reports were analysed for 20 plants. For 2007-08, 44 reports were studied for 28 plants while in 2008-09, 17 reports were analysed for 10 plants.

- **West Bengal:** Sixty seven inspection reports for only 12 plants were made available over a period of three years, (2006-07, (2007-08) and (2008-09). Analysis of 18 reports was carried out for 2006-07 for eight plants. Twenty five inspection reports for 10 plants were analysed for 2007-08. In 2008-09, 24 reports were studied for 25 plants.

- **Jharkhand:** In Jharkhand, a total of 62 inspection reports were available for (2005-06), (2006-07), (2007-08) and (2008-09) for 24 plants. 11 inspection reports were analysed for the first year for 11 plants, 16 for the next year for 16 plants, 19 for the third year for 19 plants and 16 for the last year for 16 plants.

For the available inspection reports, 189 ambient air quality (AAQ) monitoring reports were made available for plants only in Odisha and Chhattisgarh. Data was made available for the years (2006-07), (2007-08), (2008-09) and (2009-2010).

- For the year 2006-07, 21 AAQ reports were analysed for Chhattisgarh for seven plants. No data for the year was made available for Odisha.
- For 2007-08, 25 AAQ reports were made available for 22 plants in Odisha. For the year 2007[88], 53 AAQ reports were analysed for 11 plants in Chhattisgarh.
- In 2008[89], 34 AAQ monitoring reports were analysed for 10 plants in Chhattisgarh. For Odisha, 46 reports were studied for 43 plants in 2008-09.
- For 2009, 31 reports were made available for 10 plants in Chhattisgarh.

Two hundred sixty five stack monitoring reports were made available for (2006-07), (2007-08), (2008-09) and (2009-2010) for Odisha, Chhattisgarh and West Bengal.

- **Odisha:** 53 stack monitoring reports were studied for 45 plants in 2007-08 while 59 reports were studied for 50 plants in 2008-09.

- **Chhattisgarh:** In 2007, 44 stack monitoring reports for nine plants were studied. In 2008, 32 reports for 10 plants and in 2009, 27 reports for 9 plants were studied.

- **West Bengal:** 22 stack monitoring reports were studied for nine plants in 2006-07. 16 reports were analysed in 2007-08 for 11 plants. In 2008-09, 12 reports were analysed for eight plants.

5.1 Poor compliance

Among industrial sectors, sponge iron is the most unorganized and unregulated in the country and has recorded very high rate of non-compliance. Most of the non-compliances in the industry can be divided into: (i) non compliance with respect to air pollution control equipment and (ii) non compliance with respect to standards[91].

5.1.1 Non compliance with respect to air pollution control equipment

In terms of meeting the legal requirements, performance of this sector is not encouraging. There are many instances where production is on but ESP does not function or in some cases production has commenced without installing the pollution control equipment. SPCB has quite often issued show cause notices against the defaulters but pollution goes unabated. Even the defaulting plants seemed to have realised that show-cause notices will not bring significant halt in their production and profit.

In the consent conditions, SPCBs put in a condition to install the ESP at the main kiln. Data for ESP installation was obtained for 133 plants only. Eighty seven per cent (116 plants) had installed an ESP while 13 per cent were operational without one. This points to the fact that although put as a consent condition, its implementation is not really verified. In 2006-07, 25 per cent plants[92] had an operational ESP while 11 per cent had a partially operational one implying 64 per cent non functional ESPs. Compliance increased in 2007-08, with 79 per cent of the plants[93] having a functional ESP and two per cent having a partially functional one. About 19 per cent of the plants still remained operational with a non functional ESP. In 2008-09, non functionality of ESPs came down to 11 per cent and functionality increased to 85 per cent of the plants[94]. Thus over the period of these three years, although functionality of ESPs has increased, a number of sponge iron plants are still operating without a proper ESP. For example, in Jharkhand one fourth of the plants are operating without one[95]. Also, in 2008-09, almost 50 per cent of the plants in the sample[96] exhibited leakage of flue gases from the emergency cap of the ESP. This implies that the ESPs were either not functional or inadequate defying the purpose of having one in place.

Amongst the night inspections conducted by the SPCBs to check the compliance status, 73 per cent of the plants[97] operated their ESPs partially and 27 per cent were with non operational ESPs. Thus 100 per cent non compliance was observed. Hundred per cent of the plants in the sample also showed leakage from ESP cap further pointing towards the non operation of ESPs at night (see *Box 6: Non compliance of plants during night inspection*)[98].

Another important concern for small and medium scale sponge iron plants is the lack of continuous power supply for the pollution control equipment. The small-scale plants lack power backup and in case of a power cut, the emergency caps of the ESP opens and spills the black dust into the atmosphere causing a huge black cloud. Sponge iron plants save electricity by shutting down the ESPs at night and as a result compliance with emission standards is minimal during night.

Bag filter is also an important pollution control equipment. It needs to be installed at a number of locations in the plant to abate fugitive emissions (see *Table 5.1: Bag filter locations in a sponge iron plant*). Ninety eight per cent of the plants in the sample[99] had installed a bag filter at the coal crushing plant. Ninety six per cent of the plants[100] had installed a bag filter at the iron ore crushing plant and 98 per cent of the plants in the sample[101] had installed a bag filter at the transfer point. At cooler discharge, 99 per cent of the plants installed a bag filter[102]. Intermediate bins had bag filters installed in 99 per cent of the plants in the sample[103] while bag

BOX 6: NON COMPLIANCE OF PLANTS DURING NIGHT INSPECTION

In Odisha, eight plants were found non compliant during night inspections. The common non-compliances were non functional or partially functional pollution control equipment, emissions from stack, fugitive emissions and leakage of flue gases. In West Bengal 17 plants and in Chhattisgarh 16 plants were non compliant during these inspections for similar reasons. In West Bengal and Chhattisgarh most of these plants were repeatedly found non compliant during night inspections but were usually let go after just being served a direction[1].

Table 5.1: Bag filter locations in a sponge iron plant

Location	Function
Stock house	The place where all the raw materials are stored
Coal crushing unit	Here coal is crushed and screened to the required size and sent to the stock house
Iron ore crushing unit	Here iron is crushed and screened to the required size and sent to the stock house
Transfer point	From here the raw materials are conveyed to the required sites in the plant
Cooler Discharge	Sponge iron is cooled in the cooler using water. This is the place from where the product is discharged
Intermediate bin	Sponge iron is stored here temporarily
Product separation	Is the unit where sponge iron is screened to the required size and separated from the fines
Product house	Products are stored here for dispatch to the customers

Source: *http://www.jankicorp.com/process_flowsheet_steel.html as viewed on April 15, 2010.*

filter installation at product house was 99 per cent[104]. On an average, bag filters were installed at four to five locations and most of the plants installed one at coal crushing plant and cooler discharge. A problem with bag filter data was that most of the plants did not report on it at all. Therefore, in the absence of a bag filter at a certain location, due to no reporting, was considered as no data and hence not included in the sample. High fugitive emissions were recorded during inspection at 68 per cent plants in the sample[105] in 2008-09. This large number of plants exhibiting fugitive emissions in spite of near 100 per cent presence of bag filters points towards their non functionality and inadequacy. The night inspections recorded presence of high fugitive emissions in 100 per cent of the sample[106].

In Odisha, 98 per cent of the sample[107] had a bag filter attached at the coal crushing plant and 95 per cent[108] plants had one at their iron ore crushing plant. Ninety seven per cent of the sample[109] installed a bag filter at the stock house while 100 per cent of the sample[110] has installed bag filter at the transfer point. Hundred per cent of the sample[111] also installed a bag filter at the cooler discharge. Twenty one plants in the state have a bag filter at the product separation plant/site. In Chhattisgarh the situation is grim. Only three plants had a bag filter installed at the stock house, four at the coal crushing plant, two at the iron ore crushing plant, one at the transfer point, four at cooler discharge, 10 plants at the intermediate bin, four at product separation and seven plants at product house. None of these were found operating at the time of inspection. In case of Jharkhand, out of 23 plants, bag filters are installed at 18 plants for coal crushers, at nine plants for iron ore crushers, at 13 plants for transfer points, at 19 plants for cooler discharge, at 13 plants for intermediate bins and at 18 plants for product house[112]. In West Bengal, bag filters are located at product house (in eight plants out of 12), coal crushing plant (six plants), iron ore crushing plant (two plants), cooler discharge (seven plants), stock house (four plants), transfer points (one plant), intermediate bin (three plants) and product separation (one plant).

5.1.2 Non-compliance with respect to meeting the standards

The standard for stack emissions for the sponge iron industry was 150 mg/Nm^3 but from May 2008, a new standard of 100 mg/Nm^3 was made compulsory for the plants irrespective of their size[113]. The standard does not give any limit for the emission of SO_2 and oxides of nitrogen (NO_x). Overall, the sector is performing poorly when it comes to meeting regulatory standards and consent conditions. SPCBs have carried out stack monitoring for various sponge iron plants in their states and even though the pollution control equipment are installed, their stack emissions did not meet the standard. The range was extremely varied for all locations. At the main stack, the particulate matter was in the range of 30-2,292 mg/Nm^3 across different sized plants[114]. In Odisha, nine per cent non compliance was observed in meeting the standard for PM at the main stack. In West Bengal, the range lay between 16 and 4,746 mg/Nm^3. Fifty two per cent of the plants[115] were non compliant with the standard. Highest value was noted for M/s Govinda Impex with a stack reading of 4,746 mg/Nm^3. These ranges indicate very high levels of particulate matter exceeding the limit of 100 mg/Nm^3 many folds.

Also the ambient air quality within the factory premises and adjoining areas does not meet the prescribed standards. There have been several cases of non-compliance in meeting the emission standards as reported from different parts of the country. In Odisha, the ambient SPM range near office area was[116] 134-687 µg/m^3. SPM levels near ESP in Odisha were also very high, in the range of 340-1,126 µg/m^3. M/s Shiv Metalliks in the Bonai cluster repeatedly exhibited very high levels - 2780 µg/m^3 in 2006-07; 2,025 µg/m^3 in 2007-08 and 570 µg/m^3 in 2008-09. A number of plants defaulted and went beyond the standard of 500 µg/m^3 for industrial areas at different locations (see *Table 5.2: Ambient air quality*).

Adding to the industry's air pollution potential is the proximity of sponge iron plants in these clusters. The guidelines for location are not being abided in different states and this has become a serious cause of concern for the regulators and also a cause of conflict between the sponge iron plants and local people. In West Bengal, a 0.13 MTPA sponge iron plant of Jai Balaji Industries is located next to a village. There are also instances where the sponge iron clusters are present next to reserved forests, for example Kuarmunda and Bonai clusters in Odisha.

5.1.3 Show cause and closure notices

In Odisha over the last five years, 137 show-cause notices were issued by the Odisha SPCB.[117] But the problem of environment degradation still exists rather it has been magnified in sponge iron dominated areas. Out of the 74 plants for which data was made available, close to 50 per cent were served show cause or closure notices. Reasons revolved around high emissions, defective pollution control equipment, improper solid waste disposal, etc. But in spite of these notices, many plants remained repeat offenders.

Odisha SPCB served closure notices to nine plants in Sundargarh[118] due to non-compliance of pollution norms. ESPs were not properly functioning resulting in heavy emissions. No preventive measures to arrest fugitive emission at coal injection sites and iron ore crushers and screening plants were taken despite directions from the SPCB. Villagers residing in the nearby areas constantly complained about the pollution leading to the Odisha SPCB serving closure notices to another seven sponge iron plants in Sambalpur and Jharsuguda districts[119]. The reasons for these notices were:

- M/s Jai Hanuman Udyog and M/s L N Metallics were dumping solid wastes outside factory premises haphazardly and even after repeated directions,
- The other five sponge iron plants failed to manage their ESPs resulting in high emission from the plants.
- In one case, it was noticed that solid waste was being disposed off in an abandoned quarry close to the Hirakud reservoir.

Show-cause notice was also issued by Odisha SPCB to M/s Surya Sponge Iron, the oldest sponge iron plant in the state, located at Badhakendua village in Jajpur district. The plant was directed to close down the facility for operating without permission for a period of six months[120]. Also, during inspection it was found that stack emission was above the prescribed limit, dust emission were observed from the outlet area of kiln, coal crushers and product house of kiln indicating malfunction of bag filters. Twenty sources of pollution were identified in the plant. The plant was served a closure notice in March, 2008 which was

Table 5.2: Ambient air quality

State	Plant	SPM (µg/m^3) 2009
Odisha	Aarti steels Ltd.	603
	Beekay Steel & Pvt Ltd.	559
		868
		670
	Joy Iron & Steel	670
		548
	Rathi Steel and Power Ltd.	544
	Shree Madhav Ispat Pvt Ltd.	582
	Bhushan Steel Ltd.	643
	Samaleswari Ferro Metals Ltd.	595
		618
	Sumrit Metalliks Pvt. Ltd.	538
	Hima Ispat Pvt. Ltd.	586
	Rungta Mines Ltd.	598
	Visa Steel Ltd.	687
	Orion Ispat Ltd.	530
	Vedvyas Ispat Ltd.	658
	Nixon Steel & Power Ltd.	825
	Kalinga Sponge Iron Ltd.	785
	Agrasen Sponge (P) Ltd.	729
	Shree Ganesh Metalliks Ltd.	689
	Shiv Metalliks Ltd.	570
Jharkhand	Balaji Industrial Products	510
	Maa Chinnamastika Cement & Ispat Pvt. Ltd.	589
	Vallabh Steels Ltd.	1530
Karnataka	Benaka Sponge Iron Ltd.	657
		526
	Bellary Ispat Pvt. Ltd.	517
	Hothur Steel	922
		811
	Gayatri Metals	537
		599
		754
	Bellary Steels & Alloys	516
		523
		528

Source: *Analysis based on data from SPCBs under the Right to Information Act (RTI), 2005.*

revoked stating that the industry would comply and operate ensuring the running of pollution control equipment.

Similar conditions prevail in West Bengal, where over a couple of years, the West Bengal SPCB issued some 250 closure notices to 55 plants for flouting the norms[121]. In Jharkhand, 21 show cause notices were issued to 24 plants between 2007 and 2008 for not installing or not operating ESPs and for flouting other pollution norms[122]. Notices were issued and later withdrawn without achieving any result.

5.1.4 Court cases

Since SPCBs fail to bring these flouting plants to book, people resort are approaching judiciary. Other than air pollution problems, cases have been registered with respect to ground water withdrawal from the state. Due to illegal drawing of groundwater in Sundargarh district, water scarcity was observed[123]. Ten sponge iron plants were found to be drawing groundwater in an unauthorized way. Police cases were instituted against these which had not obtained the NOC from Central Ground Water Authority. The plants included Kushal Ferro Metal, Vasundhara Metalliks, Sainath Ispat, Deo Ispat Alloys and Swastik Ispat Limited.

In July 2009, the Karnataka high court ordered closure for a sponge iron plant in Londa due to pollution of land water and air in the region[124]. This judgment was issued as a result of a writ petition filed by people of Londa in Khanpur *taluka*[125]. The plants had damaged the road from National Highway 4A (Belgaum-Goa Highway) to the railway station due to heavy loaded trucks. However, a month later the industry was allowed to operate by the SPCB.

In Goa, in 2006, the SPCB shut down five sponge iron plants - Jain Udyog, Shraddha Ispat, Srithik Ispat, Goa Sponge and Power and Ambey Metallics[126]. The closure notices, issued under Air (Prevention and Control of Pollution) Act, 1981, and the Water (Prevention and Control of Pollution) Act, 1974, state that the plants violated prescribed environmental standards and the conditions laid down in the consent order. They were to remain closed till further directives. The Panaji bench of the Bombay High Court directed the collector of South Goa district to ensure strict compliance of the order.

6. Way forward

If one were to compare steel consumption figures, Indians lag far behind the rest of the world. Against the world average of 215 kg, per person steel consumption in India is just 50 kg a year. This consumption gap is likely to reduce in coming years. With rapid economic growth, steel requirement for housing, infrastructure and industry is poised to grow significantly.

Post liberalisation, steel production in India has grown seven to eight per cent annually. At this rate, which many experts consider sustainable, steel production will jump to 300 MT in 2030 from 60 MT at present.

Traditionally, steel was manufactured from pig iron using blast furnace. India does not have reserves of coking coal, an important raw material for blast furnace route to make steel, and presently imports about 70 per cent of its coking coal requirement. This pushes up steel prices. Therefore, blast furnace route cannot meet the 300 MT target.

The other way to produce steel is by recycling used steel via the steel scrap route. Currently, about 15 per cent of steel production in India is from scrap. Due to limited scrap availability and ever increasing prices of imported scrap, not more than 10 per cent of steel can be produced from scrap by 2030.

The only option left is production of steel through DRI (sponge iron) route. DRI can be produced using gas but it is expensive and gas availability is not assured. So, the real option is to produce steel using non-coking coal, through DRI. In 2030, more than 60 per cent of the steel produced in India will come from coal-based sponge iron. This means more than 200 MT of sponge iron and hundreds of sponge iron factories. Hence, there is an urgent need to develop an action plan for the sector to contain its environmental impact.

BOX 7: STAFF CRUNCH IN SPCBS IN SPONGE IRON DOMINATED STATES

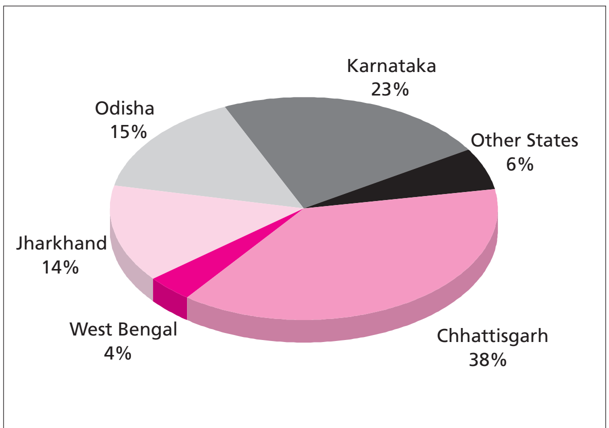
A majority of the boards have failed to recruit personnel for their vacant posts for enforcement and monitoring. The Karnataka SPCB has 60 per cent of its total sanctioned positions lying vacant every year. This means that the board's day-to-day activities were being run by less than half of its sanctioned staff. The WBPCB has 24 per cent of its total sanctioned positions lying vacant, while the Chhattisgarh board has 32 per cent vacant posts every year.[1]

6.1 Bigger factories better

'Bigger the better' is the mantra for the sector. Kilns with less than 200 tonnes per day (TPD) capacity cannot adopt cleaner technologies like an AFBC boiler that burns kiln gas to generate energy. Similarly, a boiler to burn char is not economically viable for smaller factories. These two technologies alone can reduce emissions significantly. It is for this reason that the government must devise a plan to phase out smaller kilns and immediately stop commissioning of kilns with less than 200 TPD capacity.

Most of the sponge iron plants in the country are either small or medium scale. Small and medium scale sponge iron plants cause more pollution and managing them is more difficult for the regulators due to multiple reasons. The prime reason is lack of technical capacity in SPCBs (see *Box 7: Staff crunch in SPCBs in sponge iron dominated states*). As a result even the consent conditions are hardly verified by the boards. Inadequacy especially in terms of technical staff in SPCBs has been observed for different states. Chhattisgarh Environmental Conservation Board has 53 per cent non-technical staff as compared to 47 per cent technical staff[127]. Similar staff pattern has been observed in West Bengal Pollution Control Board where technical staff is 55 per cent as compared to 45 per cent non-technical staff[128]. This ultimately leads to increase in workload on the existing staff as number of industries increases, but vacancies are not filled. For example, in Karnataka, the number of industries has increased 2.5 times over five years (2001-02 to 2005-06), while the number of sanctioned posts has gone down from 769 to 675 during the same period[129].

Graph 1: Number of operational sponge iron plants less than 0.03 MTPA



Source: *Analysis based on data obtained from SPCBs under Right to information Act, 2005.*

The guidelines for sponge iron plants state that the plants with less than 0.033 MTPA shall not be permitted in future[130]. This was decided based on the fact that installation and operation of pollution control equipment is not found economically viable for plants smaller than 0.033 MTPA. Programme for phasing out these plants is to be worked out by the SPCBs. However, no efforts are seen by the boards to either stop or phase out the small-scale plants. (See *Graph 1: Number of operational sponge iron plants less than 0.03 MTPA).* Around 24 per cent of sponge iron plants in India i.e. 78 plants are of capacity less than 0.033 MTPA[131]. The largest number of plants with capacity less than 0.033 MTPA is present in Chhattisgarh which accounts for 38 per cent of the total plants with less than 0.033 MTPA capacity. Karnataka comes in second with 23 per cent followed by Odisha with 15 per cent and Jharkhand accommodating 14 per cent of the total plants under 0.033 MTPA capacity.

BOX 8: AMBIENT AIR QUALITY IN CHHATTISGARH 5.46 TIMES THE STANDARD

All together, 42 sponge iron plants in three clusters of Chhattisgarh add around 0.45 MTPA of dust into the ambient air; as a result the concentration has reached up to 546 g/m^3 in the surrounding air basin. Out of the total emission in air 47 per cent is contributed by the Urla industrial estate alone. The other two estates, Siltara and Borjhara-Urla contribute 37 per cent and 16 per cent, respectively. If all the plants run their electrostatic precipitators (ESP) then contribution will be as low as 27 g/m^3.

Table: SPM emission load from different industrial estates

Industrial estate	Dust emission load (TPD)
Siltara	505.57
Borjhara-Urla	224.11
Urla	631.97

Source: *Padma S. Rao, A. Kumar, M. F. Ansari, P. Pipalatkar, T. Chakrabarti, Air Quality Impact of Sponge Iron Industries in Central India, Springer Science Business Media, LLC 2008.*

6.2 Standards

Most of the standards made for the sponge iron industry have been devised keeping stand alone plants in mind. For example, the standards on fugitive emissions state that fugitive emissions within the premises should not exceed 2,000 µg/m^3 at a distance of 10 m from the specified area. For sponge iron plants in clusters, this standard would not maintain the air quality within the prescribed limit, even if each plant emits within the standards, since cumulative impact of all the plants in the cluster would lead to huge pollution load *(see Box 8: Ambient Air quality in Chhattisgarh 5.46 times the standard).* Thus there is a need to make cluster based standards or lower the current one.

The guidelines for siting of sponge iron industries state that the radial distance between two sponge iron plants should be five km for plants having capacity 0.33 MTPA or more. However, the guidelines do not specify anything for small and medium scale plants which are more in number. The guideline specifies that the distance between the sponge iron plants/clusters and human settlement, ecological/sensitive area should be at least one km but in places like Sundargarh (Odisha) and Raipur (Chhattisgarh), the sponge iron plants have come up just next to human settlements[132].

The minimum stack height prescribed for a sponge iron plant is 30 m and it varies from 30 to 70 m based on the SO_2 emission rate depending on the sulphur content in the coal used (see *Table 6.2: Permissible SO_2 emission level*). The prescribed range needs to be revised since proper dilution and dispersion is not possible with this standard in case of clusters. For instance, in Halkundhi cluster in Karnataka and Siltara in Chhattisgarh most of sponge iron plants range between 0.02-0.07 MTPA. Assuming the specific coal consumption to be 1.3 tonnes/tonne sponge iron and 0.5 per cent sulphur content, most of the stack heights fall between 30-50 m[133]. When such a huge quantity of coal is burnt, emissions released will be immense and the stack height of 30-50 m will not give enough mass of air for dispersion. The phenomenon worsens during winters due to inversion and the pollutants get trapped at ground level itself causing more emission load in the nearby areas.

Table 6.2: Permissible SO_2 emission level

S. No.	Emission of SO_2 in kg/hr (Q)	Stack height (in meters, H)
1	12.7	30
2	33.1	40
3	69.6	50
4	127.8	60
5	213.6	70

Source: *Anon, 2007, Comprehensive Industry Document: Sponge Iron Industry, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 105.*

6.3 Strengthen enforcement

It is evident that our current system of environmental monitoring and enforcement is not working. The problem with SPCBs is lack of capacity and accountability, non-transparent functioning and corruption. This has happened largely because of neglect and politicization of these institutions. The result is these institutions are incapable of taking strong enforcement actions. Industries pollute as there is no credible deterrence for non-compliance. The charade of issuing show cause and closure notices and imposing small bank guarantee is not going to solve the problem.

What we need is a system that ensures non-compliance is dealt with strictly. Increasing capacity, transparency and accountability of SPCBs is the first step in this direction. We then need to amend the Environment Protection Act to increase penalty amounts and set up a civil-administrative mechanism that can impose penalties without taking recourse to the lengthy legal process. But this will not work unless we tighten technology and emission benchmarks for the sector.

Material handling is a major source of fugitive dust and needs to be tackled by implementing mandatory technology and management norms. Ultimately, there has to be further technology development in this sector as the current technology, even with all refinements, is still polluting. We need a technology mission for the sponge iron sector.

CHAPTER 2

Sponge Iron Industry in Odisha

1. Introduction

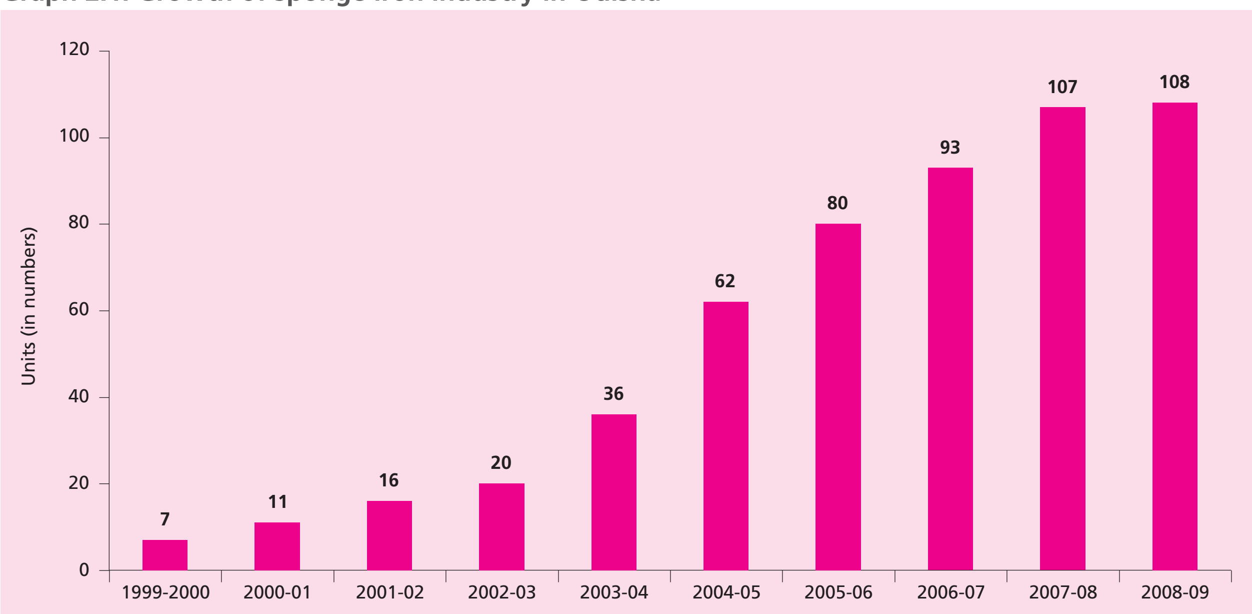
The sponge iron industry took birth in Odisha with the setting up of 0.1 MTPA plant of Orissa Sponge Iron Limited in 1979 in Keonjhar district[1]. At present, the state has 108 sponge iron plants with 242 kilns and a total of 10.5 MTPA capacity[2].

During 1999-2000, only seven plants were operating in the state[3] (see *Graph 2.1: Growth of sponge iron industry in Odisha*). In a span of five years, the number increased to 62 registering a nine-fold increase. At present the number is 108, almost double the number since 2004.

Odisha is dominated by medium scale plants i.e., with production capacity between 0.033 to 0.165 MTPA (see *Table 2.1: Distribution of sponge iron plants in Odisha*). The state has 65 medium scale (60 per cent), 25 small scale (23 per cent) and 18 large scale plants (17 per cent).

This distinction into small, medium and large scale takes into account the combined capacity of all the kilns in the plant. However, if individual kilns are analysed, the picture changes. There are a total of 12 kilns in six plants

Graph 2.1: Growth of sponge iron industry in Odisha



Source: *Himansu Patra et al, 2009, Status of sponge iron plants in Odisha, Vasundhara, Bhubaneshwar, pg.6.*

Table 2.1: Distribution of sponge iron plants in Odisha

District	Small	Medium	Large
Angul	0	3	0
Cuttack	2	1	1
Dhenkanal	0	3	1
Jajpur	1	2	2
Jharsuguda	1	8	3
Keonjhar	2	16	4
Mayurbanj	1	1	0
Sambalpur	2	4	4
Sundargarh	16	27	3
Total	**25**	**65**	**18**

Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

Table 2.2: Capacity distribution of sponge iron industry in Odisha

Scale	Capacity (MTPA)	Percentage Contribution
Small	0.62	5.91
Medium	5.22	49.73
Large	4.65	44.35

Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

Table 2.3: Cluster-wise distribution of plants

Cluster	Scale		
	Small	Medium	Large
Barbil	1	4	2
Bonai	3	4	
Kalunga Industrial Estate	2	7	
Kuarmunda	5	5	1
Rajgangpur	1	4	1
Rengali		2	3
TOTAL	12	26	7

Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

in the state that qualify as large scale with capacity equal to or more than 0.165 MTPA individually[4]. Twenty six kilns are medium scale present in 20 plants and 204 small scale kilns in 84 plants[5]. There is one plant which is a mix of small and medium scale kilns and another one of large and medium scale kilns. Thus, if individual kilns are analysed, Odisha can be said to have majority of small scale plants (84 per cent), followed by medium scale plants (11 per cent) and five per cent large scale plants.

In terms of capacity, medium scale plants[6] contribute almost 50 per cent to the total capacity of 10.5 MTPA (see *Table 2.2: Capacity distribution of sponge iron industry in Odisha*). Large scale plants contribute about 44 per cent and even though the number small scale plants are huge, their contribution to the total capacity is a mere six per cent.

Sundargarh district has most of the sponge iron plants in the state (43 per cent) followed by Keonjhar (20 per cent) and Jharsuguda (11 per cent). These plants are mostly present in clusters[7]. Kuarmunda cluster in Sundargarh is the most populated with 11 sponge iron plants (see *Table 2.3: Cluster-wise distribution of plants*)[8]. Kalunga Industrial Estate in Sundargarh has nine plants and Bonai has seven. Barbil cluster in Keonjhar has seven sponge iron plants while Rajgangpur in Sundargarh has six. Rengali in Sambalpur has five plants.

- **Kuarmunda:** located at a distance of about 12 kilometers (km) from Rourkela city[9], has 11 operating sponge iron plants. Most of these plants are small and medium scale. The average capacity of a plant in this cluster is 0.065 MTPA while the total capacity is 0.72 MTPA. The cluster has one big sponge iron plant M/s Adhunik Metallics Limited with a capacity of 0.165 MTPA contributing about 23 per cent to the total capacity.

- **Kalunga Industrial Estate:** is a part of Kalunga, located about eight km from Rourkela city and about four km from Rajgangpur area[10]. In the industrial estate, nine plants are operational and two are present outside the estate but in Kalunga totaling to 11 plants[11]. These are located within a radius of 10 km. The average capacity of the nine plants is 0.065 MTPA while the total capacity is 0.587 MTPA[12]. Seventy eight per cent of these are medium scale plants (seven) and 22 per cent are small scale plants (two).

- **Bonai:** is at distance of 75 km from Rourkela city on the banks of River Brahmani[13]. The cluster has seven plants, 57 per cent of these are medium scale (four) and 43 per cent are small scale plants (three). The total capacity of the plants in the cluster is 0.347 MTPA while the average capacity is 0.049 MTPA.

- **Barbil:** a municipality in Keonjhar is the fifth largest deposit of iron ore and manganese in the world[14]. The cluster consists of six sponge iron plants out of which, four are medium scale and one large scale and small scale each. The average capacity of a plant in the cluster is 0.095 MTPA while the total capacity is 0.568 MTPA. Rungta Mines Limited owns the large scale sponge iron plant in the cluster.

- **Rajgangpur:** has six operating sponge iron plants within a radius of 20 km[15]. The six plants have a total capacity of 0.495 MTPA while the average capacity is 0.083 MTPA. M/s Agrasen Sponge Private Limited is the only large scale plant in the cluster with a capacity of 0.165 MTPA.

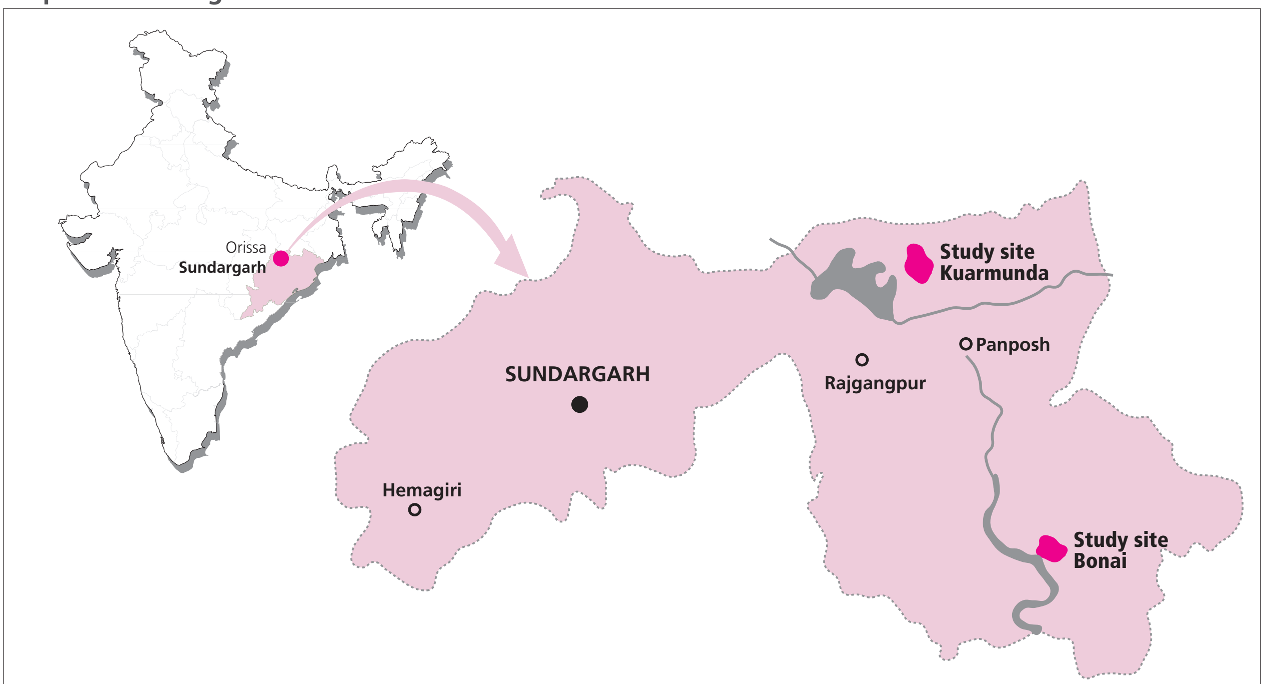
- **Rengali:** is a cluster of five sponge iron plants in Sambalpur district. The total capacity of the industry in this cluster is 1.254 MTPA which is the highest amongst all clusters even though the number of plants is the least. The average plant capacity is around 0.251 MTPA. There are three large scale plants and two medium scale plants.

1.1 The study

Two clusters **Bonai** and **Kuarmunda** were chosen as the sample for our study. Both these clusters are located in Sundargarh district in Odisha (see *Map 2.1: Sundargarh*). The criteria based on which these were selected are:

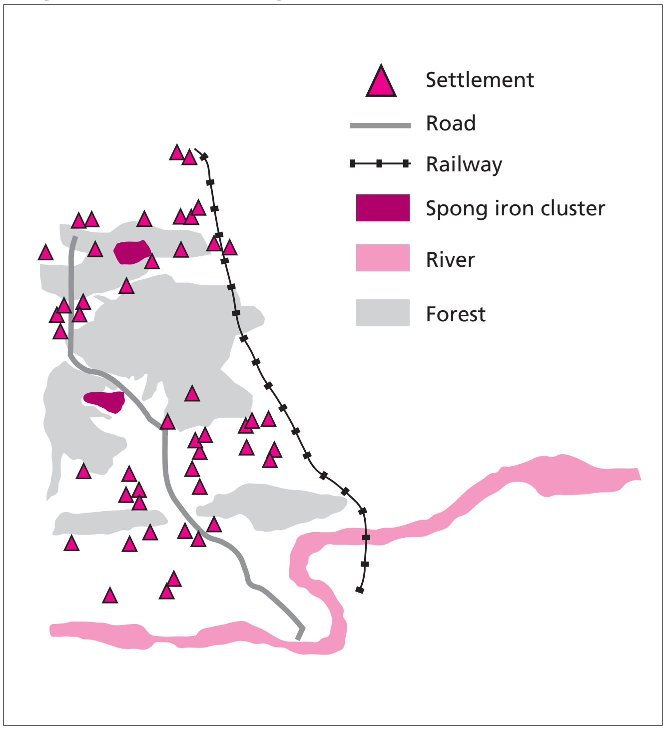
- Distance between plants,
- Number of villages located in vicinity,
- Location of water bodies, forests with respect to the cluster,

Map 2.1: Sundargarh



Source: *Himansu Patra et al, 2009, Status of sponge iron plants in Odisha, Vasundhara, Bhubaneshwar, pg. 6.*

Map 2.2: Land use map of Kuarmunda



Source: *Anon, Toposheet no: 73B/15, Survey of India.*

Table 2.4: Forests around the sub-clusters

Reserved Forests	Distance from the cluster
Sub Cluster 1	
Dumberijhar	Adjacent
Chadri	0.5 km
Sub Cluster 2	
Chadri	Adjacent
Chilang pahar	1.5 km
Salanga Bahal	2 km
Lassey	3 km

Source: *Information received from OSPCB under the Right to Information Act, 2005.*

- Population getting affected, and
- Pollution tract record of the sponge iron plants in the clusters.

1.1.1 Kuarmunda

Kuarmunda town is located at a distance of 15 km from Rourkela city. The area is well connected by national highway no. 23, joining Rourkela city with Ranchi. Kuarmunda is a small industrial block of Sundargarh district. Eleven sponge iron plants are located in the cluster. Seven are located in a sub cluster near the Kuarmunda city (1-1.5 km aerial distance), while four plants are located in another sub cluster at a distance of 2.8 km from the city (see *Map 2.2: Land use map of Kuarmunda*).

The location of the sub-clusters is such that they are surrounded by forests. A number of Reserved Forests (RF) are present around the cluster (see *Table 2.4: Forests around the sub-clusters*). These are mostly dry deciduous forests with trees like *mahua*, sal, tamarind, mango, jackfruit, etc.

The cluster also houses a number of water bodies some very close to the sub-clusters[16]. Raja pond, covering an area of 2.05 hectares (ha) is located at a distance of 0.3 km from sub-cluster-1. Two small water bodies are found near this sub-cluster and five ponds are present within a radius of five km. Sub-cluster-2 has 12 ponds within a radius of five km. Also, a pond is located about 0.5 km from the sub-cluster in Chad-Hariharpur. There are small nallahs around sub-cluster-2 originating from Chad RF, at about 0.5 km from the cluster. These fall into a prominent nallah of the area called *Kalishiria nallah*. There are other small water bodies around the *Salang Bahal* village as well.

There are 21 villages under the Kuarmunda cluster (see *Table 2.5: Villages in Kuarmunda cluster*). Ten of these are in or around sub-cluster-1 and 11 are in or around sub-cluster-2. The total population in the villages of sub-cluster-1 is 13,563 and of sub-cluster-2 is 8,784. Most of the population is tribal. About 62 per cent of the population surrounding sub-cluster-1 is tribal. Chundatoli, Manaria, Bankibahal, Jagdishpur, Chandiposh are completely inhabited by tribals. Most of villagers in Kuarmunda, Teliposh, Kheraposh and Padampur also belong to the tribal population. Similarly about 84 per cent population in the surrounding villages of sub-cluster-2 are tribal. Karlabudi village is completely inhabited by tribals where as in other villages; the tribal population varies between 70-90 per cent. These tribals belong to *Kissan* or *Munda* sub-groups.

Table 2.5: Villages in Kuarmunda cluster

Village	Distance from Cluster (km)	Population (numbers)
Sub-cluster 1		
Usra	6	2449
Manaria	7	410
Bankibahal	7	378
Kheraposh	8	331
Padampur	0.5	1171
Jagdispur	0.7	696
Chandiposh	0.6	276
Kuarmunda	0.5	6417
Chundatoli	0.7	99
Teliposh	0.7	1336
Sub-Cluster 2		
Gobira	0.5	1326
Chadrihariharpur	0.2	279
Lodosara	0.5	655
Ratakhandi	0.7	1684
Kukhundiubahal	1	1033
Karlabudi	1.5	245
Harapali	0.9	502
Bartaghutu	0.8	771
Dumangdiri	3	858
Dumkishiria	2.5	451
Puturikhaman	3.5	98

Source: *Anon, 2001, District Census Handbook, Census of India, Government of India.*

Table 2.6: Sponge iron plants in Kuarmunda

Plant	Capacity (MTPA)
Adhunik Metallic Ltd.	0.165
Bajrang Ispat Ltd.	0.092
Govindam Projects Pvt. Ltd.	0.066
Jagannath Sponge (P) Ltd.	0.017
Khederia Ispat Ltd.	0.017
Maa Sakumbari Sponge Iron (P) Ltd.	0.033
Mangalam Ispat (P) Ltd.	0.066
Pawanjaya Sponge Iron Ltd.	0.066
Shree Ganesh Metalliks Ltd.	0.132
Swastic Ispat (P) Ltd.	0.033
Vedvyas Ispat Ltd.	0.033

Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

The cluster has 11 plants with total installed capacity of 0.719 MTPA (see *Table 2.6: Sponge iron plants in Kuarmunda*). M/s Adhunik Metallic is the largest plant in the cluster with a capacity of 0.165 MTPA followed by M/s Shree Ganesh Metalliks with a capacity of 0.132 MTPA.

Most of the plants are in a bad state. The plant premises are covered with dust and mud. Pollution level on site is found to be quite high and most of the plants are disposing the fly ash and coal dust in their own premises, aggravating the pollution level[17].

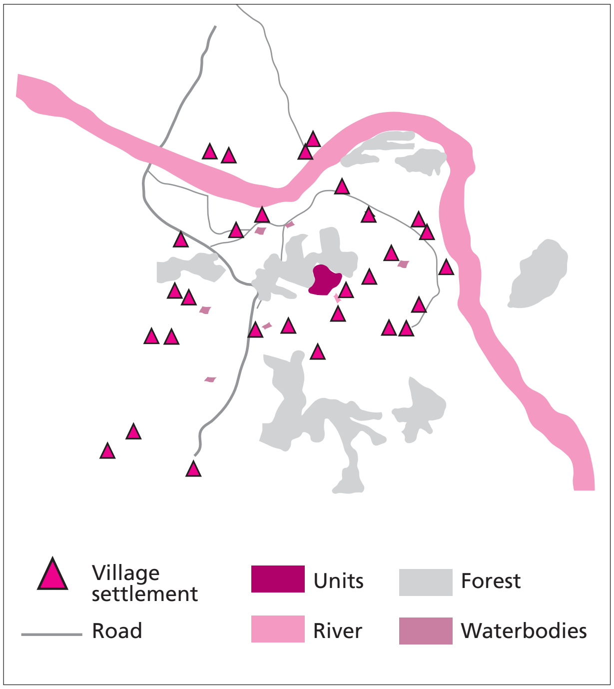
1.1.2 Bonai

The cluster is located at Kendrikala village under Bonai subdivision of Sundargarh district. It lies at an altitude of 240 meters (m) above mean sea level. The area is a mining belt concentrated with rich mineral deposits like iron ore, manganese, limestone; and forest products like bamboo, timber and tendu leaf.

Bonai cluster lies adjacent to the National Highway NH-23. The nearest railway station is Barsuan about 20 km east of the site. The cluster is located only at a distance of two km from the block level town of Bonai and 70 km from the Rourkela. It is a flat plain with a few small hillocks and boulders (see *Map 2.3: Land use map of Bonai cluster*). A major river of Odisha, Brahmani flows barely two km from the cluster in the east and north direction. Another cluster is located on the opposite side of Brahmani River (Rajamunda area) at a distance of three km from this cluster. Aerial distance between the cluster and Bonai town is 1.5 km.

Kendrikala RF is adjacent to the cluster. Saradhapur Gramya and Jhaliaberni Gramya forests are in the vicinity. Once booming with different tree varieties, now these forests are mostly home to tendu and

Map 2.3: Land use map of Bonai cluster



Source: *Anon, Toposheet no. F45M13, Survey of India.*

Table 2.7: Villages in the cluster

Village	Distance from Cluster (km)	Population (numbers)
Uparpada	Adjacent	1066
Kendrikala	Adjacent	968
Alekhpur	1	699
Babunuagoan	1	619
Dareikala	Adjacent	468
Pandursila	Adjacent	452
Bandhadihi	2	247
Gudhali	2	205
UparBahal	Adjacent	117
Rautani	1	79
Barhamusa	Adjacent	942
Baidipali	0.5	66
Jakeikala	5	2026
Talita	3	1035
Badposh	3	565
Brahamanali	4	109
Baghapali	4	136
Nuapali	2	183
Sanbhalu dungri	3	70
Gobindpur	3	997
Badbaurkela	3	774
Gopinathpur	4	463
Sana-Gopinathapur	4	649
Patrapali	4	506
Narsinghpur	4	241
Sendhpur	5	354
Laxminarayanpur	4	252
Saradhapur	2	383
Gamlei	2	625
Santumkela	2	8
Arkeikala	2	316
Boneigarh	2	6131
Deogaon	1	1847

Source: *Anon, 2001, District Census Handbook, Census of India, Government of India.*

mahua trees. Twelve ponds are located within a radius on five km around the cluster.

There are 33 villages under the Bonai cluster (see *Table 2.7: Villages in the cluster*). Bonaigarh is the largest with a population of 6,131. The cluster has a total population of 23,598. Most of the villagers near the sponge iron cluster are tribals belonging *to Kissan, Bhuiyan* or *Munda* sub-group. Out of the total population in the cluster, around 39 per cent belongs to the scheduled tribes (ST) group. Villages like Pandursila, Bandhadihi, Barhamusa, Badposh, Baghapali, Nuapali, Sana-Gopinathapur have more than 90 per cent of their population belonging to STs.

There are seven plants in the cluster with total capacity of 0.347 MTPA (see *Table 2.8: Sponge iron plants in Bonai cluster*). Biggest plants in the cluster are M/s Reliable Sponge, M/s Shiv Metalliks, M/s Sri Hari Sponge Iron and M/s Surendra Mining each with a capacity of 0.066 MTPA.

The plants in this cluster are located almost next to each other (see *Table 2.9: Distance between plants*). Most of the plants except have not installed the necessary boards at the entry gates displaying detailed information of the plant, consent, authorisation, etc[18].

Table 2.8: Sponge iron plants in Bonai cluster

Plant	Capacity (MTPA)
Mahakali Ispat (P) Ltd.	0.017
Ores ispat (P) Ltd.	0.033
Reliable Sponge (P) Ltd.	0.066
Shiv Metalliks (P) Ltd.	0.066
Sri Hari Sponge Iron Ltd.	0.066
Surendra Mining Industries (P) Ltd.	0.066
Vishal Metalliks Ltd.	0.033

Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

2. Environmental and social concerns of sponge iron industry in Odisha

2.1 Pollution

About 11 villages in the Kuarmunda cluster are severely affected by pollution from these sponge iron plants. In the Bonai cluster, about 35 villages are affected out of which 15 are critically affected.

Fugitive emissions from plying of vehicles to and from the plant premises are a big concern in the state. Roads connecting the sponge iron plants are in a damaged condition (*kutchha* road) leading to generation of huge amounts of dust during movement of vehicles. Dust moves with the direction of wind and gets deposited in villages located at a distance of even as much as 5-7 km. No provision of water sprinkling is present in this area which aggravates the scenario.

Table 2.9: Distance between plants

Plants	Location
Mahakali Ispat (P) Ltd.	Adjacent to Shiv Metalliks
Ores ispat (P) Ltd.	Adjacent to Mahakali Ispat
Reliable Sponge (P) Ltd.	Within the cluster area
Shiv Metalliks (P) Ltd.	Within 0.1 km radius of the cluster
Sri Hari Sponge Iron Ltd.	Adjacent to Surendra Mining
Surendra Mining Industries (P) Ltd.	Within the cluster area
Vishal Metalliks Ltd.	Within 0.3 km radius of the cluster

Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

Even though most of the plants have an electrostatic precipitator (ESP), they do not run them during night, turning the area into a dust chamber. Local people allege that the plants generally shut down the ESPs from 7 pm to 4 am, releasing the dust in the surrounding areas. The impact is so high that a fog like blanket can be found every morning. The roofs and walls of houses located within a radius of five km are laden with black dust. Leaves and trees in the vicinity are also covered with black dust. The Chadri Hariharpur village in the Kuarmunda cluster is worst affected. The villagers complain that even their utensils turn black due to the dust.

The impact of pollution is quite serious in villages located within one km radius of the clusters. In the Kuarmunda cluster, villages like Kuarmunda, Kukundabahal, Klashirira, and Puturikham are badly affected due to pollution from the sponge iron plants. From the Chadri RF in the Kuarmunda cluster, most of the animals like bears, foxes and hyenas have migrated to Mudra Pahad RF because of high level of pollution. High pollution is also observed in Baramusa and Kendrikala villages located about 0.5 km from the Bonai cluster. Other affected villages in Bonai cluster are Jareikala, Gobindpur, Purunapani and Rajamunda.

Water in the nearby ponds in the clusters is covered with a thick layer of dust. Locals complain of water problems as the water becomes unfit for washing and bathing. The community pond located in

Kendrikala village in Bonai cluster is covered with dust rendering the water unfit for any use. M/s Shiva Metallics dumps its char into a pond being used by villagers for daily needs.

River Brahmani is also affected and the river bed has turned black. One of the prawn species that were an important catch in this area previously are no more to be found due to pollution in the river. None of the plants in either of the clusters treat the liquid effluents and some release it directly into the surrounding agriculture fields. Local people allege that their fields are covered with a black layer due to release of these effluents. Kendrikala and Baramosi villages in the Bonai cluster are most affected with the wastewater being released into agricultural fields.

Ground water depletion is another concern in the sponge iron clusters. All these plants depend on groundwater for their operations. Most of them have dug up 5-6 bore wells in their plant premises for extracting water. Large scale ground water extraction puts pressure on the ground water table, which falls lower during summers making the area water scarce.

The initial practice of disposal by all the sponge iron plants was to dispose it in the adjacent fields, roads, forests, *gochar* land, traces of which can be found even today. After strict instructions from Odisha SPCB the plants are now depositing wastes in their own premises. However, the fine fly ash gets dispersed with wind and gets deposited in the nearby areas since it is usually stored in the open. In the Bonai cluster, the boundary wall around the plants is not of significant height, so the fugitive dust generated within the plant premises gets carried away with wind and gets deposited in the nearby areas.

2.2 Public complaints

2.2.1 Complaints related to pollution

The surrounding villages around both the clusters complain about air, water and solid waste pollution.

- Fugitive dust generated from running of vehicles, activities within plant premises, dust from dumping site, etc., are a major problem. Although most of the plants in both clusters have installed ESP, but they do not run them during night thus increasing the pollution levels.
- Most of the plants have no system for wastewater recycling and treatment. Locals complain that the wastewater is stored either inside the factory premises or on the periphery and is released in to the surrounding agricultural fields during night. This is affecting the soil fertility.
- There are complaints about the disposal of char and fly ash, which has become a nuisance in this area. Plants deposit it in their plant premises but with wind these are carried and get deposited on the nearby areas, houses, trees and agricultural fields.
- Only a few plants are spending money on peripheral development. Most of the roads are in a miserable condition. There is no provision of water supply in the area. Health camps are organised by the plants but these cater only to the employees and their families.
- Most of the villages complain about pollution affecting flora and fauna. The villages complain that drumstick plants have become unfit for consumption. Srihari Kissan of Kendrikala village (Bonai) informed that before 2005 the area was known for its mango, lemon and tendu production but now these plants do not blossom in season and those that do, don't bear fruits. The farmers also informed that the leafy vegetables which used to fetch them good income grow no more. Hence their annual income from agriculture has reduced by 60 per cent.
- There are complaints of irritation in respiratory track, irritation in skin and foul smell.
- Ground water level has fallen due to high withdrawal by deep bore-wells inside the plant premises.

The Odisha SPCB received a number of complaints against M/s MSP Sponge Iron from villages Haladiaguna and Banua regarding air pollution caused by the plant[19]. This can be attributed to faulty ESP operations, inadequate/inefficient bag filters and poor house keeping. SPCB also received complaints against M/s Shiv Metalliks from Daraikela village under the Bonai cluster[20]. The complaint was regarding the pollution caused in the village by the plant which was later withdrawn. In the Bonai cluster, M/s Surendra Mining has adopted the Baramosi village, but the villagers complain that no developmental activity has been initiated by the company. There were complaints against M/s Sumrit Metalliks from village Soyabhal regarding air pollution[21]. The inspection of the area brought out the relaxed approach of the plant towards the issue. The houses in the village were found to be covered with black dust and road dust. Most of this was attributed to plying of vehicles in the area and Sumrit Metallik was advised to install water sprinklers. The plant was also advised to install a dust handling system at the ESP.

2.2.2 Protests

A number of protests have been made by local people against pollution from sponge iron plants. Tribal population has taken the lead role in these protests. A number of times they have blocked the national highway and marched to Kuarmunda but with no result.

In July 2005, the local Jharkhand Mukti Morcha (JMM) MLA George Tirkey took up the sponge iron issue in Sundargarh district. An organisation called Anchalika Suraksha Committee was formed by him, which undertook peaceful rallies, agitation, and meetings against the sponge iron plants. On March 24, 2006 this group under the leadership of George Tirkey marched in to M/s Adhunik compounds to register their protest against sponge iron plants. Their main concerns were the pollution and lack of employment generation[22]. It was reported that the agitators were armed heavily and forcefully halted operations at the plant[23]. Police arrested 117 agitators including George Tirkey[24]. Similarly in 2009, after strong protest from local people especially from women, the regional office of state pollution control board has closed down six sponge iron plants, as they were not complying with air & water act. The protest is still going on; however the momentum of the protest has slowed down.

Although local people have formed no formal platform, women have played a vital role in protesting against the pollution by sponge iron plants. A number of times they have surrounded the district administration and regional office of SPCB. The protests have mostly been against land acquisition, pollution, improper disposal of char and employment of local people in sponge iron factories.

2.2.3 Health Impact

The health impact of the plants can be divided in to two types - on residents or on livestock.

Health impact on residents: Locals complain about different types of health problems like irritation in the respiratory tract due to inhaling the gas emitted from the sponge plants. Some have developed asthma like condition while others have fallen prey to respiratory diseases. Most of them complain about irritation in skin, allergy, discolouration of skin, tuberculosis, etc. There are also instances of acquiring various types of gastro-intestinal diseases in rainy season due to contamination of the water bodies.

Health impact on livestock: Domestic animals especially livestock such as cattle are affected. The crop residue and grasses that the cattle feed on, the air that they breathe and the water they drink is all polluted and affects them adversely.

2.2.4 Impact on Livelihood

Villages located on the periphery of sponge iron plants have their agricultural fields rendered unproductive with accumulation of dust and air emissions on the soil. The quality and quantity of the agricultural produce has been affected drastically.

The quantity and quality of crops and vegetables is getting affected in the surrounding villages. Grains of rice turn black fetching poorly in the market. Similarly fruit bearing trees like mango, jackfruit, and sapeta are affected. Vegetable production has also been affected. In Kendrikala and Baramosi (Bonai), the annual revenue loss because of lowered paddy and fruit yields is about 1- 3 lakhs a year.

3. The study[25]

Our data set comprises of 98 plants. Although the state has 108 plants in total, SPCB provided inspection reports of only 98. Two hundred two inspections reports for the year 2005-06, 2006-07, 2007-08 and 2008-09 were made available. However, inspection reports for all the plants for all the mentioned years are not available. At the same time, at least one inspection report for each plant is available. Due to lack of coherence in the format of the report, a number of data is missing even though at least one report for each plant is present. Accordingly adjustments have been made. For Kuarmunda cluster, data is available for only 10 plants while for the Bonai cluster data is available for only six.

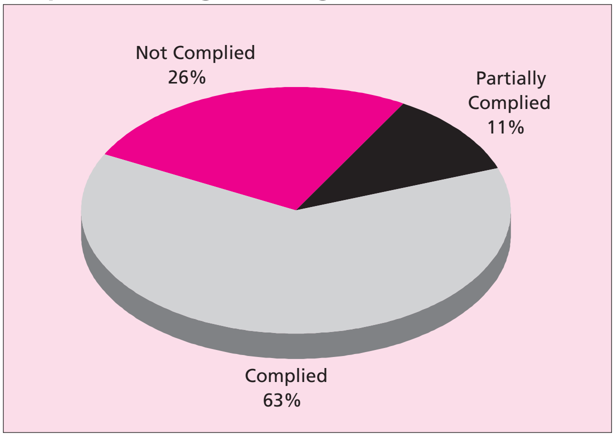
3.1 Air pollution

ESP is attached in about 87 per cent of the plants in the sample while the remaining 13 per cent are operating without an ESP[26]. Out of the plants with installed ESP, only 92 per cent had functional ones while eight per cent were not functional at the time of inspection[27]. This clearly points towards the slack approach by the industry and the overlook by the SPCB. Just the fact that 13 per cent of the plants are functional without an ESP is a let down in itself. M/s Agrasen Sponge does not have an ESP installed. The Suspended Particulate Matter (SPM) level at the main stack in the plant verified the same with a value of 390 mg/Nm^3 while a second inspection report for the same year gave an unrealistic figure of 36 mg/Nm^3. Even then the SPCB did not serve any notice to the sponge iron plant. M/s Shree Balaji Metallics in the absence of an ESP got stack SPM level at 253 mg/Nm^3 but was not penalised. M/s Monica Holdings, M/s Vasundhara Metalliks, M/s Scan Steels and M/s Utkal Metallics exhibited within limit stack SPM in spite of the absence of an ESP. Similarly, M/s Sri Hardev Steel, M/s TR Chemicals, M/s Viraj Steel and Energy and M/s Sai Sraddha Steel is running without an ESP barring any notices from the SPCB.

In the Bonai cluster, 83 per cent of the plants[28] have an ESP installed while 17 per cent are running without one. M/s Ores Ispat is the plant running without an ESP. On a recent visit to the plant, they claimed to have placed an order for an ESP[29]. The plant's stack monitoring data tells a different story by pitching ridiculously low levels of SPM. The SPM level at the stack attached to the kiln for the plant was a mere 61 mg/Nm^3 even in the absence of an ESP which is incomprehensible. To top it all the Odisha SPCB seems to have overlook such grave non-compliance as no show cause or closure notice has been served to M/s Ores Ispat yet. In Kuarmunda cluster, 91 per cent of the plants[30] met the condition of an installed ESP. M/s Jagannath Sponge is the only plant in the cluster running without one and still managing to keep the stack emissions in check. Their SPM at the main stack was recorded as low as 69 mg/Nm^3. The plant went scot-free and is running without any hassle with the SPCB.

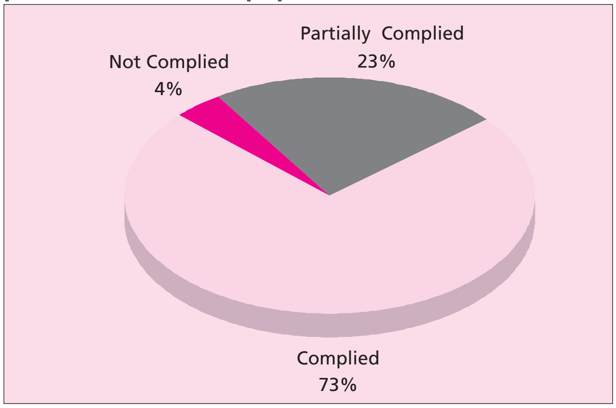
Ninety one per cent of the plants in the sample[31] complied with the condition of operating the ESP and keeping the emissions within limit in 2007-08. This went down to 84 per cent in 2008-09[32]. Also, non compliance increased from nine to 15 per cent exhibiting the attitude of the industry towards pollution control equipment and its operation and the associated air pollution. M/s Aarti Steels exhibited beyond limit SPM levels[33] at the Waste Heat Recovery Boiler (WHRB) stack for two consecutive years, 180 mg/Nm^3 in 2007-08 and 154 mg/Nm^3 in 2008-09. These high levels at Aarti Steels in spite of the installed ESP point towards the inadequacy/inefficiency of the system. M/s Beekay Steel and Power's SPM levels at the main stack were 374 mg/Nm^3 while that of M/s KJ Ispat, the highest recorded in 2007-08, was 149 mg/Nm^3. None of these plants were served any notice or given any warning by the SPCB.

Graph 2.2: Flue gas leakage from kilns



Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

Graph 2.3: Continuous power supply for pollution control equipment



Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

Installing an ESP or other pollution control equipments at the stack to minimize emissions is not adequate. Maintenance and prevention of leakages from the equipment is also equally important. A number of times leakage was observed from emergency caps of kilns (see *Graph 2.2: Flue gas leakage from kilns*). For 63 per cent of the plants in the sample, no leakage was observed[34]. About 37 per cent of the plants were found with leakage at the time of inspection. Out of the plants with no leakage (47), for five there was leakage present in at least one inspection report but the latest one. In the Kuarmunda cluster, 50 per cent of the plants in the sample[35] had leakage from the kiln while another 50 per cent did not.

There was repeated leakage observed for M/s Maa Samleshwari Sponge Iron for 2007-08 and 2008-09. The SPCB sealed the plant in 2008 due to improper functioning of pollution control equipment and leakage of flue gas. The plant was opened within 20 days of sealing on response from them ensuring rectification of the same. Also, M/s Beekay Steel and Power exhibited leakage from the emergency cap of the Atmospheric Fluidised Bed Combustion (AFBC) boiler and was served two closure notices and is still operational. M/s Jai Hanuman Udyog was served a closure notice after a surprise inspection in 2008 due to air pollution related issues – one of them being leakage of flue gas. The plant is currently operational after complying with notice conditions but the SPCB has issued a direction to voluntary shutdown all kilns for 10 days for preventive maintenance of all pollution control equipment. M/s LN Metallics had flue gas leakage during an inspection following which it was sealed. The plant started operation after a month on rectification. Some plants like M/s Kushum Powernet, M/s Sri Ganesh Iron, M/s Sri Jagannath Metallics, M/s Sri Hardev Steel and M/s Bhushan Steel are operational without any notice being given by the SPCB even though leakage of flue gas was observed in them.

Ensuring continuous and uninterrupted power supply for the pollution control equipments, can guarantee proper functioning of the equipment in most circumstances. In 2008-09, 73 per cent of the sample[36] ensured continuous power supply to pollution control equipment while 23 per cent partially complied (see *Graph 2.3: Continuous power supply for pollution control equipment*). M/s Sri Balaji Metallik did not comply with this condition and suffered the results in beyond limit stack emissions (SPM_{stack} = 253 mg/Nm^3).

The average SPM level for 2007-08[37] is 73 mg/Nm^3 and for 2008-09[38] is 110 mg/Nm^3 while for these two years together is 91 mg/Nm^3. In the Kuarmunda cluster, the average SPM levels at the DRI kiln stack was 62 mg/Nm^3 for 2007-08[39] and 64 mg/Nm^3 for 2008-09[40]. For the Bonai cluster, the average SPM levels stood at 62 mg/Nm^3 for 2007-08[41] and 70 mg/Nm^3 for 2008-09[42].

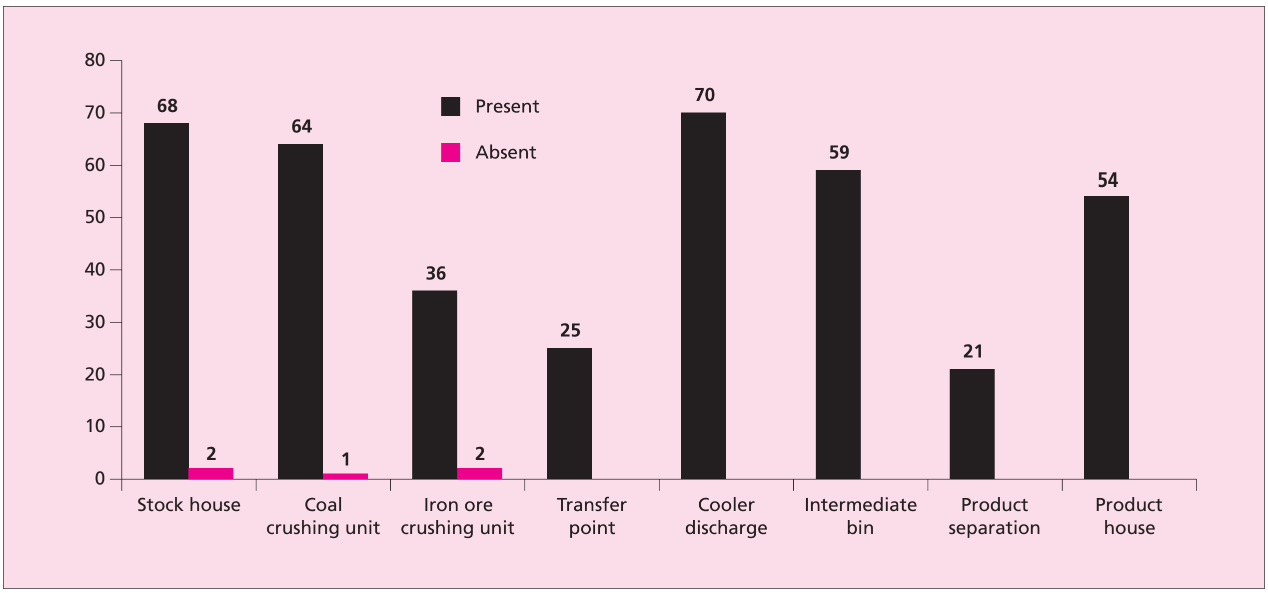
In order to reduce fugitive emissions inside the plant premises, bag filters are to be placed at specific locations in the plant. Stock house where all the raw material is stored should have a bag filter. Ninety seven per cent of the sample, which is 68 plants, has installed a bag filter at the stock house (see *Graph 2.4: Bag filter installation*)[43] while two plants are working without one. In Bonai and Kuarmunda clusters, 100 per cent plants[44] have installed a bag filter at the stock house location.

The coal crushing plant bag filter installation is met by 98 per cent of the sample[45]. In both the clusters, 100 per cent of the plants in the sample[46] have bag filters attached at the coal crushing plants. Functionality data is available only for 57 out of the 65 plants and the installed bag filters at coal crushing plant are operational in 96 per cent of the cases. Bag filters at M/S Joy Iron and Steel (Kalunga Industrial Estate) and M/s Sri Balaji metallik (Sundargarh) were not operational during inspection. All the installed bag filters at the coal crushing location in both the clusters were found to be operational during the inspection visit.

Ninety five per cent of the sample has installed a bag filter at the iron ore crushing plant[47]. Two plants defaulted. M/s Aaditya Sponge is one plant which does not have a bag filter at any of the above mentioned three locations and SPCB has not taken any note of that. Although bag filter is installed in 36 plants, it is functional in only 30[48]. M/S Joy Iron and Steel has a non-operational bag filter at the iron ore crusher. The plant exhibited high levels of ambient SPM near office and ESP areas – 548 µg/m^3 and 670 µg/m^3, respectively but was saved from any notice by SPCB. Seven plants in the Kuarmunda cluster and one in the Bonai cluster met the condition of a bag filter at the iron crushing plant and all were operational. Hundred per cent of the sample[49] has installed bag filter at the transfer point and these were functioning as per the inspection reports. Four plants in Kuarmunda and one in Bonai met this condition and were 100 per cent functional.

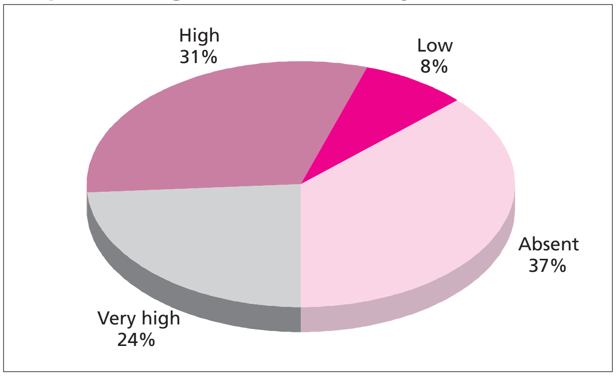
Hundred per cent of the sample[50] has also installed a bag filter at the cooler discharge. Functionality data is available only for 64 plants out of which 98 per cent were found operational. M/s Shree Madhav Ispat was the only plant which had an un-operational bag filter at the cooler discharge. In Bonai and Kuarmunda 100 per cent of the plants in the sample[51] complied with the bag filter at the cooler discharge location condition and were all functional. Fifty nine plants have installed a bag filter at the intermediate bin[52] and 54 of these were found operational at the time of inspection[53]. In Bonai and Kuarmunda, 100 per cent of the plants in the sample[54] complied with this condition with 100 per cent functionality. Twenty one plants in the state have a bag filter at the product separation plant/site[55]. Functionality data is

Graph 2.4: Bag filter installation



Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

Graph 2.5: Fugitive dust visibility



Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

Table 2.10: Ambient air quality

Parameter	2007-08	2008-09
SPM (mg/Nm³)		
Near office	373	423
Near ESP	614	635
Others	460	473
RSPM (mg/Nm³)		
Near office		138
Near ESP	117	141
Others	110	232

Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

available for 18 out if these 21 plants, all being operational. Fifty four plants have installed a bag filter at their product house and 47 of these are functional[56]. In Bonai cluster, only one plant had a bag filter installed at its product house – M/s Surendra Mining, and it was functioning. In the Kuarmunda cluster, again one plant met this condition – M/s Govindam Projects. Not even a single plant in either of the clusters had all the bag filters in place at the required locations.

The SPCB requires these plants to also upgrade and maintain the installed bag filters at various locations in the plant. In 2007-08, only 57 per cent of the plants in the sample complied with this condition while 41 per cent were non-compliant and four per cent partially complied[57]. In 2008-09, the non compliance has decreased to 32 per cent and compliance has increased to 68 per cent[58]. In the Kuarmunda cluster, 33 per cent plants[59] did not comply with this condition while 67 per cent did for the year 2008-09. In the Bonai cluster, only three plants met the condition.

There are instances where fugitive dust emissions are visible in the plant which is beyond the normal range. This was present in 62 per cent of the sample[60] with low to very high range (see Graph 2.5: *Fugitive dust visibility*). Twenty four per cent out of this sample exhibited very high dust visibility and 31 per cent fell in the high range. Low dust visibility was observed for eight per cent of the sample. In the Kuarmunda cluster, 86 per cent of the sample[61] had visible dust emissions and that to in the high to very high range.

Ambient air quality data available consists of SPM and Respirable Suspended Particulate Matter (RSPM) levels at different locations (see *Table 2.10: Ambient air quality*). The average SPM figures near office area for 2007-08 and 2008-09 are 373 μg/m³ and 423 μg/m³, respectively[62]. A number of plants defaulted and went beyond the standard of 500 μg/m³ for industrial areas. For 2007-08, M/s Jai Hanuman Udyog's SPM near office was 584 μg/m³. This is expected as Jai Hanuman lacks in proper ESP operation, bag filter operation and dust handling system[63]. In 2008-09, plants reporting high levels were M/s Aarti Steels (603), M/S Joy Iron and Steel (548), M/s Sumrit metallik (538, near main gate), M/s Hima Ispat (586) and M/s Visa Steel (687).

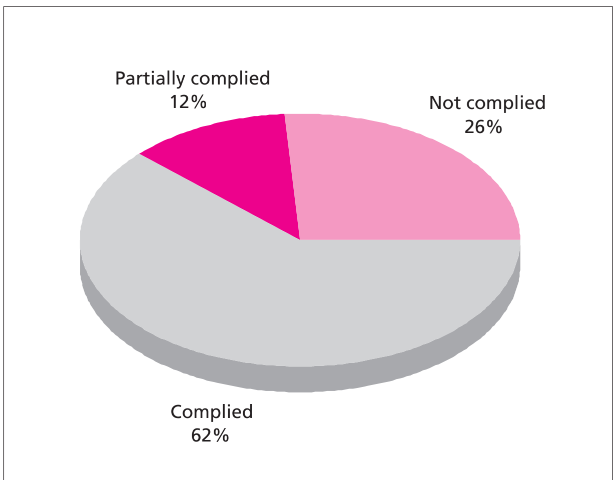
Kuarmunda cluster's average SPM[64] near office area for 2008-09 was 412 μg/m³ while that for the Bonai cluster[65] was 404 μg/m³. Average SPM level near ESP were very high, 614 μg/m³ in 2007-08 and 635 μg/m³ in 2008-09[66]. M/s BR Sponge and Power recorded the highest level in the two years - 1126 μg/m³. M/s Nixon Steel and Power recorded the second highest levels at 825 μg/m³. For Nixon this can be attributed to non-blacktop approach roads from coal circuit to ESP[67]. Eleven different plants defaulted in the inspections. M/s Shree Ganesh Metalliks in the Kuarmunda cluster exhibited a very high level of SPM near ESP area - 689 μg/m³. The average for the cluster for 2008-09[68], was also beyond the standard and stood at 544 μg/m³. SPM levels at other places stood at 460 μg/m³ in 2007-08[69] and 473 μg/m³ in 2008-09[70]. The average SPM level[71] for other places within the plant was higher than the standard for the Kuarmunda cluster and stood at 510 µg/m^3 and M/s Vedvyas Ispat exhibited a very high level of 658 µg/m^3 at the location. The capacity of the bag filters need to be enhanced at Vedvyas[72]. In the Bonai cluster, the average SPM[73] at other places for 2008-09 was 516 µg/m^3. M/s Shiv Metalliks in the cluster repeatedly exhibited very high levels – 2,780 µg/m^3 in 2006-07, 2,025 µg/m^3 in 2007-08 and 570 µg/m^3 in 2008-09. This can be attributed to inadequate dust handling system and bag filters.

RSPM levels also portrayed a mixed trend. For near office area, average RSPM level in 2008-09[74] was 138 µg/m^3. M/s Aarti Steels and M/s Visa Steels defaulted for this parameter as well with levels as high as 196 µg/m^3 and 271 µg/m^3 respectively. Average RSPM levels near ESP were 117 µg/m^3 in 2007-08[75] and 141 µg/m^3 in 2008-09[76]. Average RSPM level at other places was recorded as 110 µg/m^3 in 2007-08[77] and as 232 µg/m^3 in 2008-09[78]. Defaulters are – M/s Bindal Sponge Iron (165), M/s Maithan Ispat (174) and M/s Scaw Industries (296). M/s Bhushan Steel and M/s Shree Metalliks were repeated defaulters with high RSPM.

Constructing *pucca* roads and paving the internal roads in the plant premises and sprinkling water reduce the fugitive dust emissions. In 2007-08, 57 per cent of the plants in the sample[79] constructed pucca roads within the premises. By 2008-09, the compliance had increased to 62 per cent[80] (see *Graph 2.6: Construction of roads inside plant premises*). A good 26 per cent of the plants still need to comply with the condition. There were some plants that partially complied with the condition, about 12 per cent in 2008-09. Forty four per cent plants[81] in the Kuarmunda cluster constructed *pucca* roads inside the premises while 11 per cent partially complied with the condition and four plants defaulted. In Bonai, 60 per cent of the plants[82] complied with the condition while 40 per cent did not. The roads should have water sprinklers installed on the sides to suppress fugitive dust. In 2007-08, 74 per cent plants in the sample complied with the condition while eight per cent partially complied[83]. The compliance for same went up to 78 per cent in 2008-09 and partial compliance came down to 11 per cent[84]. In the Kuarmunda cluster, 86 per cent of the plants[85] complied with the water sprinklers condition while 14 per cent did not. In Bonai, one plant, M/s Vishal Metalliks complied with the condition and two, M/s Ores Ispat and M/s Mahakali Ispat, partially complied.

In order to check dust emissions, dust handling systems are to be installed at the ESP and at the bag filter locations. 72 per cent of the sample[86] has a dust handling system attached at the ESP while only 33 per cent of the sample[87] follows the same condition at the bag filter location. The same parameter in the Kuarmunda cluster[88] was complied by 67 per cent of the plants at ESP and 33 per cent at the bag filter location. Seventy five per cent plants in the Bonai cluster[89] installed a dust handling system at ESP while only 50 per cent installed one at the bag filter location.

Graph 2.6: Construction of roads inside plant premises



Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

3.2 Impact on water

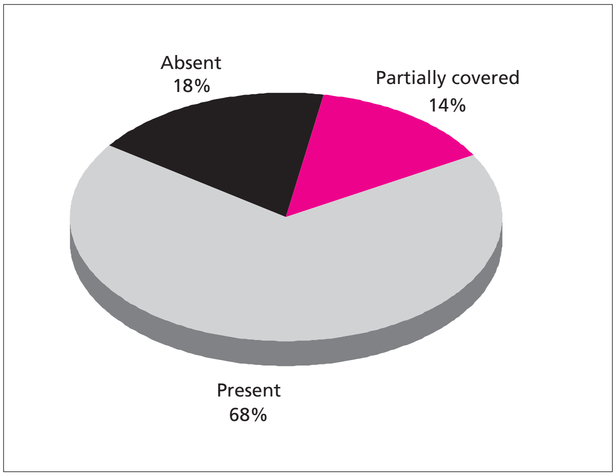
In the case of M/s KJ Ispat, it was observed that due to open dumping of raw materials and solid wastes, they get washed during rain through the storm water drain to nearby nallah, and the water of River Brahmani gets contaminated.[90] The SPCB has had to close 14 plants for flouting wastewater norms in one way or the other[91]. Also, because of the fugitive emissions from the sponge iron plants, suspended particles settle on the nearby water bodies and render the water unfit for use. M/s Bhushan Steel discharges all its wastewater into the nearby nallah – Kisinda Jhor[92].

The same was also stated in the inspection report dated September 22, 2008. However, a visit by the SPCB officials on October 15, 2008 states that they did not find any discharge into Kisinda Jhor.

At M/s Jai Hanuman there was discharge of surface runoff without any settling tank arrangement into the nearby agricultural fields[93]. Similarly, in M/s Monica Holdings during monsoon wastewater from the dumped yard drains went into the nearby nallah draining into River Brahmani.

3.3 Solid waste

Graph 2.7: Cover for solid waste dump

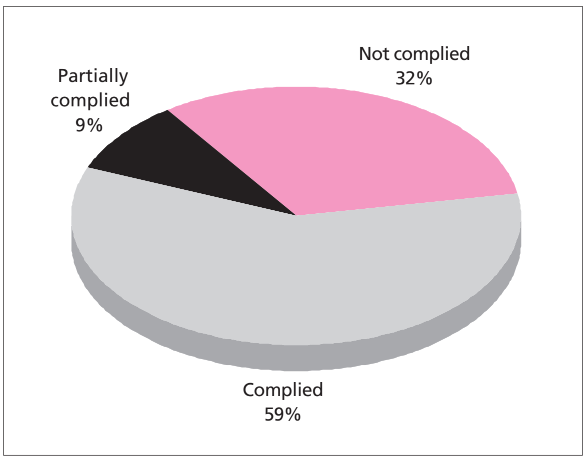


Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

Solid waste in the form of char from these plants is dumped either inside or outside the premises. Plants usually mark out a specific area inside the premises for disposal. Disposal may involve landfilling the waste, storing it to be landfilled/sold later or dumping. In 2007-08 in the state, 100 per cent plants in the sample practiced dumping the waste[94]. The scenario remained unchanged in 2008-09[95]. Considering most of the plants in the state are dumping their waste, these dumps need to be adequately covered. However, it is covered only in 68 per cent of the sample[96] (see *Graph 2.7: Cover for solid waste dump*). In 14 per cent of the plants, the dump was partially covered and in a huge 18 per cent it was completely absent. The absence of a covering is a major factor facilitating the blowing away of fines with wind. In Bonai five plants and in Kuarmunda four plants had covered solid waste dumps.

Some sponge iron plants in the state have made an effort to utilize char and solid waste generated during the process. This is being achieved by installing WHRBs, AFBC boilers, captive power plants or fly ash bricks manufacturing plants. Seventy nine per cent of the plants in the sample[97] (19) have a WHRB installed at their premises. Sixty nine per cent[98] have AFBC boilers in place and only 40 per cent[99] have installed a brick manufacturing plant. 100 per cent of the sample[100] has a captive power plant.

Graph 2.8: Improvement in housekeeping measures



Source: *Analysis based on data received from OSPCB under the Right to Information Act, 2005.*

In order to facilitate dust suppression in dumps, water spraying on the active dumps is advised. Seventy one per cent of the sample[101] adhered with this condition while seven per cent partially complied. Also, garland drains are recommended in order to reduce the impact of runoff on the nearby water bodies or storm water drainage. Only 67 per cent of the sample[102] constructed these drains while 33 per cent did not comply with the condition.

All the above mentioned measures can be met or their efficiency can be enhanced by improving housekeeping. In 2008-09, 59 per cent of the sample[103] improved various housekeeping measures while 32 per cent failed to improve any (see *Graph 2.8: Improvement in housekeeping measures*). Seventy five per cent plants in the Kuarmunda[104] cluster and in the Bonai[105] cluster have improved housekeeping.

3.4 Show cause and closure notices

Forty five per cent plants in the sample[106] were issued either a show cause or a closure notice over a period of two years. Fifteen per cent were served show cause notices while 30 per cent were served closure notices. Common reasons for show cause and closure notice were defective pollution control equipment, high fugitive dust emissions, highly visible emission from ESPs, inappropriate solid waste disposal, poor housekeeping, high SPM levels, etc. Four plants which were served either of the notices were still operational without rectification of the concerns raised during inspection visits. These were M/s MSP Sponge, M/s Bindal Sponge Iron and M/s Beekay Steel and Power. M/s Eastern Steel and Power was served a closure notice as it was operating its coal washery without obtaining consent. However, soon after, they applied for the consent and continued operations on de-sealing.

Fifty five per cent of the sample was issued some direction during the period. These directions were mostly compliance conditions as ESP installation, bag filter installation and up-gradation, proper solid waste disposal, AAQ monitoring and maintenance, etc. However, Odisha SPCB gave certain plants these directions again when it saw non-compliance of the same. This is clearly not a very correct approach to the problem since it dilutes the compliance status.

3.5 Case Studies

Some plants defaulted on a number of parameters and some defaulted repeatedly on the same one. M/s Shree Balaji Metallics is one such plant. To start with, the plant does not have an ESP in place but is operational. There was also leakage observed from the emergency cap of the ABC boiler at the kiln in the plant. Its bag filters at the coal crushing plant and the intermediate bin were non functional. The visibility of fugitive dust as observed during inspection was rated high. There is no dust handling system present at ESP or bag filter locations. There is no provision of power backup for the pollution control equipment either. The solid waste disposal at the plant is far from satisfactory. The dump of solid waste has gathered considerable height and may cause collapse of the boundary. If the boundary collapses there is danger of the waste blocking the perennial *nallah* which is adjacent to the dumping site. The plant has not installed WHRB, AFBC or brick manufacturing plant for utilisation of the solid waste and hence the ever increasing dump. There is inadequate water sprinkling facility and no garland drains around the waste dump area have been made. The plant does not comply with the condition of SPCB to use washed coal with less than 35 per cent ash. This combined with improper pollution control equipment is a spelt out disaster. In spite of all these non-compliances the plant was never given a show cause or a closure notice. During an inspection visit in 2008, it was merely issued a direction asking it to comply with these conditions.

M/s Aarti Steel has an ESP in place but the system is either faulty or inadequate for higher than normal emissions were observed from the ESP. Its SPM levels at WHRB stack were 180 mg/Nm^3 and 154 mg/Nm^3 in 2007-08 and 2008-09 respectively. The plant also exhibited high range of visible fugitive dust. The fact that its ambient SPM and RSPM levels near office area were as high as 603 $\mu g/m^3$ and 196 $\mu g/m^3$ respectively point towards inadequate or non-functional pollution control equipment. The plant did not comply with the condition to maintain and upgrade bag filters. The plant remained non compliant on construction of *pucca* roads within the premises. The waste dumping is done with a casual attitude as was observed during an inspection visit by the SPCB. The plant is dumping the waste into the open, adjacent to coal fines stock yard, without proper dust suppression and runoff management system. The plant remains devoid of being served any notice even with such huge number of non compliances.

M/s Joy Iron and Steel exhibited very high visibility of fugitive dust. Also, its waste disposal was not satisfactory in addition to it being only partially covered. The plant's ambient SPM levels near office and ESP areas were way beyond the limit – 548 $\mu g/m^3$ and 670 $\mu g/m^3$, respectively. It is one plant which failed to improve its housekeeping and up-gradation if bag filters. The plant did not construct *pucca* roads inside the premises till the latest inspection report. The same had also been observed in 2007-08 as well but the plant did not take any action for a year. It lacked a dust handling system as well. This factor combined with inappropriate bag filters could be a major reason for high ambient air SPM levels. The plant does not have any of the methods of utilization of char in place – WHRB, AFBC or brick manufacturing plant. The plant has not been served any notice till date.

M/s Beekay Steel and Power also exhibited very high visibility of fugitive dust. Its stack emission stood at 374 mg/Nm^3 of SPM pointing to an above limit condition. Also, the ambient SPM levels near ESP area were as high as 868 µg/m^3 indicating towards the inefficiency of the system. SPM near the weighing bridge was also on the higher side at 670 µg/m^3. Up-gradation and maintenance of bag filters was not carried out in 2007-08 and there was repeated non compliance on the parameter even in 2008-09. The plant failed to comply with the condition of improving housekeeping. Also *pucca* road was not constructed within the plant's premises. SPCB served them a closure notice in 2008 due to faulty pollution control equipment, leakage from ABC boiler, non-working water sprinklers, high levels of stack monitoring and unsatisfactory disposal of solid waste. The plant replied back claiming rectification and was allowed to operate. However, as per the inspection report in 2009, the plant was again found to be flouting the norms.

M/s Ores Ispat is operational without an ESP in place. It exhibited high visibility of fugitive dust. The plant does not have a WHRB, AFBC or a brick manufacturing plant making char utilisation almost nil. The plant did not comply with the condition of constructing *pucca* roads within the premises. Also, there is no dust handling system in place. In addition, the plant does not have adequate water sprinkling facility for dust separation adding to the fugitive dust problem. Even then the plant has not been served a show cause or a closure notice.

M/s Jai Hanuman Udyog has an ESP installed at the main stack. But abnormal emissions from ESP were observed in 2007-08 and in 2008-09 as well. Leakage of flue gas was observed from the emergency cap at the kiln at various inspections. The same was reported during inspection twice in 2007-08 and then again in 2008-09. High fugitive dust visibility was also noticed in both the years. The inadequacy of the installed bag filters can be judged by the high ambient SPM levels, 584 µg/m^3 near office and 630 µg/m^3 near pump house. The solid waste site at the plant is uncovered which flouts an important condition. The plant has failed to improve housekeeping and upgrade bag filters at various locations. All the roads in the premises are not *pucca* and the water sprinklers installed were not working. No dust handling system has been installed. After a surprise inspection visit, the plant was served a closure notice in 2008 due to leakage of flue gases, high fugitive dust, poor housekeeping, non-functional bag filter in product handling area. The plant is operational according to the latest inspection report after rectification of the above concerns. However, the SPCB directed the plant to voluntarily shut down all the kilns for 10 days for protective maintenance of all pollution control equipment but the same has not been intimated by the plant yet.

M/s Hardev Steel does not have an ESP installed at the main stack. There was leakage of flue gases observed from the kiln. There is no provision of char utilisation at the plant in the form of WHRB boiler, AFBC boiler or a brick manufacturing plant. The plant was non compliant with the condition of improving housekeeping and constructing *pucca* roads within the premises. With inadequate water sprinkling facility, the plant also does not have garland drains around the waste dump area. The plant has not been served a notice for any of these non compliances.

M/s MSP Sponge Iron exhibited abnormally high emissions from the ESP. Leakage of flue gases from the kiln was also observed. Its bag filter at the product house location was non functional and the visibility of fugitive dust was very high in three different sets of inspection reports over the two year period. There were also complaints about the pollution being caused by the plant from the adjoining villages. The plant failed to comply with the condition of improving housekeeping, installation of water sprinklers along roads and up-gradation and maintenance of bag filters installed. SPCB served the plant a direction to follow these conditions but on follow up inspection the plant was found flouting the norms again.

M/s Bhushan Steel is another such plant. There are issues like leakage of flue gases from emergency caps of ABC boiler at the kiln, high fugitive dust visibility, high ambient SPM level of 643 $\mu g/m^3$, high ambient RSPM levels consecutively for four inspection reports in 2008-09 - 229 $\mu g/m^3$, 514 $\mu g/m^3$, 198 $\mu g/m^3$ and 205 $\mu g/m^3$. The conditions like construction of pucca roads and installation of water sprinklers next to roads were only partially complied with by the plant. The plant was not given any notice for these non-compliances.

CHAPTER 3

Sponge Iron Industry in West Bengal

1. Introduction

Growth of sponge iron industry was a slow and gradual process in West Bengal. The initial development of this sector was observed in Burdwan district, which later spread to Bankura, Purulia and Medinipur. The main reason for the spread was the introduction of siting restrictions in Burdwan in January 2004[1]. The siting restrictions were[2] :

- No new sponge iron plants will be allowed within the municipal areas of Burdwan district expect those proposed to be set up in Jamuria Industrial Estate (JIE)
- Expansion of existing sponge iron plants will be allowed only after examining compliance of emission norms in the existing plants
- Setting up of sponge iron plants in *panchayat* areas in clusters will be discouraged.

Table 3.1: Number of sponge iron plants

District	Number of plants
Bankura	11
Burdwan	26
East Medinipur	1
Kolkata	1
Purulia	14
West Medinipur	4
Total	**57**

Source: *Analysis based on data received from WBPCB under the Right to Information Act (RTI), 2005.*

Table 3.2: District-wise capacity

District	Capacity (MTPA)
Bankura	0.842
Burdwan	1.634
East Medinipur	0.066
Kolkata	0.105
Purulia	0.875
West Medinipur	0.644
Total	**4.166**

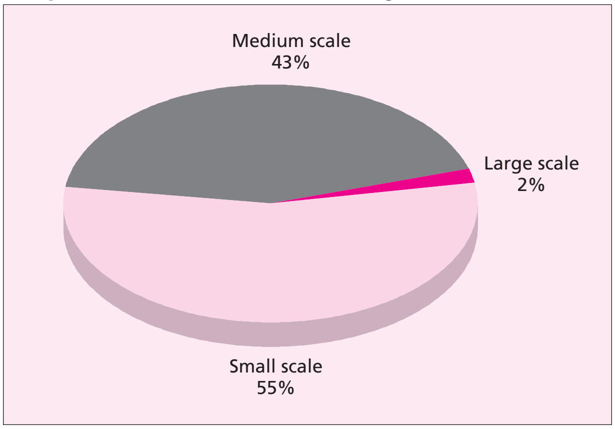
Source: *Analysis based on data received from WBPCB under the Right to Information Act (RTI), 2005.*

Today, there are 57 sponge iron plants in the state with an installed capacity of 4.16 MTPA[3]. There is a conflict in the number of plants in West Bengal with a CPCB report stating 60 sponge iron plants; out of which 27 small scale plants are a part of the unorganized sector[4]. Sponge iron production in the state in 2007-08 was 1.47 MT which was a 17 per cent increase from the previous year.

Burdwan district has the maximum number of sponge iron plants in the state (46 per cent) followed by Purulia (25 per cent) and Bankura (19 per cent) (see *Table 3.1: Number of sponge iron plants*). Two of the large plants are in West Medinipur and one is in Bankura. The average plant capacity in the state stands at 0.073 MTPA[5].

Burdwan contributes most to the capacity in the state (39 per cent) (see *Table 3.2: District-wise capacity*). Purulia with a capacity of 0.875 MTPA contributes 21 per cent to the total capacity and is closely followed by Bankura (20 per cent). West Medinipur with just four plants contributes

Graph 3.1: Kiln based size analysis



Source: *Analysis based on data received from WBPCB under the Right to Information Act (RTI), 2005.*

about 16 per cent of the total installed capacity of sponge iron.

The state houses the maximum number of medium scale sponge iron plants in the country. A total of 38 medium scale plants are located in the state. Sixty seven per cent of these are medium scale, 28 per cent are small scale (16 plants) and a mere five per cent (three plants) are large scale. The state contributes about 14 per cent of the total coal based sponge iron installed capacity in India[6]. Medium scale plants contribute about 80 per cent of the installed capacity in the state[7]. Almost 12 per cent of the installed capacity is contributed by small scale plants and eight per cent is attributed to large scale ones[8].

A look at the kilns in the sponge iron plants in the state gives a different picture. There are 149 kilns in the 57 plants in the state[9]. Out of these, 55 per cent are small scale (see *Graph 3.1: Kiln based size analysis*) followed by medium scale (43 per cent). Three kilns are large scale accounting for only 2 per cent. These three kilns are present in M/s Sova Ispat, thus qualifying it as the only large scale plant as opposed to three when the combined capacity is taken into account. The sponge iron plant of M/s Rashmi Cement, the large scale plant in the state with respect to combined capacity has ten kilns of 0.033 MTPA each.

Sponge iron clusters[10] in West Bengal are Barjora, Durgapur, JIE and Raniganj. Twenty nine out of the 57 plants are located in clusters (see *Table 3.3: Sponge iron clusters in West Bengal*). Only one large scale plant is present in the cluster in Barjora. JIE has the maximum number of plants (nine). Forty seven per cent of the total installed capacity in the state is attributed to these clusters. Durgapur in Burdwan district is the biggest cluster in terms of capacity with eight plants and a capacity of 0.677 MTPA.

1.2 Environmental and social concerns related to sponge iron industry

Fate of West Bengal is similar to other states where sponge iron plants are located. The water quality of village ponds has been severely affected having a tarry layer over the surface of water bodies. Groundwater table has been lowered and villagers claim that earlier the tube-wells only needed to be 30-40 feet deep but now they are unable to find water even at 70-100 feet. The damage created by a single sponge iron plant per annum on ecological constituents is financially calculated as[11]:

- Agricultural: ₹1,09,23,300/-
- Cattle: ₹3,89,18,125/-
- Human Health: ₹5,20,83,325/-

Table 3.3: Sponge iron clusters in West Bengal

Cluster	Small	Medium	Large	Capacity (MTPA)
Barjora	1	3	1	0.4290
Durgapur	1	7		0.6765
JIE	6	3		0.3795
Raniganj	1	6		0.4785

Source: *Analysis based on data received from WBPCB under the Right to Information Act (RTI), 2005.*

1.2.1 Burdwan District

The sponge iron plants in the cluster are located at distances of just 150-300 meters (m) of each other. Occupational health and safety aspects in the area are poor as no one uses hard hats, boots or dust filters[12]. Workers are covered with black dust as are the leaves in the area. The air quality is poor and smells acrid[13]. People in the nearby villages complain of deposition of dust on homes and on water. This is a pointer towards inadequate or non operational pollution control equipment by industries in the cluster. Most approach roads to the plants are in a poor state and high dust emissions are present in the absence of water sprinklers. Ash is dumped in ditches near the highway and char is dumped on land belonging to the Asansol Durgapur Development Authority[14].

1.3 Impact on livelihood and health

Agricultural yield from fields located close to sponge iron plants has been severely degraded due to the indiscriminate disposal of dolo-char in the fields. Many people claim a decrease in agricultural productivity from 12-13 bags[15] per bigha before the plant (M/s Jai Balaji) was set up to 6-7 bags per bigha in the last three years. The rice they produce has become black and only fetches half the usual price. The settling of dust on all surfaces including their bodies and respiratory illness in children are other health issues. People have moved to nearby villages from Banskopa due to the presence of dust[16].

Residents further claim that the sponge iron plants in the region have a very poor safety record resulting in major injuries or fatalities to workers almost every month; with the last one having taken place on January 3, 2010[17]. People also had written to the local officials and the plant manager on the issue; threatening an agitation if the administration did not act soon enough.

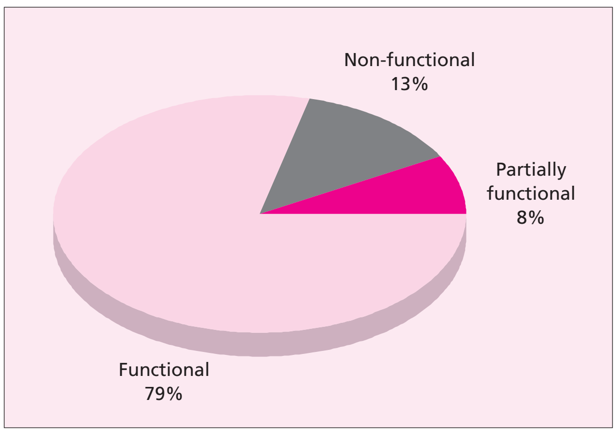
2. The study

Our data set comprises of 12 sponge iron plants. For these, between 2006 and 2009, 67 inspection reports, obtained from West Bengal Pollution Control Board (WBPCB), were analysed. Inspection reports for all the plants are not available for all the mentioned years but at least one inspection report for every plant is available.

2.1 ESPs and their operation

All the 12 plants have installed an ESP at the kiln. As per the latest inspection reports of the 12 plants ESP was functional in 11. However, from 2006 to 2009, over various inspection reports, non compliance on ESP functionality was observed about 14 per cent of the time (see *Graph 3.2: Operational Status of ESPs*). According to Biswajit Mukherjee, chief law officer at the state department of environment, the non-compliance rate in sponge iron plants is very high as compared to the average non-compliance rate in West Bengal. He said most issues have to do with operation of ESPs.

Graph 3.2: Operational Status of ESPs



Source: *Analysis based on data received from WBPCB under the Right to Information Act (RTI), 2005.*

A faulty/non functional/partially functional ESP translates itself into higher stack emissions. Out of the 11 plants for which stack monitoring reports are made available nine exceeded the prescribed limit at least once from 2006 to 2009. The fact that these 11 plants have an ESP installed but still give heavy stack emission readings means that the installed pollution control equipment is inadequate. On a number of occasions show cause notices, closure notices and directions were issued based on the stack monitoring reports or public complaints. However, the plants claim to comply with the conditions and the notice is suspended. In a few months, the same plant develops the same non compliance. Clearly, the impact of closure/show cause/direction is negligible.

The inspection reports also noted the leakage of flue gas from various sections of the plant. Over the set of inspection reports analysed for seven plants[18], 92 per cent of the times leakage was detected. To illustrate, a few case studies are presented here:

M/s Bisco Metal and Power:

- Five inspection reports were provided by the WBPCB for the company.
- The plant was found repeatedly non compliant for ESP functionality. Inspection report dated 15/11/2007 stated that the ESP was only partially functional. According to the inspection report dated 09/09/2008, it was not functional. The non operation of ESP was also confirmed in the surprise inspection dated 27/11/2009.
- The inspection reports state the presence of high emissions from the after-burning chamber (ABC) and attribute this to the non functional ESPs.
- A show-cause notice was issued on 21/12/2009 based on photographs taken on 16/11/2009 and 18/11/2009 exhibiting high emission due to non operational ESP.
- This brings out the lax approach of the company towards operation of pollution control equipment. The repeated non compliance is also a mark of poor regulation by the WBPCB.

M/s Savitri Sponge:

- Nine inspection reports including a surprise visit report to the plant and five show-cause notice copies were made available by the WBPCB.
- The plant was served a show cause notice on 03/02/2006 for not being able to meet the air emission standards with respect to Particulate matter (PM) emissions. The stack monitoring report dated 16/01/2006 found the PM levels above the limit of 150 mg/Nm^3 at 236.95 (stack connected to rotary kilns), 204.29 (stack connected to product house), 289.30 (stack connected to product house) and 163.66 (stack connected to coal handling plant).
- It was decided to recommend a closure notice for the plant in a meeting dated 20/09/2006.
- A similar show-cause notice was served on 22/01/2007 to the company again for not meeting PM standards.
- The plant was then asked to submit a bank guarantee of ₹10 lakh to ensure compliance of PM emission standards within a period of six months according to an order dated 29/03/2007.
- As per the inspection report dated 13/05/2008, leakage of flue gas was observed from kilns. The same report observed high emissions from stack attached to ESP and leakage from ESP hopper.
- Inspection report dated 16/06/2008 recorded leakage again. ESP stack emissions were visible.
- The company faltered once again in meeting the stack PM emission standards and was issued a show-cause notice dated 07/07/2008. This was based on the stack reading taken during the 13/05/2008 inspection.
- WBPCB carried out a surprise visit to the plant on 11/02/2009 after observing high black emission from the plant. The inspection confirmed that ESP was non functional even though the plant was in operation.
- A night inspection was carried out as a result of a mass public complaint from residents of Raniganj and Bakhtarnagar about high air pollution levels. According to the report dated 09/03/2009, very high emissions were observed from the top of the ABC at both the kilns in the plant. ESP was found to be only partially functional. Leakage was observed from the recuperator as well.

- Another night inspection was carried out dated 13/04/2009 after yet another mass public complaint of high air pollution. The report observed high emissions from the top of the ABCs, leakage from the recuperator and non functional ESP. Vide an order dated 11/05/2009 the company was asked to appear for a hearing to take regulatory action against it.
- The inspection report dated 22/04/2009 found similar flaws at the plant - non functional ESP, high emission from the stack, leakage, etc.
- Show-cause notices dated 27/05/2009 and 17/06/2009 were served to the company for not being able to meet the PM emission standards.
- The plant committed the same non compliance year after year. Although five show-cause notices were issued for non compliance with respect to stack emissions, they failed to have the desired effect. Even the bank guarantee did not change the company's attitude. The WBPCB although very active in serving show-cause notices, did not deal with the company stringently. Even after having decided to serve a closure notice to the company, the same was not carried out bringing out the leniency of the WBPCB towards non complying companies.

M/s Govinda Impex:

- Six inspection reports including a surprise inspection, four show-cause notice copies and three closure notices were provided by the WBPCB.
- In the inspection report dated 26/02/2008, ESP was found operational but considerable amount of leakage from ABC cap was observed.
- Vide an order dated 09/04/2008 the SPCB issued a closure notice for considerable emission from the ABC caps. The same was brought into the board's notice after a public complaint was filed by the Barjora Zonal Committee. However, a month later the closure order was suspended vide order dated 08/05/2008 on the pretext that the industry had rectified the faults.
- A subsequent surprise night inspection dated 12/06/2008 revealed that although the plant was in operation; both the ESPs were out of service. Also the plant representative refused to accept the inspection notice.
- SPCB again issued a closure notice to the company with disconnection of electricity. The order dated 06/08/2008 was based on the fact that the plant was operational without operating the ESPs. The notice was however suspended (we do not have a copy of the order but subsequent inspections reports).
- The board issued a show-cause notice to the company dated 18/09/2008 for not submitting the requisite bank guarantee and pollution cost.
- Show-cause notices dated 11/11/2008 and 01/12/2008 were issued for not being able to meet the stack emission standards.
- For the inspection reports dated 30/07/2009, noticeable emissions and leakage from ABC cap were observed even though the ESP was operational.
- A show-cause notice dated 12/11/2009 was served to the company for not complying with stack emission standards. Highest value of stack emission was noted for the plant in the sample with a reading of 4745.54 mg/Nm^3.
- A closure notice dated 24/12/2009 was served to the plant. The basis were mentioned as: strong public resentment due to high pollution levels, very high stack emission, high visible emission from ABC cap, etc. The closure notice was unclear. It said that the plant is "hereby closed from the date of issuance of this order" and at the same time also mentioned that the company will be given a month's time from the order date to fix the problems. During this month the electricity connection of the plant was not disconnected either.
- It is interesting to note that closure notices against the company were suspended twice even though there have been a string of non compliances. The fact that ESPs were operational most of the times but still there were visible emissions/leakage of flue gas point towards inadequacy of pollution control equipment. Show-cause and closure notices leave much to be desired since they failed to have the required effect.

M/s Rishab Sponge:

- Copies of six show-cause notices, one direction and three inspection reports were analysed for the plant.
- The plant was served a direction dated 07/01/2008 based on a public complaint alleging operation of the plant without ESP leading to heavy emissions. The Board had carried out a surprise inspection on 10/09/2007 and found 'high level of emission from the stack and also leakage through the ABC cap'. The ESP was however operational. Stack readings failed to comply with the standards: 256.5 mg/Nm^3 at rotary kiln II, 160.3 at rotary kiln I and II and 340.62 at product discharge. The company representative informed that due to water availability issues the GCT linked to the ESP was not operating efficiently and hence the non compliances that occurred. The order directed the company to ensure compliance of emission standards and proper functioning of emission control equipment. The plant was asked to shut down operations in case the pollution control equipment fails. The company was also asked to submit a bank guarantee of ₹2 lakh for ensuring compliance of the above.
- WBPCB served the company a show-cause notice dated 24/04/2008. As per the inspection carried out on 17/04/2008, there was visible emission from stack and leakage from ABC cap.
- According to the inspection reports dated 27/04/2008 and 05/08/2008, high emission was observed from the stack with leakage from the ABC cap.
- A show-cause notice dated 11/08/2008 was served to the company for not being able to meet the stack emission standards.
- Another show-cause notice dated 22/10/2008 was issued for visible emissions from stack and leakage from ABC cap among other reasons.
- The inspection report dated 25/02/2009 found heavy emission from ABC caps and stacks even with an operational ESP.
- A show-cause notice dated 19/03/2009 was served to the company for not meeting the stack emission standards.
- Another show cause notice dated 06/08/2009 was for high stack emission and leakage from ABC cap.
- Shortly after, a show-cause notice dated 10/08/2009 was served to for not meeting the stack emission standards.
- The ESP was found functional in most of the inspections but there was still heavy visible emission from the stacks and leakage from ABC cap. This brings to fore the inadequacy of the present pollution control equipment in the plant. The plant did not change its non complying nature in spite of the show-cause notices and the bank guarantee. The WBPCB regulatory function is ineffective.

A number of other plants defaulted every now and then and were let go without any substantial action. Public complaints have been registered for seven plants out of the 12 plants. These were related to air pollution from the plants and detected non-operation of ESPs especially at night. In order to ensure ESP functionality, the WBPCB introduced the interlocking Environmental Compliance Monitoring System (ECMS). ECMS is voluntary and 40 plants installed it in its peak (late 2008). However, there were several technical and logistical issues; mostly to do with the operation of a day and night office to provide new passwords for unlocking the system in case of a power cut[19].

2.2 Six point directives

West Bengal PCB issued **six point directives** in May 2007 that are to be verified during inspections. These directives are:

(i) Under no circumstances the industry will store coal char/fines, dust, etc., in the open: Seventy six per cent non compliance and seven per cent partial compliance was observed for the parameter over a set of 29 inspection reports available for nine plants. Non compliance was repeated and frequent. To illustrate, M/s Govinda Impex stored coal char in the open as per the inspection report dated 01/10/2008. Coal char and fines dumping in the open was also cited as one of the reasons for serving the closure notice dated 24/12/2009 to the company. Similarly, M/s Rishab Sponge showed non compliance for the parameter a number of times. Storing coal char and fines in the open along with other non compliances resulted in a show-cause notice to the company dated 24/04/2008. However, just three days later, the story was repeated with inspection report dated 27/04/2008 stating open storage of coal char and fines. As per the inspection report dated 05/08/2008, the plant was storing coal char and fines in the open still. A show-cause notice dated 22/10/2008 was again served to the plant for storing coal char in the open among various other reasons. M/s Concast Bengal Industries was non compliant with the directive on a number of inspections dated 24/09/2008, 1/12/2009 and 16/12/2009. A closure order dated 21/05/2008 was also served to the plant where one of the non compliances was storing of coal char, etc., in the open.

(ii) Dust collection system in ESP should be provided with pneumatic control system along with silo and pug mill: This directive aims at enhancing the efficiency of ESP and reducing the spillover of dust inside the factory premises. Forty nine per cent non compliance and three per cent partial compliance was observed for the parameter over a set of 35 inspection reports for 10 plants over the three year period-2006 to 2009.

(iii) The industry must provide dry fog suppression system for controlling fugitive emission: Non compliance for the parameter stood at 36 per cent with three percent partial compliance. A set of 31 inspection reports were analysed for 10 plants.

(iv) Concrete/paved roads: Thirty inspection reports were analysed for nine plants for the parameter showing 30 per cent non compliance and 27 per cent partial compliance.

(v) Water tankers and sprinklers are to be in place for dust suppression: Twenty seven reports spread across the three year period were analysed for 10 plants. 37 per cent non compliance and 30 per cent partial compliance was observed for the parameter.

(vi) Good housekeeping and green buffer covering 40 per cent of the total area: 59 per cent non compliance and 36 per cent partial compliance for the parameter was observed on analysing a set of 39 reports for 10 plants.

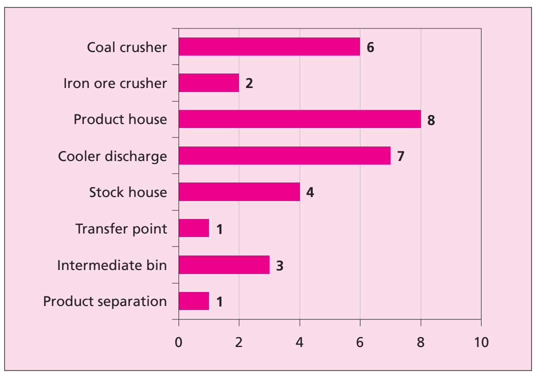
For all the six directives taken together, the non compliance spread over the three year period stood at 49 per cent for the 10 plants. Partial compliance was 18 per cent.

2.3 Bag filters and fugitive emissions

Bag filters are to be located at a number of locations in a sponge iron plant. Installation data was made available for eight plants out of 12. Bag filters were present at product house, cooler discharge and coal crusher for most of these plants (see *Graph 3.3: Bag filters at various locations*). Even with bag filters installed, heavy fugitive dust emission is observed during inspections.

Fugitive emissions were observed in 98 per cent of the cases. The analysis is based on a set of 40 inspection reports for 11 plants over the three year period. Such high instance of fugitive emissions in the presence of bag filters at most of the locations raises questions about the pollution control equipments, their functionality and adequacy and the inspections. A number of plants were repeatedly non compliant for the parameter.

Graph 3.3: Bag filters at various locations



Source: *Analysis based on data received from WBPCB under the Right to Information Act (RTI), 2005.*

For instance, M/s Rishab Sponge

- High fugitive emission from cooler discharge and product separation house observed at the plant according to the direction dated 07/01/2008.
- Show-cause notice dated 24/04/2008 served for high fugitive emission at the plant.
- High fugitive emission was still present as per the inspection report dated 27/04/2008.
- Inspection report dated 05/08/2008 also stated the presence of high fugitive emission at the facility.
- Another show-cause notice dated 22/10/2008 was served to the plant due to high fugitive emissions among other non compliances.

Similarly for M/s Govinda Impex, high fugitive emission was observed near product house and cooler discharge due to improper suction as per the inspection report dated 26/02/2008. High fugitive emissions were again observed at the plant as per the inspection report dated 24/12/2009.

Thus, a number of non compliances have been observed by the sponge iron plants in the state on various accounts. While the board has tried to correct these with frequent inspections, their efforts prove futile with the same non compliance occurring repeatedly. Even show-cause and closure notices to these plants have failed to have the desired effect pointing towards the need for a stricter course of action.

CHAPTER 4

Sponge Iron Industry in Chhattisgarh

1. Introduction

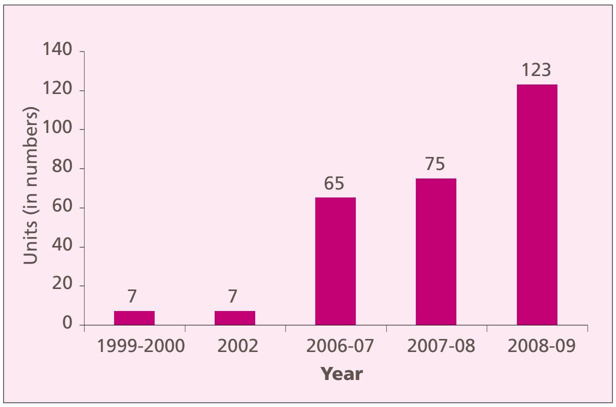
Chhattisgarh is one of the largest producers of sponge iron in India. In 2007-08, the state produced 5.20 MT of sponge iron accounting for about 26 per cent of the total sponge iron production in the country[1]. There are no coherent figures on the number of plants or kilns in the state.

During 1999-2000, only seven plants were operating in the state (see *Graph 4.1: Growth of sponge iron industry in Chhattisgarh*). In a span of seven years, the number increased to 65 registering a nine-fold increase. An estimate of the number of working plants in Chhattisgarh for 2007-08 was 75 with a working capacity of 7.5 MTPA[2].

Chhattisgarh is dominated by small scale plants with production capacities between 0.0075 to 0.033 MTPA (see *Table 4.1: Distribution of sponge iron plants*). The state has 29 small scale (43 per cent), 23 medium scale (34 per cent) and 16 large scale plants (24 per cent)[3]. Raipur has 75 per cent of the plants in the state[4] followed by Raigarh (16 per cent). The plants in these two districts are mostly present in clusters[5]. Siltara cluster in Raipur district has 32 plants[6]. Urla is a cluster of 11 plants also situated in Raipur[7].

In terms of plant capacity, small scale plants contribute a meager nine per cent of the total capacity of eight MTPA in the state (see *Table 4.2: Capacity distribution of sponge iron industry in Chhattisgarh*). Medium scale plants contribute about 22 per cent to the total capacity and even though the number of large scale plants is the lowest, their contribution to the total capacity is as much as 70 per cent.

Graph 4.1: Growth of sponge iron industry in Chhattisgarh



Source: *Based on data from –*

1. *http://www.indiastat.com/table/industries/18/statewisesteel production/449601/24498/data.aspx,*
2. *http://www.indiastat.com/table/industries/18/privatesector/ 13595/13847/data.aspx,*
3. *http://www.indiastat.com/Industries/18/StatewiseSteel Production/449601/466599/data.aspx,*
4. *http://www.indiastat.com/Industries/18/StatewiseSteel Production/449601/466658/data.aspx as viewed on April 1, 2010*

Table 4.1: Distribution of sponge iron plants

District	Small	Medium	Large
Bhilai	1	0	0
Bilaspur	1	0	1
Champa	0	0	1
Durg	0	2	0
Raigarh	2	4	5
Raipur	25	17	9
Total	29	23	16

Source: *Analysis based on data received from CECB under the Right to Information Act, 2005.*

Table 4.2: Capacity distribution of sponge iron industry in Chhattisgarh

Scale	Capacity (MTPA)	Percentage Contribution
Small	0.69	9
Medium	1.72	22
Large	5.59	70

Source: *Analysis based on data received from CECB under the Right to Information Act, 2005*

According to CPCB there are 167 kilns in the state spread over six districts (see *Table 4.3: Sponge iron kilns in Chhattisgarh*). Raipur and Raigarh have most of the sponge iron industry both in terms of kilns as well as individual plants. In terms of individual kiln capacity, the size distribution changes tremendously. There are about 80 per cent small scale kilns, 15 per cent medium scale ones and five per cent large scale kilns in the state. 0.033 MTPA kilns are the most common ones while the average kiln capacity in the state is 0.046 MTPA..

The clusters identified in the state are Siltara and Urla *(see Map 4.1: Raipur).* Raigarh district although not a cluster by definition, has a large chunk of sponge iron plants of the state. The district has 11 plants out of which 18 per cent are small scale (two plants), 36 per cent are medium scale (four plants) and 46 per cent are large scale ones (five plants). The largest plant in the sample is M/s Jindal Steel and Power in Raigarh with a capacity of 1.37 MTPA[8].

Siltara: situated at a distance of about 10 km from Raipur town[9] has 33 sponge iron plants. The industrial growth centre in Siltara situated on NH-200 is spread over an area of 1300 hectares (ha)[10]. The plants are mostly small and medium scale. Average capacity of a sponge iron plant in the cluster is 0.084 MTPA[11]. The total installed capacity of the cluster is 2.92 MTPA *(see Table 4.4: Sponge iron plants in Siltara).* The largest plant in the cluster – M/s Godawari Power and Ispat has a capacity of 0.495 MTPA followed by M/s SKS Ispat (0.27 MTPA).

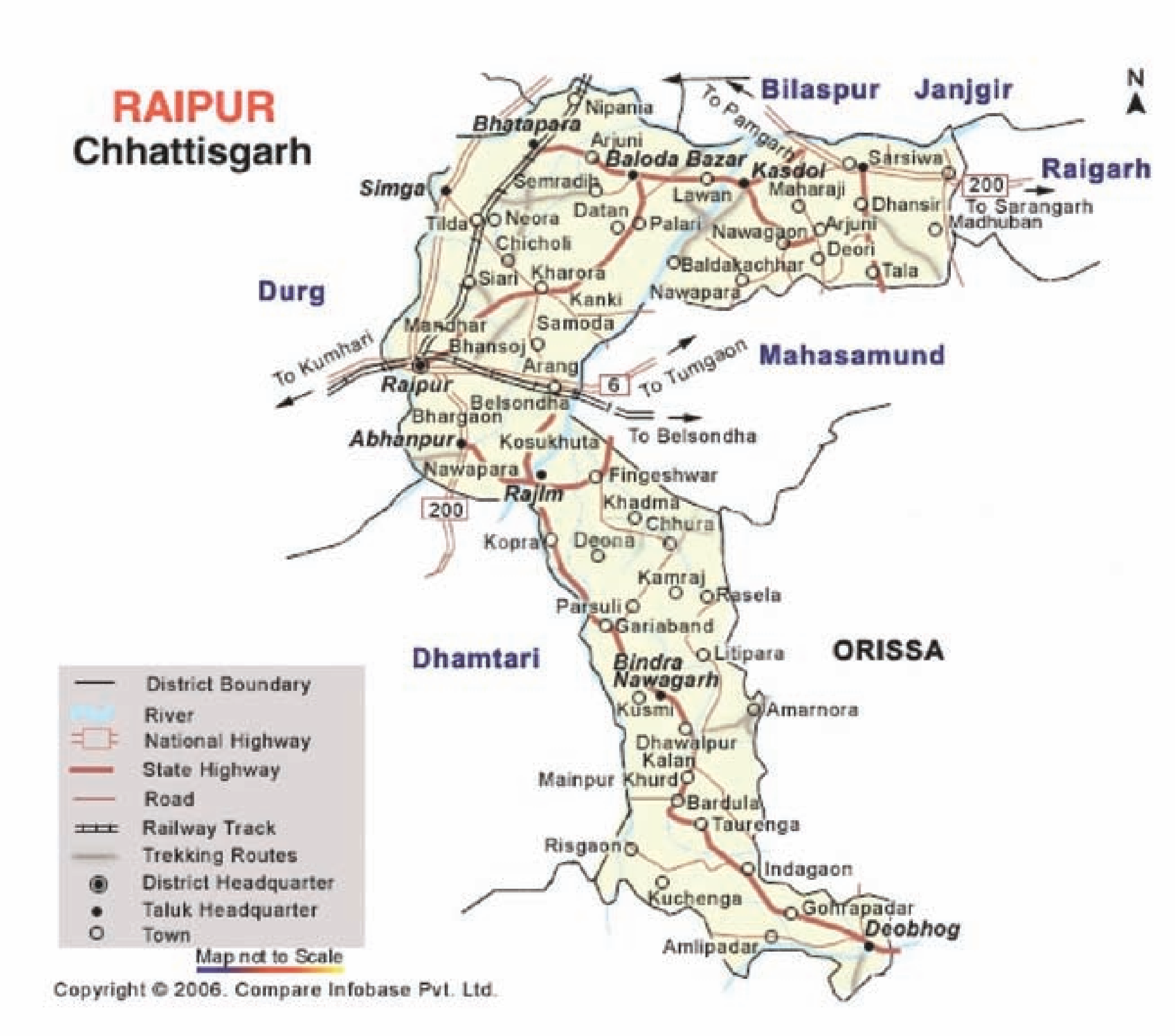
Urla: spread over an area of 815 ha, Urla is a very important industrial hub of the state[12]. It has around 60 medium and large scale industries and 550 small-scale industries. Investments made in Urla are of the order ₹400 crore providing employment to over 16,000 people[13]. There are 11 sponge iron plants in Urla (see *Table 4.5: Sponge iron plants in Urla*). Most are small scale followed by medium ones. The cluster has one large scale plant. In terms of capacity contribution, the small scale plants although more in numbers contribute only 20 per cent of the capacity in the cluster. Medium scale plants contribute 46 per cent of

Table 4.3: Sponge iron kilns in Chhattisgarh

Capacity	No. of sponge iron kilns						
(in MTPA)	Raipur	Raigarh	Bilaspur	Durg	Korba	Jagdalpur	Total
0.165	2	4	3				9
0.116	7	4					11
0.099	3	8					11
0.066	1			1			2
0.074		1					1
0.033	45	36	10	4			95
0.030	1						1
0.017	15	5	3	2	1		26
0.013		3					3
0.010		1					1
0.008	4	1				2	7
Total	78	63	16	7	1	2	167

Source: *http://www.cpcb.nic.in/Highlights/2007/57-90.pdf as viewed on May 12, 2010.*

Map 4.1: Raipur



Source: *http://www.mapsofindia.com/maps/chhatisgarh/districts/raipur.htm as viewed on April 2, 2010.*

the capacity and the single large scale plant contributes about 34 per cent of the capacity. The average plant capacity in the cluster is 0.058 MTPA[14]. The cluster is dominated by small and medium scale plants. M/s Bajrang Metallics is the only large scale plant in the cluster with a capacity of 0.21 MTPA.

2 The study

Although the state has close to 125 plants, the Chhattisgarh Environment Conservation Board (CECB) provided inspection reports of only 59. Inspections reports for the years 2007, 2008 and 2009 were made available. However, inspection reports for all the plants for all the mentioned years are not available. At the same time, at least one inspection report for each plant is available over the three year period. Due to lack of coherence in the format of the reports, a number of data is missing. Accordingly adjustments have been made. For Siltara cluster, data is available for 31 plants while for the Urla cluster data is available for only two plants.

Table 4.4: Sponge iron plants in Siltara

Plants	Capacity (MTPA)
M/s Sarda Energy and Minerals	0.210
M/s Godawari Power and Ispat	0.495
M/s Vandana Global	0.060
M/s S K S Ispat	0.270
M/s Drolia Electrosteels	0.066
M/s Mahendra Sponge and Power	0.060
M/s Shree Nakoda Ispat	0.066
M/s Baldev Alloys	0.030
M/s Gagan Resources	0.015
M/s Rashmi Sponge Iron and Power Industries	0.030
M/s Indian Steel and Power	0.030
M/s Aarti Sponge and Power	0.045
M/s Gopal Sponge and Power	0.030
M/s Mahamaya Sponge Iron	0.015
M/s Shree P.D. Industries	0.030
M/s Agrawal Sponge	0.015
M/s Shri Harekrishna Sponge Iron	0.210
M/s G. R. Sponge and Power	0.030
M/s Sunil Sponge	0.030
M/s Ghankun Steel	0.015
M/s Abhijeet Infrastructure	0.120
M/s Euro Pratik Ispat	0.030
M/s Bhagwati Power and Steel	0.030
M/s A.P.I. Ispat and Powertech	0.105
M/s Trimula Sponge Iron	0.030
M/s Ramniwas Ispat	0.008
M/s Raipur Alloys and Steel	0.210
M/s Jayaswals Neco Industries	0.250
M/s Ispat Godavari	0.100
M/s Jagdamba Power and Alloys	0.150
PD Industries	0.030
Ispat Godawari	0.105

Source: *Analysis based on data received from CECB under the Right to Information Act, 2005*

2.1 Air pollution

ESP is attached in 98 per cent of the plants in the sample[15]. Ten plants have a scrubber installed[16] and five of these are plants with an ESP as well. Out of the plants with installed ESP, only 79 per cent have functional ones while 21 per cent are partially functional[17]. In the Siltara cluster, 100 per cent of the plants in the sample[18] have an ESP in place. Both the plants in Urla cluster have an ESP. Even though an ESP is installed, some plants exhibit above normal emissions from ESP as recorded in the inspection reports. For instance, M/s Prakash Industries showed very high ESP emissions in the year 2008[19]. The plant has an ESP installed but its stack monitoring report is far from satisfactory and this combined with emissions from ESP point towards inadequacy or non-functionality of the system (see *Graph 4.2: Main stack SPM emissions for ßPrakash Industries*). For the year 2007, eight set of inspection reports were analysed for the plant out of which three displayed beyond limit (150 mg/Nm^3) concentrations – 309 mg/Nm^3, 280 mg/Nm^3 and 490 mg/Nm^3. In 2008, out of the four set of reports analysed, one gave a high value – 358 mg/Nm^3. In 2009 also the situation remained the same. Out of four sets of reports, three exhibited beyond limit values of 156 mg/Nm^3, 183 mg/Nm^3 and 168 mg/Nm^3.

Table 4.5: Sponge iron plants in Urla

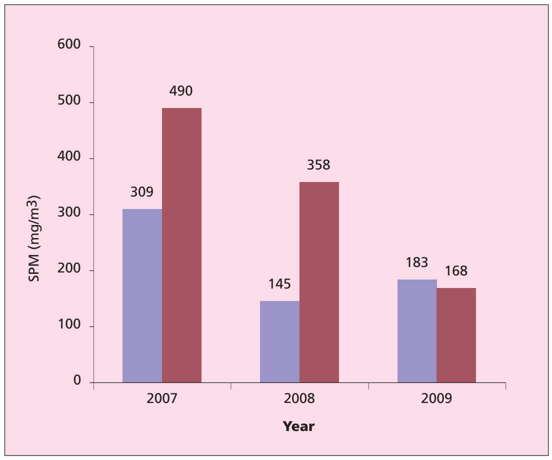
Plants	Capacity (MTPA)
M/s Shree Bajrang Power and Ispat	0.231
M/s Gravity Trexim	0.008
M/s Shivalaya Ispat and Power	0.033
M/s Shree Sita Ispat and Power	0.033
M/s Satyartha Steel and Power	0.033
M/s Real Ispat	0.066
M/s Shilphy Steel	0.050
M/s Indsil Energy and Electrochemicals	0.024
M/s Hira Ferro Alloys	0.075
M/s Hira Power and Steel	0.042
M/s Bajrang Metallics	0.210

Source: *Analysis based on data received from CECB under the Right to Information Act, 2005*

Another plant M/s Nova Iron and Steel exhibited abnormally high ESP emissions in 2008 and 2009. The plant's main stack SPM levels have been extremely varying over the period. In 2007[20], the lowest level recorded was 88 mg/Nm^3 while the highest was 178 mg/Nm^3. For 2009, the level suddenly shot up to 2,292 mg/Nm^3 while another report in the same year reported the level as low as 46 mg/Nm^3.

There was also leakage of flue gases observed at the kilns of these plants. In 2007, six plants showed leakage while in 2008 over a set of four inspection reports there were 16 such cases. In 2009, leakage was observed in seven cases over a set of three inspection reports. Most of these were repeated defaults. M/s Shakun Iron is the plant with maximum instances of leakage detection during inspection over two years, five times. Other plants like M/s Prakash Industries, M/s Radha Madhav Industries and M/s Satya Power and Ispat also showed repeated non-compliance on the parameter.

Graph 4.2: Main stack SPM emissions for Prakash Industries



Source: *Analysis based on data received from CECB under the Right to Information Act, 2005.*

The data on bag filter installation and functionality is rather poor. One thing that comes out very clearly is that wherever a bag filter is installed, it is found to be not functioning defying the very purpose of the installation. Only three plants have a bag filter at the stock house, four at the coal crushing unit, two at the iron ore crushing unit, one at the transfer point, four at cooler discharge, 10 plants at the intermediate bin, four at product separation and seven plants at product house. None of these were found operating at the time of inspection.

The absence/inadequacy of bag filters is reflected in the poor ambient air quality figures. M/s Prakash Industries' ambient SPM level near office area were as high as 520 µg/m^3 in 2007 and 678 µg/m^3 in 2008. The plant was non-compliant for the same even near the FBB stack with figures like 595, 710, 601, 533 and 561 µg/m^3 in 2007, 565 and 540 µg/m^3 in 2008 and 598, 616, 610 and 582 µg/m^3 in 2009. Near labour quarters, the SPM levels went up as high as 813 µg/m^3 while near the hazardous waste shed the maximum was 879 µg/m^3 in 2007. M/s Nova Iron and Steel has a bag filter at the transfer point and another one at product separation although both non-functional as per the available inspection reports. The ambient SPM levels near the workshop were very high for this plant – 550 µg/m^3 on an average for 2007[21] and 508 µg/m^3 for 2008[22].

M/s Satya Power and Ispat is another plant with bag filters installed in most of the required locations but non-functional ones as per the inspection reports. Its ambient air SPM levels confirm the same *(see Table 4.6: Ambient SPM levels for M/s Satya Power and Ispat).* The average level of SPM near the office area was 706 µg/m^3 in 2007[23] and 620 µg/m^3 in 2009[24]. The levels near back gate were also quite high – 753 µg/m^3 in 2007, 540 µg/m^3 in 2008 and 524 µg/m^3 in 2009[25]. Abnormally high fugitive emissions were observed at M/s Satya Power and Ispat during inspection for 2008[26] and 2009[27].

Fugitive emissions were observed in the plants over the three years. Ideally, installation of bag filters should minimise or abate these but this is not the case. In 2007, 10 plants exhibited emissions while four of these fall in the high to very high range[28]. For

Table 4.6: Ambient SPM levels for M/s Satya Power and Ispat

Location	2007	2008	2009
Near office	706		620
Near back gate	753	540	524

Source: *Analysis based on data received from CECB under the Right to Information Act, 2005 .*

one set of inspection reports in 2008, there were seven plants with high to very high range of emissions. In 2009, one set of reports give six plants as lying in the high to very high range of fugitive emissions. Some companies defaulted repeatedly - M/s Indian Steel and Power over 2007[29] and 2008[30], M/s Agrawal Sponge for 2007[31], M/s Radha Madhav Industries for 2008[32] and 2009[33].

Pucca road construction is a measure towards trying to minimise fugitive emissions due to plying of vehicles. In 2007 two plants, in 2008 five plants and in 2009 four plants did not comply with this condition. One plant in 2009 was partially compliant. Information is available only for these plants.

Solid waste management is an important aspect for a sponge iron plant. There is an urgent need for proper disposal or utilisation of wastes like char. In 2007[34], M/s SKS Ispat, M/s Indian Steel and Power, M/s Bhagwati Power and Steel and M/s Arsh Iron exhibited improper solid waste management as per the inspections. In 2008[35], eight plants carried out unsatisfactory disposal of solid waste while in 2009 this number was six[36]. Plants like M/s Indian Steel and Power, M/s Satya Power and Ispat and M/s Kalindi Ispat were repeatedly non-compliant for the parameter.

2.2 Show cause and closure notices

The CECB did not provide any information on show cause or closure notices for these 59 plants. However, the plants were given directions from time to time to comply with certain conditions. The directions are all related to compliance conditions – stack emission, functioning of pollution control equipment, housekeeping, functionality of ESP, heavy fugitive emission, improper solid waste management, etc.

For heavy emission from the stacks, three plants were served directions in 2007 while 16 were served directions in 2008. Fourteen plants were given directions to comply with this condition and bring down stack emissions in 2009. Some plants that repeatedly defaulted are M/s Shivalay Ispat and Power, M/s SKS Ispat, M/s Raimata Ispat, M/s Abhijeet Infrastructure and M/s Mahamaya Sponge Iron.

A number of plants were served directions for emissions from emergency cap. In 2007, seven plants were non-compliant, in 2008 18 plants and 11 plants in 2009. Repeated offenders are – M/s Baldev Alloys, M/s Sunil Sponge, M/s Satyartha Steel and Power, M/s Shivalay Ispat and Power and M/s Geetanjali Ispat and Power. The performance on pollution control equipment functionality is also very poor with 20 plants being served directions for the same in 2008 and 18 plants in 2009. Heavy fugitive emissions were observed during inspection and 18 plants each in 2008 and 2009 were served directions to rectify the same. Poor housekeeping was observed in some of the plants with directions being served to 15 plants in 2008 and 10 plants in 2009.

Compliance with the consent conditions which is the prerequisite for a plant's operations is also not followed. In 2007, eight plants were non compliant with the conditions as laid down in the consent to operate granted to them. In 2008, the number went up to 23 while in 2009, 20 plants failed to comply. These plants were only served directions asking them to comply with the consent conditions. A number of plants repeatedly flouted the conditions but were still not served any notice as per the information provided by CECB. Some of these are – M/s Geetanjali Ispat and Power, M/s Shivalay Ispat and Power, M/s Satyartha Steel and Power, M/s Bhagwati Power and Steel, M/s Uro Pratik Ispat, M/s Abhijeet Infrastructure, M/s Ghankun Steel, M/s Sunil Sponge, M/s Mahamaya Sponge Iron, M/s Baldev Alloys and M/s SKS Ispat.

2.3 Case studies

M/s Mahamaya Sponge does not have an ESP installed although a scrubber is present. As a result, heavy emissions from the stack were observed in 2008 and 2009. The other pollution control equipment was not functioning properly when the inspection was done. There was heavy fugitive emission and leakage from emergency cap for two consecutive inspections in 2008. The solid waste management is not satisfactory and the plant has failed to improve housekeeping. *Pucca* road construction condition has also not been complied with by the plant. Needless to say that the plant does not comply with some important conditions laid down as per the consent. It was served directions twice in 2008 and once in 2009 on the above non compliances. Also during a night visit in 2007, the pollution control equipment (GCT) was found faulty and partially functional. The fact that repeated directions had to be meted out speaks volumes about the plant's attitude towards regulations and pollution control.

M/s Vandana Global has an ESP but it does not function properly[37]. As a result, the emissions from the stack and emergency cap are very high. Very heavy fugitive emissions were observed in the premises in 2008 and 2009 as well. The plant does not carry out proper solid waste management either. It does not follow the consent conditions and has shown poor housekeeping. It was served directions to rectify these issues - twice in 2008 and once in 2009.

M/s Prakash Industries has an ESP in place but abnormally high emissions were observed from it. The stack monitoring report gave very high SPM levels near the main stack. From 2007 to 2009, the highest SPM level observed was 490 mg/Nm^3. Very high leakage of flue gases was also observed in three consecutive inspection reports in 2008. The ambient air SPM levels were dismal. Near the office area, the highest SPM level was 678 µg/m^3 while it was 610 µg/m^3 near FBB stack. The level near labour accommodation was as high as 813 µg/m^3 and 879 µg/m^3 near the hazardous waste shed. The highest level of SPM observed was near the captive power plant – 1,589 µg/m^3. The plant continuously showed poor housekeeping in 2008[38] and 2009. The *pucca* road construction was not complied with in 2008[39]. Leakages from fly ash storage and supply pipes and solid waste storage were present during the inspection. The plant was repeatedly served directions to rectify these faults – four times in 2008 and once in 2009.

M/s Radha Madhav is another plant with an ESP. The ESP was found non functional over 2008[40] and 2009. However, this was not reflected in the stack monitoring report of the plant where all SPM levels met the standard. Very high leakage of flue gas was observed and the bag filters at cooler discharge and intermediate bin were not functioning. As a result very high fugitive emissions were observed repeatedly in 2008 and 2009. Also, the ambient SPM levels were high – 659 µg/m^3 (near weigh-bridge), 561 µg/m^3 (near boundary wall), 554 µg/m^3 (near coal yard) and 1,238 µg/m^3 (near iron ore yard). The plant was served a direction in 2007 to rectify these problems.

M/s Satya Power and Ispat is a plant with a non functional ESP even then the SPM levels at the main stack ranged between 60 mg/Nm^3 and 132 mg/Nm^3 only. Very high leakage of flue gases was observed during two inspection visits in 2009. The plant has a bag filter attached at most of the required locations in the plant but they were are all found non functional during inspections[41]. Very high fugitive emissions were present in the plant through 2008[42] and 2009[43]. Its ambient air quality data is also very poor. The plant's solid waste management was not satisfactory.

M/s Baldev Alloys has an ESP and a scrubber installed at the premises. Still there were the regular problems like heavy stack emissions, heavy emissions from emergency cap, non functionality of the pollution control equipment, very poor housekeeping, heavy fugitive emissions, improper solid waste management, non compliance with consent conditions, etc. During two separate night inspections in 2007, partial functionality of the pollution control equipment and very high fugitive emissions were recorded. The plant received one direction in 2006 and two in 2008 from the authorities to rectify the errors.

Another plant with an installed ESP is M/s Shivalay Ispat and Power. Heavy stack emissions were observed at the plant through the year 2008 and 2009. Very high emissions from the emergency cap and heavy fugitive emissions were also present. The pollution control equipment were repeatedly reported as not working properly in 2008 and 2009. The housekeeping and solid waste management conditions were not complied with. The plant also failed to comply with the conditions laid down in the consent. As a result it was served directions twice in 2008 and twice in 2009 to rectify these defects.

M/s Mangal Sponge Iron is a plant without an ESP or a scrubber. This did not translate into the stack monitoring reports where the highest stack SPM was only 163 mg/Nm^3. Leakage of flue gases was recorded during the inspection visit. Bag filters at the coal and iron ore crushing plants were not functioning at the time of inspection. The ambient SPM level near office area was 503 µg/m^3, near temple was 568 µg/m^3 and near furnace area was 585 µg/m^3. Very high fugitive emissions and improper solid waste management was recorded in 2008. The plant was not even served a direction as per the information provided by CECB.

These case studies point to the fact that CECB inspection is suspect. The plants may have been inspected without checking for their operations. Another concern is that the plants have repeatedly non-complied for the same parameter without any strict action from the authorities.

CHAPTER 5

Sponge Iron Industry in Jharkhand

1. Introduction

Jharkhand, carved out of Bihar in 2000, is a state in eastern India. Spread over an area of 7.97 million ha[1], the area is rich in forests and minerals. Twenty nine per cent of the total area in the state is classified as forests[2]. The state houses 24 districts with a population of 21.8 million[3]. Twenty eight per cent of the population belongs to the Scheduled Tribes (STs) while 12 per cent belongs to Scheduled Castes (SCs)[4].

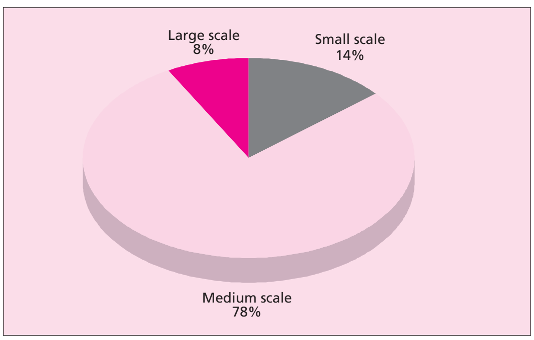
The state possesses coal reserves of the order of 76,712 million tonnes[5] accounting for 29 per cent of the coal reserves in India[6]. The state also accounts for 28 per cent of the iron ore reserves in the country[7]. Easy availability of raw materials like iron ore and coal has led to the establishment of many sponge iron plants in the state.

The first sponge iron plant to be set up in the state was in 1989 - Bihar Sponge Iron. Established in Singhbhum district the plant had a capacity of 0.15 MTPA[8]. At present, there are 37 sponge iron plants in Jharkhand with an installed capacity of 2.37 MPTA[9]. The state contributes about eight per cent to the total coal based sponge iron capacity in India[10]. Thirteen small plants contribute about 14 per cent of the total capacity in the state while 23 medium scale plants contribute 78 per cent (see *Graph 5.1: Capacity contribution*)[11]. Eight per cent of the total capacity is contributed by the single large scale plant – M/s Bihar Sponge Iron[12].

Districts with sponge iron industry concentration are Giridih, Saraikela-Kharsawan, Hazaribagh and Koderma. Saraikela-Kharsawan is the largest cluster in the state contributing 59 per cent to the state capacity (see *Table 5.1: District-wise distribution of sponge iron plants*). The cluster has 19 sponge iron plants. Hazaribagh with just four plants contributes about 15 per cent of the state capacity followed by Giridih with five plants and 11 per cent capacity contribution.

The average capacity of a sponge iron plant in the state is 0.0641 MTPA[13]. Jharkhand experienced a boom in this sector between 2004 and 2006 when the state government signed memorandums of understanding (MOU) with 45 companies worth ₹2 trillion.

Graph 5.1: Capacity contribution



Source: *Analysis based on data received from SPCB under the Right to Information Act (RTI), 2005.*

2. The study

Inspection reports for 23 plants were made available by the Jharkhand SPCB. These account for over 60 per cent plants in the state. Sixty two inspection reports were

Table 5.1: District-wise distribution of sponge iron plants

S.No.	District	No. of plants			Total	Installed capacity
		Small	Medium	Large		(in MTPA)
1	Saraikela-Kharswan	6	12	1	19	1.39
2	Hazaribagh	1	3		4	0.35
3	Giridih	2	3		5	0.26
4	Koderma		3		3	0.16
5	East Singhbum	2			2	0.06
6	West Singhbum		2		2	0.13
7	Dhanbad	1			1	0.01
8	Ramgarh	1			1	0.01
	Total	**13**	**23**	**1**	**37**	**2.37**

Source: *Analysis based on data received from SPCB under the Right to Information Act (RTI), 2005.*

analysed for these plants over four years 2005 – 06 to 2008 – 09. The SPCB did not provide any stack monitoring or AAQ reports of the sponge iron plants.

Based on the kiln data, 15 of these 23 plants are small scale and the remaining eight are medium scale. The largest plant in the sample is M/s Bihar Sponge Iron with 0.165 MTPA capacity spread across three kilns. The smallest is M/s Palash Sponge Iron with one kiln of capacity 0.0083 MTPA. The average plant capacity in the sample is 0.0711 MTPA.

2.1 Raw material consumption[14]

Use of iron ore in the state varies from 1.1 to 3.0 tonnes per tonne of sponge iron produced. On an average, 1.8 tonnes of iron ore is utilised for every tonne of sponge iron produced. Coal quantity varies from 0.9 to 3.0 tonnes per tonne of sponge iron depending on the quality of coal used. The average requirement is 1.5 tonnes of coal per tonne of sponge iron. Average quantity of dolomite required is 45 kg per tonne of sponge iron.

Water utilisation in the industry is an important aspect that governs the ground water regime. Water consumption in a plant consists of water used for industrial purpose, which covers the cooling water and the process water and that used for domestic purpose. Seventy five per cent of the plants in the state consume water from bore wells. The average water consumption in a sponge iron plant is 1.28 m^3 per tonne of sponge iron produced. Industrial water amounts to about 93 per cent of the total water consumption. Average industrial water consumption in these industries is 1.19 m^3 per tonne of sponge iron and average domestic water consumption is 0.092 m^3. The quantity of water withdrawn for the sponge iron plants has resulted in changes in the ground water scenario and has caused scarcity of water for the people residing in the surrounding areas.

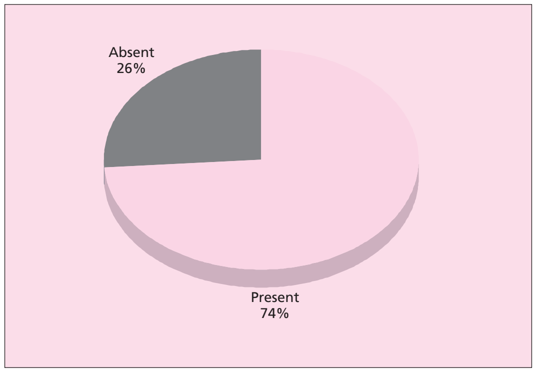
2.2 Air pollution

Dust and smoke from the sponge iron plants cause a variety of skin diseases and respiratory problems. Lung diseases like chronic bronchitis, asthma and pneumoconiosis and eye ailments like conjunctivitis have been on the rise in Giridih in recent times[15].

According to the Blacksmith Institute, Kandra and Ratanpur villages in the Saraikela-Kharsawan district are listed under the most polluted places in the country. Nearly 10,000 residents in Kandra and 2,000 in Ratanpur have been affected by pollution from the sponge iron industries there[16]. No specific health trends were observed but typical effects include:

- Lung, kidney, liver, skin disorders
- Metal fume fever characterized by nausea, headache, fever and chills
- Cancer – particularly lung
- Eye disorders

Graph 5.2: ESP in sponge iron industry



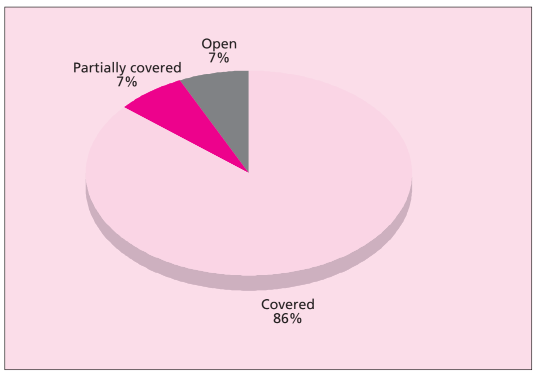
Source: *Analysis based on data received from SPCB under the Right to Information Act (RTI), 2005.*

Air pollution caused by the sponge iron industry is mainly due to emissions from stacks. Pollution control equipment at stacks is recommended to control these emissions. ESPs are present for about 74 per cent of the plants in the state (see *Graph 5.2: ESP in sponge iron industry*). The rest 26 per cent do not have an ESP but production in these plants remains unabated. Out of the plants with ESPs at the stack, three are small scale and 13 are medium scale. The only large scale plant has an ESP in place.

Merely installing an ESP does not serve any purpose when they are not operated. For 69 per cent of the cases, the ESPs were not functional during inspections[17]. Action taken by the state pollution control board is in terms of a show cause notice or a direction. Out of the six plants which have not installed an ESP, four plants have been served with show cause notices. Show cause notices were issued to M/s Siddhi Vinayak for four consecutive years and still the plant has not installed an ESP at the stack as per the latest available inspection report.

Bag filters are placed at coal crushing unit, iron ore crushing unit, transfer points, intermediate points and product house to reduce fugitive dust emissions. Bag filters are present at coal crushers in 18 out of 23 plants in the state, at iron ore crushing unit in nine out of 23 plants, at transfer points in 13 plants, at cooler discharge in 19 plants, at intermediate bins in 13 and at product house in 18 plants. On an average, bag filters are located at three or four locations in all the plants. Over the years, sponge iron plants have complied and installed adequate bag filters but there are a few plants like M/s Palash Sponge Iron which still do not have any bag filters in place. No action has been taken against such plants. About 19 per cent plants[18] have not complied with the condition and 38 per cent have complied only partially. Thus, only about 44 per cent of the sponge iron plants in the state have installed bag filters at all the required locations.

Graph 5.3: Storage area of coal

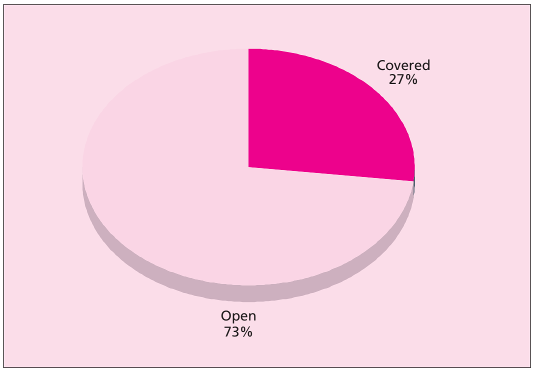


Source: *Analysis based on data received from SPCB under the Right to Information Act (RTI), 2005.*

Such non-compliance with respect to the pollution control facility is a major drawback of the industries, since it amplifies the problems of the worsening air quality among other issues.

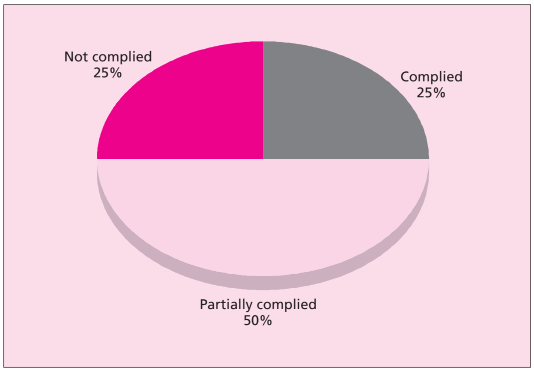
Storage of raw materials is a major source of fugitive dust. Thus whether the storage area is covered or open plays an important role in curbing the fugitive dust. In Jharkhand, 86 per cent of the coal storages are covered, seven per cent are partially covered and the rest are uncovered (see *Graph 5.3: Storage area for coal*). However, in the case of iron ore and dolomite storage areas, 73 per cent of the storage is open while only 27 per

Graph 5.4: Storage area of iron ore



Source: *Analysis based on data received from SPCB under the Right to Information Act (RTI), 2005.*

Graph 5.5: Compliance status for construction of pucca road



Source: *Analysis based on data received from SPCB under the Right to Information Act (RTI), 2005.*

cent is covered (see *Figure 5.4: Storage area of iron ore*). For small-scale industries, in case of iron ore, the sheds are 100 per cent open. As compared to the medium scale plants where 27 per cent of the plants maintain closed iron ore sheds.

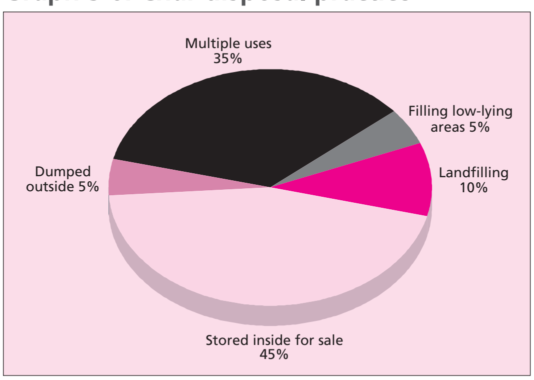
In 73 per cent plants, dolomite is stored in the open. Trend for iron ore storage and dolomite is similar in the case of small scale as well as medium scale industries; none of them are covered in small scale while in medium scale 27 per cent of the sheds for iron ore and dolomite are covered.

Source of fugitive dust in a sponge iron plant may also be due to unpaved roads that exist inside the factory. An important factor to be considered is sprinkling of water on the roads where trucks ply for the transportation of raw materials and finished product. Even though the condition has been in place for a few years, 25 per cent of the plants in the state were non compliant and 50 per cent were only partially compliant (see *Graph 5.5: Compliance status for construction of pucca road*). A number of plants in the state like M/s Bimaldeep Steel, M/s Jai Durga Iron, M/s Sai Sponge India, M/s Shiva Rama Sponge Iron, M/s Vallabh Steels, M/s Kohinoor Steel, M/s Sidhi Vinayak Metcom, M/s Balaji Industrial Products and M/s Jai Mangla Sponge Iron failed to meet the condition. All these plants were served a show cause notice for the same. Some still remain repeated offenders – Vallabh Steels, Bimaldeep Steel and Balaji Industrial Products.

2.3 Solid waste

Other than air pollution, sponge iron industries pose a problem of solid waste. Industries in Jharkhand produce, on an average, 0.37 tonnes of char per tonne of sponge iron[19]. Char comprises about 57 per cent of the total solid waste generated from the plant[20]. Most of the producers in the state dispose off the char, sell it, use it for land filling or dump it outside the premises. Five per cent of the sample[21] use char to fill low lying areas while 10 per cent consider using a secured landfilling (see *Figure 5.6: Char disposal practices*). Another 45 per cent store the char inside the factory premises for sale to a third party while five per cent of the sample dumped it outside the factory. 35 per cent put the char to multiple uses which were essentially a combination of all the above. Thus, these plants partially dumped the char outside, partially stored it inside for sale, partially used it for landfilling, partially sold it to the villagers, etc.

Graph 5.6: Char disposal practice



Source: *Analysis based on data received from SPCB under the Right to Information Act (RTI), 2005.*

The practices of disposal being followed in the state leave a lot to be desired. The char when dumped out in the open tends to fly or get washed into nearby fields thus affecting the agricultural productivity. Filling of low lying areas with this char can contaminate the groundwater through seepage or run off. The pollution control board does not specify any mode of disposal for the char generated nor does it take any action against the irresponsible char dumping practices prevalent in the sponge iron clusters. This aggravates the issues caused due to improper char disposal.

2.4 Closure and show-cause notices

About 74 per cent plants were issued show-cause notices. Two closure notices were also issued. Common causes for issuing show-cause notices in the state are non installation or inadequate performance of the air pollution equipment, uncovered storage sheds, non compliance under Water and Air act, absence of rain water harvesting plan, non installation of energy and water meters, absence of water sprinklers, non construction of *pucca* roads, leakage from raw material feeding and product discharge side, etc. These failed to have any desired impact with plants continuing to flout norms repeatedly.

2.5 Case studies of repeated non compliance

Bihar Sponge Iron: The SPCB made available eight set of inspection reports where each one contains an inspection report (air) and an inspection report (water), one direction and two show cause notice copies. The SPCB also provided two sets environmental statements for the year 2006-07 and 2008-09.

- In the inspection report dated 17/11/2006, it was observed that the ESP attached to kiln-2 was not operating since the kiln was under shut down and the one attached to kiln-3 was under construction. The report also noted that the company has applied for a new 100 TPD plant which is operational even though the NOC has not been granted. The report recorded that the flyash was being dumped outside the premises. The report suggested initiation of a show cause notice. Some of the consent conditions like ESP and bag filter operation, environmental clearance from the state, submission of emergency plan, etc., were not complied with either. The report also noted emissions from transfer points, kiln, cooler discharge, loading and unloading points, etc.
- Inspection report dated 26/09/2007 recorded emissions from transfer points, kiln, cooler discharge, loading and unloading points, etc. The stack was not monitored as reported in the inspection.
- Fugitive emissions from transfer points, cooler discharge, loading and unloading points, etc., were recorded in the inspection report dated 21/09/2007. Consent conditions like submission of AAQ report, interlocking system installation and submission of stack monitoring reports. The plant was also discharging effluent outside the plant premises flouting a consent condition.
- The plant was served a show cause notice dated 24/09/2007 under section 3 of the Air (Prevention and Control of Pollution) Act, 1981. The plant was not complying with two important conditions – to keep effluent in close circuit and to install interlocking system.
- A show cause notice dated 22/03/2007 was served under section 21 of the Air (Prevention and Control of Pollution) Act, 1981. The reasons were -high fugitive emissions from product separation, absence of bag filter at the cooler discharge, non operational ESP at the power house, absence of *pucca* road within the premises and operation of iron ore crushing plant without an NOC.
- As per the inspection report dated 23/08/2008, the plant was only partially complying with the conditions of installation of water spraying facility and operation of pollution control equipment.
- The plant was served a direction under section 31A of the Air (Prevention and Control of Pollution) Act, 1981 and section 33A of the Water (Prevention and Control of Pollution) Act, 1974. The flaws were – non operational effluent treatment plant, discharge of effluent to River Subernekha directly, bypass of ESP, beyond limit stack emissions, uncovered waste dumps within the premises and poor housekeeping. The plant was also asked to submit a bank guarantee of Rs. 10 lakh to comply with effluent and emission standards.

Vallabh Steel: Seven sets of inspection reports with some containing both air and water reports were provided by SPCB. Four show cause notice copies and one environmental statement were also made available.

- The first set of inspection reports dated 23/02/2006 and 23/03/2006 mentioned that the 350 TPD plant was under construction.
- The ESP was found non operational as per the inspection report dated 20/06/2006. The bag filters at various locations were also not working. The report observed that the *pucca* road construction condition has not been complied with and the housekeeping is poor. Heavy dust emissions were also recorded during the inspection and it recommended legal action against the plant.
- Based on the above inspection report, a show cause notice was issued to the plant on 24/06/2006 under section 21 of the Air (Prevention and Control of Pollution) Act, 1981 and sections 25 and 26 of the Water (Prevention and Control of Pollution) Act, 1974.
- As per the inspection dated 24/01/2007, the bag filters at the product house, transfer points, cooler discharge and stock house were not working satisfactorily. The report also recorded that neighbouring villages had complained about air pollution from the plant. The plant was served a direction not to operate the plant without properly functional pollution control equipment. The plant was also found to be not complying with a number of consent conditions like submission of AAQ and stack monitoring report, *pucca* road construction, interlocking arrangement, upgrade and maintain bag filters, etc. The plant had also not paid water cess as required under the Water (Prevention and Control of Pollution) Cess Act 1977.
- The plant was subsequently served a show cause notice dated 09/02/2007 under section 21 of the Air (Prevention and Control of Pollution) Act, 1981 and sections 25 and 26 of the Water (Prevention and Control of Pollution) Act, 1974.
- As per inspection report dated 02/03/2007, the plant was again found non compliant with conditions like payment of water cess as required under the Water (Prevention and Control of Pollution) Cess Act 1977, rainwater harvesting arrangement, stack monitoring report submission, *pucca* road construction, interlocking system installation, etc.
- Following a complaint against the plant, the SPCB carried out an inspection on 10/09/2007. The plant was found under shut down condition for repair and hence the efficacy of the pollution control equipment could not be checked.
- The plant was served a show cause notice dated 24/09/2007 under section 21 of the Air (Prevention and Control of Pollution) Act, 1981. The flaws were – leakage from raw material feeding and product discharge, poor housekeeping, absence of interlocking system and absence of *pucca* road construction.
- As per the inspection report dated 01/02/2008, the bag filters in the plant were not properly functional, the interlocking system was absent, there were complaints of air pollution from the plant, etc.
- The ESP was found non operational as per the 13/11/2010 inspection report. All the installed bag filters were also found non operational. The report recorded that the air pollution from the plant is affecting the nearby area and there have been protests against the plant. The report recommended strict legal action to be taken against the plant.

Usha Martin: Five sets of inspection reports with some containing both air and water reports were provided by SPCB. Two show cause notice copies and three environmental statements were also made available.

- The inspection report dated 30/04/2005 recorded heavy fugitive dust emissions from a number of locations in the plant which was attributed to absence of pollution control equipment. Housekeeping was found inadequate and *pucca* road had not been constructed in the premises. The inspection report recommended initiation of legal action against the plant.
- Based on the above inspection, the plant was served a show cause notice dated 07/05/2005 under section 21 of the Air (Prevention and Control of Pollution) Act, 1981.
- Inspection report dated 17/06/2006 found beyond limit SPM levels at three different locations. The report recorded that there were complaints of air pollution from the plant.
- The plant was served another show cause notice on 17/08/2006 under section 21 of the Air

(Prevention and Control of Pollution) Act, 1981. This was based on the beyond limit SPM levels as observed during the above inspection.

- Inspection report dated 18/11/2006 recorded that there were complaints of air pollution from the plant.
- Inspection report of 01/11/2007 also recorded complaints of air pollution. Conditions like interlocking system installation also the raw materials and products were not stored in closed sheds.

Nilachal Iron and Power: Five sets of inspection reports with some containing both air and water reports were provided by SPCB. Three show cause notice copies and two environmental statements were also made available.

- Inspection report dated 19/12/2005 found non compliance on a number of consent conditions – ensuring uninterrupted power supply to pollution control equipment, ESP operation, bag filter installation, etc. The report also found beyond limit SPM levels at all points.
- The plant was served a show cause notice dated 24/06/2006 under section 21 of the Air (Prevention and Control of Pollution) Act, 1981 and sections 25 and 26 of the Water (Prevention and Control of Pollution) Act, 1974.
- Inspection report of 26/12/2006 recorded that there were complaints of discharge of effluent into the neighbouring fields and ensured that the same has been dealt with.
- The plant was served a show cause notice dated 24/09/2007 under section 31A of the Air (Prevention and Control of Pollution) Act, 1981.
- Inspection report dated 27/12/2007 once again recorded that there were complaints of discharge of effluent into the neighbouring fields and ensured that the same has been dealt with. The report suggested issuing a show cause notice to check for non compliance of consent conditions.
- The plant was served a warning letter dated 28/01/2008 before issuance of closure order. The show cause notice of 24/09/2007 was not handled seriously by the plant and the plant had failed to make a representation before the SPCB.
- Inspection report dated 23/10/2008 also recorded that there were complaints of discharge of effluent into the neighbouring fields and ensured that the same has been dealt with. The report suggested issuing a show cause notice to check for non compliance of consent conditions.

REFERENCES

Chapter 1: Indian Sponge Iron Industry

1. *http://www.steelworld.com/a%20nerve.htm* as viewed on February 15, 2010.
2. ibid.
3. ibid.
4. ibid.
5. ibid.

6a. Analysis based on data received from SPCBs under the Right to Information Act, 2005.
6b. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 63-64.
6c. *http://www.essarsteel.com/steel/profile.htm* as viewed on May 5, 2010.
6d. *http://www.ispatind.com/milestone.htm* as viewed on May 5, 2010.
6e. *http://www.welspunpowerandsteel.com/* as viewed on May 5, 2010.

7. Analysis based on data received from SPCBs under the Right to Information Act, 2005.
8. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 3.
9. Analysis based on data received from SPCBs under the Right to Information Act, 2005.
10. *http://www.steelworld.com/a%20nerve.htm* as viewed on April 20, 2010.

11a. Analysis based on data received from SPCBs under the Right to Information Act, 2005.
11b. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 63-64.
12a. *http://www.essarsteel.com/steel/profile.htm* as viewed on May 5, 2010.
12b. *http://www.ispatind.com/milestone.htm* as viewed on May 5, 2010.
12c. *http://www.welspunpowerandsteel.com/* as viewed on May 5, 2010.

13. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 4.
14. Anon, 2008 – 09, *Annual Report,* Ministry of Steel, Government of India, New Delhi, pg. 51.
15. *http://www.essarsteel.com/steel/profile.htm* as viewed on May 5, 2010.
16. *http://www.ispatind.com/milestone.htm* as viewed on May 5, 2010.
17. *http://www.welspunpowerandsteel.com/* as viewed on May 5, 2010.
18. Analysis based on data received from SPCBs under the Right to Information Act, 2005.
19. ibid.
20. ibid.
21. Anon, 2007, *Infopack on sponge iron industry – Issues & Campaigns*, National Centre for Advocacy Studies, Pune, pg. 13.
22. A cluster is defined as a location with five or more sponge iron plants.
23. Coking coal: Based on coking property, coal is classified into two categories namely, Coking Coal and Non-coking Coal. Coking coal generally has volatile matter content of up to 32 per cent.
24. Analysis based on data received from SPCBs under the Right to Information Act, 2005.
25. *http://www.steelworld.com/coal.htm* as viewed on April 12, 2010.
26. Data is for Jan-Dec 2008 and Jan-Dec 2009.
27. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 20.
28. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 22.
29. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 25.
30. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 26.
31. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 28.
32. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 33.
33. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 34.
34. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 40.

35. Anon, 2001, *Best Available Techniques Reference Document on the Production of Iron and Steel*, European Commission, pg. 349.
36. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 42.
37. Anon, 2001, *Best Available Techniques Reference Document on the Production of Iron and Steel*, European Commission, pg. 323.
38. Assuming sponge iron production to be 20 MT.
39. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 61.
40. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 62.
41. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 28.
42. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 26, 30 & 51.
43. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 43.
44. Anon, 2001, *Best Available Techniques Reference Document on the Production of Iron and Steel*, European Commission, pg. 322.
45. ibid.
46. *http://www.ecacwb.org/editor_upload/files/Sponge%20Iron%20Industry%20Scenario%20In%20the%20State.pdf* as viewed on April 29, 2010.
47. Based on coal based capacity of 29.4 MTPA.
48. Analysis based on data obtained from JSPCB under Right to Information act, 2005.
49. *http://infochangeindia.org/index2.php?option=com_content&do_pdf=1&id=7552* as viewed on April 26, 2010.
50. ibid.
51. *http://www.business-standard.com/india/news/ban-fails-to-curb-new-sponge-iron-units/312885/*as viewed on April 9, 2010.
52. *http://www.goarticles.com/cgi-bin/showa.cgi?C=1304310* as viewed on March 18, 2010.
53. ibid.
54. Anon, *Mining and Industrialisation Update,* Odisha Environmental Information on Industries and Mining in Odisha, July-August 2008.
55. Sagar Dhara, 2006, *Risk appraisal study: Sponge iron plants, Raigarh District*, Cerana Foundation, Hyderabad, pg. 8.
56. Manshi Asher and Rifat Mumtaz, *A Report On The Sponge Iron Industry - Stories from Chhattisgarh, Odisha and Jharkhand,* , NCAS Pune.
57. Based on field visit to Chhattisgarh.
58. *http://www.thehindu.com/2009/04/22/stories/2009042260410600.htm* as viewed on February 26, 2010.
59. Anon, 2007, *Comprehensive Industry documents series, Sponge iron industry*, Central Pollution Control board, pg. 67- 68.
60. Anon, 2007, *Comprehensive Industry documents series: Sponge iron industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 72-73 and 105 (standard = 2000µg/m^3).
61. ibid.
62. *http://infochangeindia.org/index2.php?option=com_content&do_pdf=1&id=7552* as viewed on April 26, 2010.
63. Analysis based on data received from SPCB under the Right to Information (RTI) Act, 2005.
64. ibid.
65. ibid.
66. Manshi Asher, Rifat Mumtaz, 2007, *Info pack on sponge iron industry issues & campaign,* National Centre for Advocacy Studies, Pune, Pg. 79.
67. ibid.
68. *http://www.indianexpress.com/news/workers-feel-the-heat-from-sponge-iron-units/443305/* as viewed on 24th February, 2010.
69. Analysis based on field visit to Banskopa village in West Bengal.
70. Analysis based on field visit to Karnataka, Halkundi village near Halkundi Cluster.
71. *http://www.thehindu.com/2006/04/07/stories/2006040720710400.htm* as viewed on 12th April 2010.
72. Analysis based on field visit to Bonai.
73. ibid.
74. *http://envfor.nic.in/legis/ep/414E.pdf* as viewed on April 27, 2010.
75. ibid, Based on the formula $H= 14\ Q^{0.3}$ where, H=height of the stack, Q= emission of SO_2 in kg/hr.
76. *http://envfor.nic.in/legis/ep/414E.pdf* as viewed on April 27, 2010.
77. *http://www.cpcb.nic.in/National_Ambient_Air_Quality_Standards.php* as viewed on April 27, 2010.
78. *http://www.cpcb.nic.in/divisionsofheadoffice/pci2/CREPspong&other.pdf* as viewed on April 27, 2010.
79. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg. 107.
80. ibid.
81. *http://www.thehindu.com/2009/08/05/stories/2009080556090300.htm* as viewed on February 15, 2010.
82. ibid.
83. *http://www.cpcb.nic.in/divisionsofheadoffice/pci2/CREPspong&other.pdf* as viewed on April 27, 2010.
84. ibid.
85. ibid.

86. ibid.
87. ibid.
88. Jan-Dec 2007.
89. Jan-Dec 2008.
90. Jan-Dec 2009.
91. Analysis based on data received from SPCBs under the Right to Information Act, 2005.
92. Sample consists of 28 plants.
93. Sample consists of 57 plants.
94. Sample consists of 80 plants.
95. Analysis based on data received from SPCBs under the Right to Information Act, 2005
96. Sample consists of 65 plants.
97. Sample consists of 26 plants.
98. Sample consists of 19 plants.
99. Sample consists of 94 plants.
100. Sample consists of 51 plants.
101. Sample consists of 41 plants.
102. Sample consists of 101 plants.
103. Sample consists of 86 plants.
104. Sample consists of 88 plants.
105. Sample consists of 59 plants.
106. Sample consists of 21 plants.
107. Sample consists of 65 plants
108. Sample consists of 38 plants.
109. Sample consists of 70 plants.
110. Sample consists of 25 plants.
111. Sample consists of 70 plants.
112. Analysis based on data received from SPCBs under the Right to Information Act, 2005.
113. *http://envfor.nic.in/legis/ep/414E.pdf* as viewed on April 27, 2010.
114. Analysis based on data received from SPCBs under the Right to Information Act, 2005.
115. Sample consists of 11 plants.
116. Analysis based on data received from SPCBs under the Right to Information Act, 2005.
117. *http://www.thehindu.com/2009/08/05/stories/2009080556090300.htm* as viewed on April 8, 2010.
118. *http://www.thehindu.com/2008/04/01/stories/2008040157460100.htm* as viewed on February 15, 2010.
119. *http://www.hinduonnet.com/2008/04/09/stories/2008040955810300.htm* as viewed on February 15, 2010.
120. *http://www.thehindu.com/2009/10/28/stories/2009102856140300.htm* as viewed on February 15, 2010.
121. *http://www.livemint.com/2010/01/13224034/West-Bengal-grapples-with-poll.html* as viewed on April 8, 2010.
122. Analysis based on data obtained from SPCBs under Right to Information Act, 2005.
123. *http://www.thehindu.com/2009/12/01/stories/2009120151880300.htm* as viewed on February 15, 2010.
124. *http://www.thehindu.com/2009/08/15/stories/2009081553750300.htm* as viewed on February 15, 2010.
125. *http://www.indiaenvironmentportal.org.in/node/289088* as viewed on February 15, 2010.
126. *http://www.indiaenvironmentportal.org.in/node/32626* as viewed on February 15, 2010.
127. Chandra Bhushan et.al, 2009, *Turnaround Reform agenda for India's Environmental Regulators,* CSE, New Delhi, pg. 6.
128. ibid.
129. ibid.
130. *http://www.cpcb.nic.in/divisionsofheadoffice/pci2/CREPspong&other.pdf* as viewed on April 17, 2010.
131. Analysis based on data obtained from SPCBs under Right to Information Act, 2005.
132. *http://www.indiatogether.org/2009/sep/rvw-loha.htm* as viewed on April 8, 2010.
133. Based on the formula $H = 14\ Q^{0.3}$.

Box 1: Number game

1. Anon, 2009, *Annual Report 2008-09,* Ministry of Steel, Government of India, New Delhi, pg. 16.
2. *http://www.indiastat.com/Industries/18/StatewiseSteelProduction/449601/466658/data.aspx* as viewed on May 5, 2010.
3. *http://uk.reuters.com/article/idUKSGE6380FX20100414* as viewed on May 5, 2010.
4. Anon 2008, *Energy and environment management framework in Indian steel sector,* APP-STF Meeting, Beijing.
5. *http://php.statetimes.in/news/2010/04/15/low-supply-affects-sponge-iron-cos/* as viewed on May 5, 2010.

Box 2: Reasons for mushrooming of sponge iron industry

1. *http://www.indiaenvironmentportal.org.in/node/38603* as viewed on December 15, 2009.
2. Anon, *Industrial Policy 2004 – 2009,* Government of Chhattisgarh.
3. Anon, 2001, *Industrial Policy –2001,* Government Of Orissa.

Box 4: Illegal plants in Odisha

1. Analysis based on data obtained from Orissa SPCB under the Right to Information Act, 2005.

2. *http://www.business-standard.com/india/news/ban-fails-to-curb-new-sponge-iron-units/312885/* as viewed on April 9, 2010.

Box 5: Impact on livelihood of people in Chhattisgarh

1. Manshi Asher & Rifat Mumtaz, *Infopack on sponge iron industry – issues & campaigns,* National Centre for Advocacy Studies, Pune Pg 40 -43.

Box 6: Non compliance of plants during night inspection

1. Analysis based on data obtained from SPCBs under the Right to Information Act, 2005.

Box 7: Staff crunch in SPCBs in sponge iron dominated states

1. Chandra Bhushan et.al, 2009, *Turnaround Reform agenda for India's Environmental Regulators,* CSE, New Delhi, pg 4.

Chapter 2: Sponge Iron Industry in Odisha

1. *http://www.odishasponge.com/aboutus.htm* as viewed on March 19, 2010.
2. Analysis based on data received from Odisha State Pollution Control Board (OSPCB) under the Right to Information Act (RTI), 2005.
3. Himanshu Patra et al, 2009, *Status of sponge iron plants in Odisha,* Vasundhara, Bhubaneshwar, pg. 6.
4. ibid.
5. ibid.
6. Medium, large and small scale based on total plant capacity.
7. Cluster: as defined is any location with more than five plants.
8. Analysis based on data received from OSPCB under the Right to Information Act, 2005.
9. Himanshu Patra et al, 2009, *Status of sponge iron plants in Odisha,* Vasundhara, Bhubaneshwar, pg. 11.
10. ibid.
11. Analysis based on data received from OSPCB under the Right to Information Act, 2005.
12. ibid.
13. Himanshu Patra et al, 2009, *Status of sponge iron plants in Odisha,* Vasundhara, Bhubaneshwar, pg. 12.
14. *http://en.wikipedia.org/wiki/Barbil* as viewed on March 19, 2010.
15. Himanshu Patra et al, 2009, *Status of sponge iron plants in Odisha,* Vasundhara, Bhubaneshwar, pg. 10.
16. ibid.
17. Analysis based on site visit.
18. ibid.
19. Inspection report of M/s MSP Sponge Iron dated February 22, 2008.
20. Inspection report of M/s Shiv Metalliks dated February 2, 2008.
21. Inspection report of M/s Sumrit metallik dated February 6, 2009.
22. *http://samatha.in/2008/08/25/tribal-india-news-a-compilation/* as viewed on March 22, 2010.
23. *http://ncst.nic.in/writereaddata/linkimages/SLNO_535799455082.pdf* as viewed on March 22, 2010.
24. ibid.
25. Analysis based on data received from OSPCB under the Right to Information Act, 2005.
26. Sample consists of 95 plants for this parameter.
27. ESP functionality data is available only for 72 plants.
28. Sample consists of 6 plants.
29. Inspection report of M/s Ores Ispat dated March 7, 2009.
30. Sample consists of 11 plants.
31. Analysis based on 2 sets of inspection reports:
    a. First set consists of 31 plants,
    b. Second set consists of 3 plants.
32. Analysis based on 2 sets of inspection reports:
    a. First set consists of 48 plants,
    b. Second set consists of 7 plants.
33. Limit: 150 mg/m^3.
34. Analysis based only on the latest inspection reports of 75 plants.
35. Sample: $n_{Bonai} = 5$ and $n_{Kuarmunda} = 9$ plants.
36. Sample consists of 26 plants.
37. 3 sets of inspection reports were analysed:
    a. First set consists of 42 plants,
    b. Second set consists of 10 plants,
    c. Third set consists of 1 plant.
38. 4 sets of inspection reports were analysed:
    a. First set consists of 49 plants,
    b. Second set consists of 8 plants,

c. Third set consists of 1 plant,
d. Fourth set consists of 1 plant.

39. Sample consists of 8 plants.
40. Sample consists of 6 plants.
41. Sample consists of 4 plants.
42. Sample consists of 3 plants.
43. Sample consists of 70 plants.
44. Sample consists of 5 plants.
45. Sample consists of 65 plants.
46. Sample: n_{Bonai} = 6 and $n_{Kuarmunda}$ = 10 plants.
47. Sample consists of 38 plants.
48. Sample is of 31 plants.
49. Sample consists of 25 plants.
50. Sample consists of 70 plants.
51. Sample: n_{Bonai} = 5 and $n_{Kuarmunda}$ = 10 plants.
52. Sample consists of 59 plants.
53. Functionality data is available for 55 plants only.
54. Sample: n_{Bonai} = 5 and $n_{Kuarmunda}$ = 10 plants.
55. Sample consists of 21 plants.
56. Functionality data is available for 48 plants only.
57. Analysis based on 2 set of inspection reports:
    a. First set consists of 21 plants,
    b. Second set consists of 6 plants.
58. Analysis based on 2 set of inspection reports:
    a. First set consists of 36 plants,
    b. Second set consists of 5 plants.
59. Sample consists of 6 plants.
60. Sample consists of 51 plants.
61. Sample consists of 7 plants.
62. 2 sets of inspection reports were analysed for each year:
    a. First set consists of 19 plants,
    b. Second set consists of 6 plants,
    c. Third set consists of 41 plants,
    d. Fourth set consists of 5 plants.
63. Inspection report of M/s Jain Hanuman Udyog dated February 24, 2009.
64. Sample consists of 6 plants.
65. Sample consists of 3 plants.
66. 2 sets of inspection reports were analysed for each year:
    a. First set consists of 10 plants,
    b. Second set consists of 2 plants,
    c. Third set consists of 22 plants,
    d. Fourth set consists of 2 plants.
67. Inspection report of M/s Nixon Steel and Power dated March 18, 2009.
68. Sample consists of 3 plants.
69. 3 sets of inspection reports were analysed:
    a. First set consists of 20 plants,
    b. Second set consists of 7 plants,
    c. Third set consists of 1 plant.
70. 4 sets of inspection reports were analysed:
    a. First set consists of 33 plants,
    b. Second set consists of 7 plants,
    c. Third set consists of 1 plant,
    d. Fourth set consists of 1 plant.
71. Sample consists of 3 plants.
72. Inspection report of M/s Vedvyas Ispat dated March 18, 2009.
73. Sample consists of 2 plants.
74. 2 sets of inspection reports were analysed:
    a. First set consists of 2 plants,
    b. Second set consists of 2 plants.
75. 2 sets of inspection reports were analysed:
    a. First set consists of 1 plant,
    b. Second set consists of 1 plant.
76. Sample consists of 1 plant.

77. 2 sets of inspection reports were analysed:
    a. First set consists of 5 plants,
    b. Second set consists of 1 plant.
78. 4 sets of inspection reports were analysed:
    a. First set consists of 5 plants,
    b. Second set consists of 2 plants,
    c. Third set consists of 1 plant,
    d. Fourth set consists of 1 plant.
79. 2 sets of inspection reports were analysed:
    a. First set consists of 48 plants,
    b. Second set consists of 10 plants.
80. 2 sets of inspection reports were analysed:
    a. First set consists of 51 plants,
    b. Second set consists of 7 plants.
81. Sample consists of 9 plants.
82. Sample consists of 5 plants.
83. Sample consists of 39 plants.
84. Sample consists of 54 plants.
85. Sample consists of 7 plants.
86. Sample consists of 68 plants.
87. Sample consists of 49 plants.
88. Sample consists of 6 plants.
89. Sample consists of 4 plants.
90. Anon, 2006, *Mining and Industrial Update – Odisha,* Environmental Protection Group, Odisha, pg. 10
91. Ibid, data used is till November 2006.
92. Inspection report of M/s Bhushan Steel dated March 25, 2009.
93. Inspection report of M/s Jai Hanuman Udyog dated February 24, 2009.
94. Sample consists of 38 plants.
95. Sample consists of 69 plants.
96. Sample consists of 56 plants.
97. Sample consists of 24 plants.
98. Sample consists of 16 plants.
99. Sample consists of 10 plants.
100. Sample consists of 10 plants.
101. Sample consists of 42 plants.
102. Sample consists of 27 plants.
103. Sample consists of 47 plants.
104. Sample consists of 8 plants.
105. Sample consists of 4 plants.
106. Sample consists of 74 plants.

Chapter 3: Sponge Iron Industry in West Bengal

1. *http://www.ecacwb.org/editor_upload/files/CE%20Durgapur%2026-03-2009.ppt* as viewed on April 28, 2010.
2. *http://www.ecacwb.org/node/56* as viewed on September 14, 2010.
3. Analysis based on data received from WBPCB under the Right to Information Act (RTI), 2005.
4. Anon, 2007, *Comprehensive Industry Document: Sponge Iron Industry*, Central Pollution Control Board, Ministry of Environment & Forests, New Delhi, pg.16.
5. Analysis based on data received from WBPCB under the Right to Information Act (RTI), 2005.
6. ibid.
7. ibid.
8. ibid.
9. ibid.
10. A cluster has five or more sponge iron plants.
11. *http://www.ecacwb.org/editor_upload/files/Sponge%20Iron%20Industry%20Scenario%20In%20the%20State.pdf* as viewed on February 26, 2010.
12. Analysis based on site visit.
13. ibid.
14. ibid.
15. Each bag is 60 kg.
16. Analysis based on discussion with Mr. Prabhakarm Kumar, who shifted from Banskopa and is currently supplying civil materials to the plant.

17. At M/s Jai Balaji.
18. A set of 25 inspection reports analysed for the parameter from 2006 to 2009.
19. Dr D Chakraborty, Chief Scientist, WBPCB.

Chapter 4: Sponge Iron Industry in Chhattisgarh

1. *http://www.indiastat.com/Industries/18/StatewiseSteelProduction/449601/466658/data.aspx* as viewed on May 14, 2010.
2. *http://www.indiastat.com/Industries/18/StatewiseSteelProduction/449601/466658/data.aspx* as viewed on April 1, 2010.
3. Medium, large and small scale based on total plant capacity. Sample consists of 68 plants.
4. ibid.
5. Cluster is defined as any location with more than five plants.
6. Analysis based on data received from CECB under the Right to Information Act, 2005.
7. ibid.
8. Analysis based on data received from CECB under the Right to Information Act, 2005.
9. *http://www.indiatogether.org/2009/sep/rvw-loha.htm* as viewed on April 2, 2010.
10. *http://chhattisgarh.nic.in/opportunities/Industrial%20Estates.pdf* as viewed on May 12, 2010.
11. Analysis based on data received from CECB under the Right to Information Act, 2005.
12. *http://www.mapsofindia.com/chhattisgarh/districts-cities/urla-raipur.html* as viewed on April 2, 2010.
13. *http://chhattisgarh.nic.in/opportunities/Industrial%20Estates.pdf* as viewed on May 12, 2010.
14. Analysis based on data received from CECB under the Right to Information Act, 2005.
15. Sample consists of 50 plants.
16. Sample consists of 10 plants.
17. ESP functionality data is available only for 27 plants over a period of three years – 2007, 2008 and 2009.
18. Sample consists of 28 plants.
19. Analysis based on 3 sets of inspection reports for the year.
20. Analysis based on 6 set of inspection reports.
21. Analysis based on 3 sets of reports.
22. Analysis based on 1 set of report.
23. Analysis based on 5 sets of reports.
24. Analysis based on 3 sets of reports.
25. Analysis based on 3 sets of reports for each year.
26. Analysis based on 2 sets of inspection reports.
27. Analysis based on 3 sets of inspection reports.
28. Sample consists of 10 plants for this set of inspection reports.
29. Analysis based on 2 sets of inspection reports.
30. Analysis based on 1 set of inspection report.
31. Analysis based on 2 sets of inspection reports.
32. Analysis based on 3 sets of inspection reports.
33. Analysis based on 1 set of inspection report.
34. Information is available only for 4 plants.
35. Information is available only for 8 plants.
36. Information is available only for 6 plants.
37. Analysis based on inspection reports in the year 2007.
38. Analysis based on 4 set of inspection reports for the year.
39. Analysis based on 3 set of inspection reports for the year.
40. Analysis based on 3 sets of inspection reports for the year.
41. Analysis based on inspection reports for year 2007, 2008 and 2009.
42. Analysis based on 2 sets of inspection reports for the year.
43. Analysis based on 3 sets of inspection reports for the year.

Chapter 5: Sponge Iron Industry in Jharkhand

1. *http://jharkhand.nic.in/about.htm* as viewed on June 11, 2010.
2. ibid.
3. ibid.
4. ibid.
5. *http://coal.nic.in/welcome.html* as viewed on June 11, 2010.
6. *http://mines.gov.in/mineralscene/state.pdf* as viewed on June 11, 2010.
7. ibid.
8. Manshi Asher, Rifat Mumtaz, 2007, *Infopack on sponge iron industry – Issues & Campaigns,* National Centre for Advocacy

Studies, Pune, pg. 70.

9. Analysis based on data received from SPCB under the Right to Information Act (RTI), 2005.
10. ibid.
11. ibid.
12. ibid.
13. ibid.
14. Analysis based on data received from SPCB under the Right to Information Act (RTI), 2005.
15. *http://www.telegraphindia.com/1090225/jsp/jharkhand/story_10587419.jsp* as viewed on February 19, 2010.
16. Anon, 2007, *Polluted Places India*, Blacksmith University, New York, pg. 114 – 116.
17. Sample consists of 13 plants.
18. Sample consists of 16 plants.
19. Analysis based on data received from SPCB under the Right to Information Act (RTI), 2005.
20. ibid.
21. Sample consists of 20 plants.