

Chapter-4: Mad Rush for Sponge Iron, the new menace and resistance

4.1. Sponge Iron:

The decade 1996-2006 witnessed a phenomenal rise of the industrial units of a new kind, now officially subsumed under the secondary sector of iron and steel industry and labelled as sponge iron industry. The real growth of this new variant of iron and steel family has become so fantastic and that too in a remarkably brief span of time that India now ranks the world's topmost producer of sponge iron with effect from 2002. Today about 20 per cent of the sponge iron produced worldwide is made in India (*K. Radhika and Maureen Nandini Mitra, Wayward Growth, Down To Earth, Tuesday, September 05, 2006*). Most of the sponge iron units fall under the category of small industry. "Some of these are unreported fly by night companies. Hence, it is quite impossible to ascertain the total number"! (*Source: Steel World, JPC, Ministry of Steel, GOI*). Of course the scale of physical displacement that these small, small units cause is comparatively less visible than the one caused by the large or mega project of any type; however, the other, tangible fall-outs of this nascent, burgeoning industry such as pollution of environment and endangerment of civic life are so total that it has alongside of its fast-forward journey given rise to a spate of numerous, localised resistance movements, which sporadically but spontaneously sprout forth, here peaceful and there violent, drawing into their vortex for the first time in the post-independence history numerous tribal and primitive groups, whose constitutional right to protect their land, water, and forests have been mortally threatened. Thus the brief chronicle hitherto of the visibly linear progress of the sponge iron industry in our country is so to say coterminus with a rich chronicle of ongoing people's struggles in their myriad forms and complexions.

4.2 Galloping rate of Sponge Iron Production in India-

The following table extracted from '*SteelWorld, September 2007*' of JPC (Joint Plant Committee), a unit of Ministry of Steel, GOI shows the growing position of sponge iron in India's steel production. In one year only (April-June, 06 to April-June 2007, the production of sponge iron jumped from 3.804 to 4.2 million tons, that is, more than 13%. The table also shows the increasing contribution of sponge iron to the making of finished steel compared to that of pig iron. In the year 2006, sponge iron accounted for as much as 3.804 million tons compared to only 1.036 million tons by pig iron in producing a total of 11.252 million tons of finished steel; and in 2007 sponge iron contributed as much as 4.2 million tons compared to only 1.165 million by pig iron in the total production of 12.123 million tons of finished steel.

Table 4.1

Indian Steel Production (June' 2007)

(000 tonnes)

Category	Main Producers		Secondary Producers		TOTAL	
	Apr-June'07 (Prov)	Apr-June'06 (Prov)	Apr-June'07 (Prov)	Apr-June'06 (Prov)	Apr-June'07 (Prov)	Apr-June'06 (Prov)
i. Pig Iron	265	211	900	825	1165	1036
ii. Sponge Iron	-	-	4200	3804	4200	3804
Semis (For Sale)	786	816	5900	5300	6686	6116
iii. Finished Steel						
Bars & Rods	1263	1188	2475	2180	3738	3368
Structurals	255	263	685	600	940	863
Rails & Rly. Material	221	226	30	27	251	253
Plates	601	587	233	196	834	783
HR Coils / Skelps / Strips	901	1003	2010	1820	2911	2823
HR Sheets	51	60	83	37	134	97
CR Coils / Sheets / Strips	409	444	1438	1263	1847	1707
Galvd. Coils / Sheets	180	213	902	782	1082	995
Elec. Sheets	18	16	26	23	44	39
Tin Plates	3	9	45	40	48	49
TMBP	0	4	0	0	0	4
Pipes (Large dia)	21	19	273	252	294	271
TOTAL (Finished Steel)	3923	4032	8200	7220	12123	11252

Source : JPC

4.3 Mad Rush by Companies:

The official figures apart, the feverish rush on the part of the profiteering companies for acquiring, owning and manning sponge iron units with an eye to gaining superprofits in quick time is typified from the following news item appearing on the website of Tata Sponge Iron Limited, a pioneer of sponge iron industry in India-

“TSIL prowling for sponge iron plants, Nisha Das 25 May 2004

Tata group company Tata Sponge Iron Ltd or TSIL is on the prowl and is looking for acquiring sponge iron plants. Taking advantage of the Orissa government's encouragement to steel manufacturing plants through incentives like the acquisition of iron ore mines, the company is going in for forward integration to convert a part of the sponge iron it makes to steel through the electric steel making route and also to sell power made from the heat of kiln waste gases. “TSIL also plans backward integration to acquire iron ore mines and coal blocks considered very necessary for the expansion programme.

“As per the growth strategy formulated by the company, TSIL is considering ultimately producing upto 2 million tonnes per annum of steel with sponge iron and scrap as its basic raw materials. To do so, the company will first increase its DRI (direct reduction iron) production capacity from 240,000 tonnes at present and simultaneously add power generation facilities of upto 47.5mw by recovering the waste heat of the kilns in the first phase of its expansion programme. “This will help the company to exploit the existing buoyant demand for DRI in the country while selling power to other industries. In the second phase, the company plans to generate additional power of upto 50 mw by putting up a fluidized bed boiler-based power plant and then install electric arc furnaces to produce steel. In the meanwhile, the company would like to acquire its own iron ore mines and a coal block to become self sufficient in the critical supply of raw materials. “TSIL officials said, "Currently, we are exploring the possibility to take over companies that are in the red and are incurring losses or have defaulted on their debt repayment to institutions. We intend to take over these non-performing assets from the institutions or from asset reconstruction companies. “TSIL 's growth in installed capacity will come partly through such acquisitions. The company is scouting for plants with manufacturing capacity of 300 tons per day at the least, for that was the economical size. TSIL will also expand the sponge iron manufacturing capacity of its plant by installing a third kiln for around Rs.70 crore.

“This expansion will see the plant capacity increase by 62 per cent to 390,000 ton a year from 240,000 tonnes and will help the company to further consolidate its position as the largest supplier of quality sponge iron in east India and the second largest coal-based sponge iron plant in India.”

4.4 TSIL admits the dark side of sponge iron industry:

Ironical as it might sound, the devastating impact of the mushrooming sponge iron units on the land and its people has been described quite authentically in the following passage occurring on the website of TSIL (Tata Sponge Iron Limited) itself, India's second largest sponge iron producing Company that also runs a unit in Keonjhar district of Orissa, “Keonjhar bears mute testimony to the ever growing and irreversible damage being caused to mother nature by the rampant growth of unorganized industrial units in this district of Orissa. A difficult drive through the dilapidated NH 210 from Panikoili to Rourkela, which primarily locates most of these plants in the proximity of its stark expanse, unfolds the complete absence of environmental consciousness towards maintenance of natural surroundings by many of these units. This has consequently amplified the air, water and other forms of pollution that have swamped the areas surrounding these sponge iron plants to the detriment of the flora, fauna and human habitat. Regular demonstrations, writ petitions and PILs made by the afflicted residents from affected areas in the vicinity of these plants are yet to evoke any plausible improvement to this sordid state of affairs”.

Box- 4.1

Tata Company on Hazards of Sponge Iron Units

“Keonjhar bears mute testimony to the ever growing and irreversible damage being caused to mother nature by the rampant growth of unorganized industrial units in this district of Orissa. A difficult drive through the dilapidated NH 210 from Panikoili to Rourkela, which primarily locates most of these plants in the proximity of its stark expanse, unfolds the complete absence of environmental consciousness towards maintenance of natural surroundings by many of these units. This has consequently amplified the air, water and other forms of pollution that have swamped the areas surrounding these sponge iron plants to the detriment of the flora, fauna and human habitat. Regular demonstrations, writ petitions and PILs made by the afflicted residents from affected areas in the vicinity of these plants are yet to evoke any plausible improvement to this sordid state of affairs”.

[Source: website of TSIL (Tata Sponge Iron Limited)

(<http://www.tatasponge.com>)]

4.5 Apex Court aware about the truth !

Not only the companies that produce sponge iron but also the executive and judicial arms of the Indian State, as the following report bears out, are fully aware of the kind of havoc that this new industry plays with the life and livelihood of the common people. A 3-member Sub-Committee under the Supreme Court Monitoring Committee consisting of Prof. S.P. Mehrotra, Dr. Claude Alvares and Dr. Sukumar Devotta that visited Orissa during 6-9 June, 2006 in order to oversee the State's compliance to the apex court's direction had inter alia been to M/s Bindal Sponge Iron Plant Ltd located in Talcher area of Angul district to ascertain the facts in connection with various complaints made by the civil society groups about the public nuisances caused by the said plant. What the Committee saw for themselves has been recorded thus in their Report: “The plant is improperly run without qualified people and is a classic example of how badly a large plant covering a vast area can be managed. The pollution from the plant has affected the health of twelve villages in the vicinity. The plant has no proper layout to segregate different handling areas. Water is flowing all over, with the contamination ultimately ending up in a pond which is only few feet away from the pristine Brahminy river. The entire plant air is full of fine dust which if inhaled can cause respiratory cancers. It is very much likely to affect the health of the workers as the Committee Members themselves could feel the severity of the pollution just as they entered into the premises. The plant, although it is only nine months old, looks like a few decades over. The Committee was informed that the plant had been given trial consent only considering the representations and protests from the nearby villagers. The unit does not have any boundary wall or even a sign board to indicate what it is operating and the type of operation being carried out, people involved, hazardous waste generated, etc. Considering the severity of the risks and hazards posed by the plant to the surroundings and the environment including the river, the Committee is of the opinion that plant should be asked to stop the operation forthwith and it should be allowed to reopen only after it rectifies all the pitfalls including material handling, water collection, storage and treatment, emission control, EHS in the plant, etc. Everything is to be reorganized in terms of better material handling, EHS, water handling etc. The plant should be allowed to restart only when an expert in sponge iron plants certifies that the necessary features have been installed and are running to his or her satisfaction”.

Then after consulting the Orissa State Pollution Control Board, the Committee noted as to what should be done by the State Board in the immediate run in regard to the Sponge Iron Units of the State as a whole, "As for the other sponge iron plants, the Board agreed that every one of them would install the necessary boards in front of their units giving details of the unit, consent, authorization etc. This shall be done in 15 days. The Board indicated that not only was there now a ban on any further plants in the six districts sorely affected by sponge iron plants and their pollution, the Board was moving to install specially designed IT programmes to ensure that there is an autolock between the ESP and the feeding of raw materials to the rotary furnace".

However, they again observed with a sense of alarm, "The Committee however feels that the problems created all over Orissa by these plants need to be urgently dealt with. We therefore request the Board to have a study or survey conducted of these plants with a view to isolating those that have become a serious issue with the local populations. A small Local Area Environment Committee may be formed for this purpose. Thereafter, this information should be placed before an eminent sponge iron expert like Prof. Dave, head of the Technical Appraisal Committee of the AP Board or any competent air pollution expert from the CPCB, who may then recommend the measures that need to be installed if problem units are to be allowed to continue with their operations". But strangely enough, there has not appeared any action-taken-report so far by any quarter on the above observations and directions issued by the Apex Court's Committee in the face of the shoddy state of affairs surrounding the sponge iron units of the State.

4.6 Liberalisation down the line: The drive for production of sponge iron as a part of steel industry got a very good boost following the economic reforms initiated by the government in 1991. The paper '*Managing Technological Change: The Case of Iron and Steel Manufacturing in India*' by P. K. De, Dean (Academics) and Professor of Operations Management has listed out the important features of the said reforms as follows:

- Licensing requirement for capacity creation has been abolished.
- Steel industry has been removed from the list of industries reserved for the state sector.
- Automatic approval granted for foreign equity investment in steel has been increased up to 74% [Government of India 1999].
- Price and distribution controls were removed from January 1992 [Report to the Ministry of Industry, Science and Tourism 1997].
- Restrictions on external trade, both in import and export, have been removed.
- Import tariff reduced from 105% in 1992/93, to 30% in 1996-97. [Report to the Ministry of Industry, Science and Tourism 1997].
- Other policy measures like convertibility of rupee on trade account, permission to mobilise resources from overseas financial markets, and rationalisation of existing tax structure.

And it is not at all surprising that just in tune with GOI's trumpet of liberalisation, the Orissa Industrial Policy- 2001 expressed the Govt of Orissa's unqualified hospitality towards the industrialists seeking investment in Orissa. The new policy's open-door nuances for the industry as a whole has been scripted in unequivocal terms in the brief but pregnant definition given at Para 4.1 "GENERAL POLICY: Deregulation and simplification of rules and procedures, rationalisation of labour laws, facilitation of industrial restructuring and accelerated development of physical and social infrastructure through public-private partnership will enable a conducive business climate for attracting investments and establishment of competitive industry."

4.7 Are the Sponge Iron units truly small-scale in nature?

Compared to the sheer physical size, capital investment, manpower, machinery or other infrastructure that a large or medium steel industry in traditional sense of the term commands, a sponge iron unit can't fall under a category that stays above the small or even mini industry. But going by the criteria

of speed, output and quality of its performance, it ranks today alongside of, if not above the large and medium scale steel plants. In fact, “As of May 1991, there was only one DRI facility (*the technology used by sponge iron industry*-author) in the United States.” Assessing the role of this new, emerging breed of steel producing units, which used to be dismissively branded in early 90s as ‘mini mills’ in the steel scenario of USA, an official document [*ALTERNATIVE CONTROL TECHNIQUES DOCUMENT -NO EMISSIONS FROM IRON AND STEEL MILLS, EMISSION STANDARDS DIVISION U.S. ENVIRONMENTAL PROTECTION AGENCY, office of air and radiation, office of air quality planning and standards, research triangle park, north carolina 27711 september 1994* (http://www.epa.gov/ttn/catc/dir1/iron_act.pdf)] noted, “It has been suggested that the term mini-mill is a misnomer. The steel-melting facility used by mini-mills (i.e., EAF's) can produce up to 130 tons of steel per hour, not far from the 200- to-300-tons/hr typical of a BOF. Once viewed as suppliers of unsophisticated, low-quality products requiring minimal technology, mini-mills are now recognized as playing a growing technological role and for having made permanent inroads into the traditional domain of integrated producers. In 1990, Nucor Corporation and North Star Steel Company, two mini-mill producers, ranked seventh and eighth, respectively, among United States steel producers. Nucor, for example, has an annual production capacity of 3 million tons, and North Star an annual capacity of about 2.5 million tons. By contrast, USX Corporation (formerly U.S. Steel Corporation), the nation's leading steel producer, shipped about 12 million tons in 1990.”

4.8 Growing Spread of DRI technology:

The above document speaking on the significance of the DRI technology that underlies the sponge iron industry observes, “To produce a metric ton of pig iron requires about 1.7 metric tons of ore or other iron-bearing material, 450 to 650 kg of coke and other fuel, about 250 kg of limestone or dolomite, and 1.6 to 2.0 metric tons of air. Although the blast furnace remains the dominant source of iron for steel making, there are processes that produce iron by the reduction of iron ore below the melting point of iron. These are classified as direct reduction processes, and the products are referred to as direct-reduced iron(DRI). DRI produces several percent of the total iron produced worldwide. The major part of DRI production is used as a substitute for scrap in electric-arc steel-making furnaces. There are many DRI processes. The objective of these processes is to improve iron ore until it is sufficiently iron-rich to be charged to an electric arc furnace. A typical process uses heat to drive oxygen from the ore, leaving an iron-rich residue called sponge iron”.

To simplify the above formulation, the basic raw materials for the production of Sponge Iron are iron ore, non-coking coal, and dolomite. The process of sponge iron making aims to remove oxygen from iron ore. When that occurs, the departing oxygen causes micro pores in the ore body making it porous. The final product, when observed under a microscope, resembles a honeycomb structure, looking spongy in texture, hence, the name “Sponge Iron”.

4.9 Preference for Electric Arc Furnaces over the blast furnaces:

The next outstanding feature of the sponge iron technology is the use of EAF in place of the traditional blast furnaces. The above document continues, “The second major classification of steel making furnaces is the EAF. In 1991, EAF production accounted for about 37 percent of the total steel produced in the United States and Canada. Almost all of the balance was produced in basic oxygen furnaces. Electric arc furnaces produce liquid steel primarily by melting steel scrap. However, metallic iron, including pig iron and direct-reduced iron, are sometimes added to the charge. Generally, steel is produced in an EAF from a metallic charge of about the same composition as the steel to be made. Reactions taking place in the EAF are similar to those in the basic oxygen furnace. The charge is melted, impurities are oxidized, fluxes are added to aid in the formation of slag, and alloying elements are added to achieve the desired composition. There are several different variations of the EAF. However, the direct-arc, three-phase electric furnace is the most common”. The said document further mentions, “Electric arc furnaces offer several advantages including low construction cost, flexibility in the use of raw materials (steel can be made directly from scrap without having a source of molten iron), the ability to produce steels over a wide range of compositions, improved process control, and the ability to operate below full capacity. The improved

process control makes the EAF well suited for stainless steel and other high-alloy steels. Economic constraints tend to favor the use of EAF's for low to medium tonnage steel making facilities”.

4.10 Sponge iron spreads in India:

Before we proceed further, let's look at the factors that induced a phenomenal rise in sponge iron industry in the country, particularly in its Central eastern region comprising States of Jharkhand, Chhatisgarh, Orissa and West Bengal. Sponge iron also known as direct reduced iron (DRI) is extracted from iron ore and is used in the making of steel. With the rise in the global demand for steel over the past few years the sponge iron industry has also seen a boom. To facilitate growth of the steel industry, the government of India in 1985 de-licensed the iron and steel industry and removed it from the list of industries reserved for the public sector. Over the years pricing and distribution of steel have also been deregulated. To support availability of adequate finance, 100 percent Foreign Direct Investment is permitted in this sector under the automatic route. Customs duty on raw materials has been progressively reduced to meet the requirement of the industry as also to reduce the cost of production of steel. Such subsidies and de-licensing have heightened the growth of sponge iron industry in India. Even steel giants of the world like POSCO and Mittal and domestic giants of steel like Tata and Jindal have already incorporated sponge iron into their agenda of steel industry.

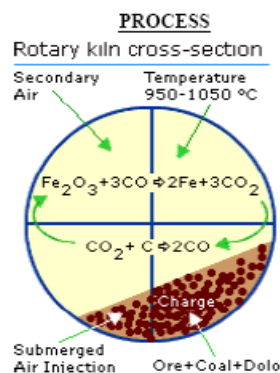
4.11 Ingredients and Process of Sponge Iron Production:

In the secondary sector, the steel production is mainly by EAF (Electric Arc Furnace) and induction furnace. Induction furnace route is gaining importance due to low investment cost and ability to produce quality steel at lower cost. With the increasing demand of sponge iron as the major raw material for the secondary steel makers, there is mushrooming growth of sponge iron units in the country, particularly in the eastern side.

The non-coking coal used for sponge iron making should possess such chemical properties as fixed carbon, ash-content and volatile material etc. and such physical properties as reactivity and ash-fusion temperature. In sponge iron making, iron ore is reduced in solid state. Unlike in the conventional steel melting process, the gangue content of iron ore cannot be separated as a slag. Therefore, it becomes imperative to select an iron ore with a high iron content and a low gangue content, to optimize yield during steel making. Apart from this, to ensure a better kiln campaign life and output, iron ore is made to undergo a series of other tests such as shatter, tumbler and abrasion indices, reducibility, etc. Dolomite acts in the processes as a Desulphuriser removing sulphur from the feed mix during the reduction process. It is mixed in small proportion along with other raw materials before charging into the kiln.

Production of Steel through the conventional blast furnace requires coking coal of which India has limited reserves. Therefore, evolution of a technology for the reduction of Iron Ore using abundantly available non-coking coal was contemplated, giving birth to Direct Reduction Iron (DRI) Technology. Sponge iron is cheaper because it is just a direct reduction from iron and not high quality steel as produced in integrated steel plants.

Figure 4.1 : A Diagram on Process of Production of Sponge Iron



[Source: STATUS OF SPONGE IRON UNITS IN ORISSA, prepared by Environment Conservation Team (Aruna Murthy, Himansu Sekhar Patra), Vasundhara, Bhubaneswar, September 2005]

Iron ore (Hematite) and non-coking coal are the prime raw materials for the production of sponge Iron. These are charged into a rotary kiln in a requisite proportion along with some dolomite. Coal plays a dual role in the process by acting as a reductant as well as a fuel for providing heat to maintain the requisite temperature inside the kiln at 950-1050°C. The reduction process occurs in the solid state. The crucial factor in this reduction process is the controlled combustion of coal and its conversion to carbon monoxide to remove oxygen from the iron ore. The overall process requires a duration of approximately 10-12 hrs inside the kiln, during which iron ore is optimally reduced and discharged to rotary cooler for cooling below 120°C, before coming out into the finished product circuit.

4.12 Sponge Iron dominates the Orissa industrialisation agenda:

As can be seen from the tables presented in the recently launched website titled ‘Opportunity Orissa (Investigator’s guide)’, the Govt of Orissa within a space of 4 years last beginning 1st Oct. 2003 has signed as many as 45 Memoranda of Understanding with domestic and foreign companies on a single product only i.e. steel, while it has signed only 2 and 3 MoUs for aluminium and cement respectively. Of course 13 MoUs have been signed for power projects, but most of these projects are not independent projects as such, but adjuncts to the steel projects. For instance, the very Bhushan company which has signed the 2 MoUs for steel project (at Sl. 5 and 23) in the name of Bhushan Steel and Power Limited, has also signed the MoU for a power project under a slightly different name i.e. Bhushan Energy Limited. And these projects, as we shall see, don’t aim at establishing big, big plants with huge employment potential, massive townships, chain of ancillary industries and elaborate infrastructures as characteristic of traditional blast furnace-cum-coking coal technology, but are essentially based upon DRI technology, the other name of sponge iron technique, requiring only a small manpower to run the unit but exploiting the best of the country’s land and iron ore along with other raw materials like non-coking coal, dolomite, limestone and sources of water and power.

4.13 POSCO too eyeing on sponge iron:

Even a global steel giant like South Korean POSCO who has signed an MoU with Government of Orissa for a 4 Million Ton Per Year Integrated Steel Project is not interested to follow the traditional BOF technology as prevalent at the major steel plants of our country at Rourkela or Bhilai or Durgapur and so on. The technology POSCO is going to adopt, though given a sophisticated label ‘Finex’, is nothing but DRI technology pure and simple that requires high quality iron ore along with non-coking coal and dolomite/limestone as basic raw materials. The following excerpt from the Executive Summary of Rapid EIA Report for the POSCO proposed mega Steel Project makes the point clear-

“13. The process for Iron making in the proposed plant will not adopt the traditional process route of coking, sintering and blast furnace (BF). Rather, the process for iron making will be based on FINEX route, a proprietary process developed by Posco-Korea and VAI-Austria, using mostly iron ore fines and non-coking coal. The FINEX process is a cleaner process as it does not have upfront processes like coke making and sintering.

14. The FINEX process will use iron ore fines and lump iron ore in an approximate ratio of 3:1. Reductant will be mostly non-coking coal with nominal quantity of coke.

15. Dried iron ore fines along with limestone and dolomite will get first reduced with FINEX off gas of melter gasifier (MG) in a series of fluidised bed reactors to produce hot direct reduced iron (DRI). This DRI fines will be compacted to get hot compacted iron (HCI).”

[Source: Executive summary of rapid environmental impact assessment for 4 mtpy integrated steel project to be set up near Paradip in Orissa Posco-India Private Limited- August 2006, prepared by M. N. Dastur & Company (P) Ltd, Consulting Engineers, Kolkata]

4.14 ENVIRONMENTAL IMPACT OF SPONGE IRON UNITS:

As noted in the ‘STATUS OF SPONGE IRON UNITS IN ORISSA’ (prepared by Environment Conservation Team (Aruna Murthy, Himansu Sekhar Patra), Vasundhara, Bhubaneswar, September 2005), right from the start of the raw material processing up to disposal of the final product, every stage of the Sponge Iron production is fraught with pollution hazards:

- **Dust emission during raw material preparation and product discharge and handling:** A definite size of iron ore and coal is required for the production of sponge iron. The suppliers of these raw materials not being adequately equipped to cater to the exact needs of the sponge iron industries, the industries crush and size the raw materials at their plant premises. During the crushing and sizing operations, generation of fugitive dust and discarded ore fines and coal fines is inevitable. Major dust emitting areas include areas such as product discharge from cooler to conveying system, magnetic separator, and raw material preparation unit.

- **Reduction:** The gaseous products of reduction contain mainly raw material dust, and gases like CO₂, CO, H₂, NO_x, O₂, unreacted hydrocarbons, and SO_x.

- **Waste water discharge:** The dusts from the gaseous emissions are separated through ESP or Gas quenching system. In either case, the disposal is done by converting the dust to a slurry form to avoid flying of the same in ambient air. In order to recycle the water the slurry is allowed to settle in a clariflocculator, from where the settled solid particles are pumped out. The polluted slurry water is then allowed to settle in settling ponds, or lagoons from where the clear water is pumped back for reuse. Such water is polluted with dissolved solids.

- **Gaseous emissions:** The exhaust gas emerges out of DRI kilns at a temperature of about 900°C and contains quantities of combustibles. This gas is used to produce steam in waste heat boilers which in turn is used to produce power. The dust coming from exhaust gas is either quenched to make slurry for easy disposal or is collected in dry condition or in wet condition from the ESP. So far, no method of utilizing this dust has been designed and as a result it causes dust pollution of the air in the surrounding areas.

- **Char:** The partially burnt coal called char is discharged from the reactor along with sponge iron. After the magnetic separation, the char is separated as a waste and becomes a source of pollution.

4.15 Aggravation of problems due to negligence by the sponge iron units:

Again, the above paper continues, in many of the sponge Iron Units in Orissa, ESP has not been installed and where it is installed, these units switch off their ESPs during the nights for a few hours. Thus, the area becomes a huge smoke bowl. In some sponge iron units in Sundergarh, it was found that the precipitators were not running in several of the units. Smoke and soot from the plants carried by the wind cause wheezing problem in kids, and cows and cattle too become restless. The smoke is sometimes so thick that vision even at a distance as close as 1 meter becomes difficult. The clothes worn by people immediately become smeared with coal dust. Even cooking utensils are covered with soot. In Kormunda (Sundergarh) where Neepaz Metallics (a 1.4 lakh tonnes sponge iron plant) is set

up, the drinking water becomes covered with black soot. The emissions also cause irritation and watering of eyes in human beings.

4.16 Stories from Chhattisgarh, Orissa and Jharkhand-

A report on the sponge iron industry, compiled by Manshi Asher and Rifat Mumtaz, NCAS Pune observes, “Air Pollution is one of the biggest hazards of this plant. The effects show within six months of functioning. Sponge Iron plants’ emissions contain cadmium, nickel, hexavalent chromium (most dangerous through air and water), arsenic, manganese and copper. The heavy metals in this particulate matter are most dangerous. These emissions like oxides of Sulphur cause quick damage to fruit trees and the agricultural harvest. Lichens are the quickest to disappear with this kind of pollution. The human lungs and agriculture produce are most affected. The problem is worsened because these plants are medium and small-scale and don’t have any capacity to deal with hazardous processes and wastes. They do not install pollution control equipments because their costs escalate. What is worse is that the Pollution Control Board (an almost dysfunctional body!) has not been able to monitor this pollution. It has never done any heavy metal analysis, especially in states like Chhattisgarh and Orissa”.

4.17 Location of Sponge Iron Units in Schedule-V Areas-

The following table provided by the Orissa State Pollution Control Board in the ‘State of Environment Orissa-2006’ gives us an idea about the officially recorded district-wise numbers of Sponge Iron Units operating in the State. It will be seen that out of a total of 93 units operating in the 9 districts of the State, Sundargarh alone has 46 nos., which is a little above 50% of the total, and the location of all the units in this district falls under Schedule-V Areas. And the next biggest contingent of these plants, 19 nos., that is, a little less than 20.5 percent of the total is located in V-Schedule Areas of Keonjhar district. Next, the two districts, Jharsuguda and Sambalpur have 8 nos each, a little above 8.6 percent of the total, representing the third highest concentration of these units are also covered under V-Schedule Areas.

Table 4.2
Sponge Iron Industries Operating in Orissa

Sl.	District	Nos.	Capacity (TPD)	Iron Ore Cons. (TPD)	Coal Cons. (TPD)	Water (KLD)
1.	Sundargarh	46	6625	10600	9275	6625
2.	Keonjhar	19	5450	8720	7630	5450
3.	Jharsuguda	08	1750	2800	2450	1750
4.	Angul	03	600	960	840	600
5.	Jajpur	03	600	960	840	600
6.	Mayurbhanj	01	200	320	280	200
7.	Sambalpur	08	2300	3680	3220	2300
8.	Dhenkanal	02	800	1280	1120	800
9.	Cuttack	03	1250	2000	1750	1250
	TOTAL	93	19575	31320	27405	19575

Source: Orissa State Pollution Control Board in the ‘State of Environment Orissa-2006’

These are areas, which apart from being mineral rich, are also forest rich and dominated by tribal and forest dwelling communities dependent on subsistence agriculture for their survival. With their survival threatened, it is but natural that these tribal and forest dwelling communities have risen in revolt against the sponge iron industry. Their protest has been directed against land grabbing by the industry owners and air and water pollution impacting health, agricultural produce, water sources, and livestock grazing fields and the local livelihoods. The above table also shows that the production of 19575 Tons of sponge iron per day requires a daily consumption of 31,320 tons of iron ore, 27405 tons of coal and 19575 kilolitres of water, all exploited from the local sources.

4.18 Whither PESA?

The pattern of location of Sponge Iron Units in Orissa which is same as the one noticed in adjacent States like Jharkhand and Chhatisgarh. These are concentrated by far in those places of which are surrounded mostly by the traditional habitations of scheduled tribes including the primitive groups. These places, as already indicated, are covered under Schedule-V areas, where the over arching law called *PESA [Provisions of Panchayats (Extention of to Scheduled Areas) Act, 1996]* prevails. The Section 4(e-i) of the said Act says that every Gram Sabha shall approve the plans, programmes and projects for social and economic development before such plans, programmes and projects are taken up for implementation by the Panchayat at the village level. Section 4(i) mandates, the Gram Sabha or the Panchayat at the appropriate level shall be consulted before making any acquisition of land in the Scheduled Areas for development projects and before resetting or rehabilitating persons affected by such projects in the Scheduled Areas. And still further, its Section 4m(iii) enjoins upon the State Government to endow Gram Sabha with such power as to prevent alienation of land in the Scheduled Areas and to take appropriate action to restore any unlawfully alienated land of a Scheduled Tribe. As we shall see a little later, all these provisions have been nakedly violated by the administration to

4.19 Employment and livelihoods:

'A report on the sponge iron industry- Stories from Chhattisgarh, Orissa and Jharkhand' compiled by Manshi Asher and Rifat Mumtaz, NCAS Pune again observes, "Employment in the Sponge Iron plants is of a contractual, non-permanent and unskilled nature. Most of the labour is required in the initial phases of the industry being set-up. Employment promised prior to the construction of the plant is never met once the plant starts functioning. The Sponge Iron Manufacturers Association of Orissa claims that 37, 000 people have been employed in these plants. On the other hand, a study conducted by a group called Orissa Jan Sangathan indicates that almost 2 lakh people are affected adversely by these plants in the six districts of Orissa. While the Supreme Court has recognized that loading and unloading is a perennial work, this is still done under contract rather than employment by these companies. This further makes the company unaccountable towards the health risks faced by the workers in these plants. In July 2005, in an incident at the Jindal Steel Plant in Raigarh, 6 people died in an accident on the plant and the company could not be held accountable as the labourers were employed by the local contractors".

4.20 Administration in open collusion with Companies:

'A report on the sponge iron industry, Stories from Chhattisgarh, Orissa and Jharkhand' compiled by Manshi Asher and Rifat Mumtaz, NCAS Pune further observes, "In Orissa the most affected district is Sundergarh where almost 50 of these plants are situated. The district in spite of being a Schedule-V area is facing a situation where land is being transferred to these companies without NoCs from the Gram Sabha. Even in areas where Gram Sabhas have attempted to oppose, they have not been supported by the local administration. An example is of Ratanpur (Orissa) village where Mahavir Hi-tech Sponge Iron Company, had already acquired land last year. After local protest built up, a gram sabha was called to get the NoC but kept getting adjourned as the administration realised that the task would not be easy. Finally when the meeting did happen a majority cast their vote against the plant and land acquisition. In spite of the presence of the Collector and the police there was stoning, chaos and a lathi charge at the gram sabha.

"In Mayurbhanj, Keonjhar and Sundergarh around 130 sponge iron factories are functioning, of which 50 are illegal. In 2005, 64 sponge iron plants got registered and 18 more are in the pipeline waiting for NOCs. Many are operating even without NoCs. Clearance procedures and Public hearings are unheard of here and in spite of this in the past two years people have managed to get almost 6 plants to withdraw or stop construction in Sundergarh. The main reason cited by the people for opposition has been the large-scale air and water pollution, which had started affecting not only their health but also that of their livestock, agriculture and land".

The above report citing an instance from Keonjhar district observes that last month a public hearing was convened on the issue of Malangtoli Iron Ore Mining Lease in favour of Orissa Sponge Iron Limited, but it was conducted in a manner that completely violated the EIA Notification. The local people alleged in their letter to the concerned pollution control authorities that the expansion plan would adversely affect the Khandadhara waterfall that used to attract a lot of tourists. And further the expansion was taking place despite the *statement of Chief Secretary Sri Subash Pani in The Daily Telegraph dated 25th April 2005* that the sponge iron units were of “no great importance” to the State and that the existing ones would not be able to add to their capacities. The newspaper report clearly stated that the Orissa government decided not to allow new sponge iron units in the state following allegations of pollution caused by the existing ones.

But for all said and done, the report noted with alarm, sponge iron industry continued to play havoc with the life and livelihood of so many poor, illiterate and tribal people, and contrary to all manner of democratic norms, no spaces were being allowed for the people to raise their legitimate concerns or demand accountability from the concerned authorities. The State continued to remain a mute spectator even as the people took to the streets demanding their rights to a safe environment and secure livelihood, the report concluded.

4.21 Case of Sundargarh: Ravage and Resistance

As seen from the table provided by *OSPCB in its State of Environment Orissa Report 2006*, Sundargarh district has by far the highest number of sponge iron units in the State, that is, 46 out of a total of 93. Besides there are several such units operating here and there throughout the district, which are outside the official reporting, if not outside the official knowledge. The manner in which these units have come up in the largely tribal inhabited, Schedule-V areas of the district and that too in an exceptionally brief time-span has been depicted pithily in a *Memorandum by ‘Tribal Welfare Society’ dated 5 July 2005 addressed to Governor, Orissa*. The Memorandum signed by Mr. Nicholas Barla, President of Rajgangpur Unit of the Society and 4 other eminent citizens noted inter alia, “The business people who are non-tribals have constructed the Sponge Iron factories with the help of State Government and district administrations in and around year 2000. Their only motif is to earn profit by any means. Without proper pollution control measures, these factories have been allowed to function, emitting enormous amount of pollution in the form of dust, waste and dumping yards that pollute the air, water, soil and above all ruining the agriculture, which is the only source of livelihood of the villagers, most of whom are tribal.” The Memorandum further goes on, “Taking benefit of the poverty and illiteracy of the tribal population, by luring them, or by giving them false assurances, those business people by hook or crook have acquired the land for the construction of the said factories. Sundargarh was a predominantly tribal populated district, where the tribal population was over 80% a few years ago, but has now been diluted to 50%. The tribal villages along with their culture, economic activities, and age-old tradition for which the tribals are proud of are now threatened and shall be subject to ruins because of the large-scale economic activities in shape of highly polluting industries that are set up practically all over the District. . . . It is a big question, how all these business people have been allowed to acquire the tribal lands? Why those officers who are responsible for performing their lawful duties have not cared to protect the rights of the tribal given to them by the constitution of our country? Under the circumstances prevailing at Sundargarh district, there is every doubt . . . that the violations of the Constitution and Rules and Regulations provided for the Scheduled Areas have been intentionally committed by a few officials for the reasons best known to them”.

Then the Memorandum lists out the following instruments of law related to the protection of tribal rights that have been blissfully ignored by the officialdom who sanction and protect the sponge iron units-

- i) The Provisions of Fifth Schedule in the Constitution

- ii) The PESA, 1996
- iii) The Orissa Regulation 1 of 2002 - The Orissa Scheduled Areas Transfer of Immovable Property (By Scheduled Tribes) Amendment Regulations, 2000
- iv) The Orissa Gram Panchayats (Amendment) Act, 1997
- v) Letter No.L.A.(C)-5/2000 (Misc) 35678 dated 27.7.2001
- vi) Letter No.12694/P.R. dated 8.8.1997 from the Director PR, Govt. of Orissa
- vii) Letter No.1084/P.R. dated 21.1.1999 by the Director PR, Govt. of Orissa
- viii) Resolutions of concerned Gram Sabhas

The said Memorandum placed three specific demands to be met by the Government, such as an independent enquiry to be conducted into the messy state of affairs that has developed around sponge iron units, immediate restoration of the acquired land to the tribals and legal action to be initiated against those plant owners and their miscreants and also against those officials who have trampled under foot the human and constitutional rights of the tribals.

The Memorandum in its conclusion while seeking the intervention of the Governor as the administrator of Schedule-V areas has however reminded him about the deadly apathy and persistent hostility meted out so far by the local administration towards the people protesting against the illegal acts of sponge iron units. The Memorandum bemoaned, "We also inform you that all the complaints, representations and requests of the victims have fallen on deaf ears of the district administrators. Except one-sided police action that harasses the victims, nothing is seen on the ground".

4.22 The tribal rage against Nepaz Metallic (P) Ltd.

The dubious, and even diabolic role, played by the police and administration towards the villagers whenever they raised their voice against the deadly impact of sponge iron units comes out in bold relief from a petition dated 31.3.2006 of Zilla Jal, Jungle Aur Zamin Surakshya Manch, Sundargarh addressed to the Collector and District Magistrate, Sundargarh signed by the forum's President Mr.Tintus Samaria and 11 other activists demanding 'Unconditional release of those arrested at Kuarmunda, Nepaz Metallic (P) Ltd.' As the petition recounts, on 22nd March'06, a discussion took place between the local activists and administration at Biramitrapur where it was agreed that the members of public could hold a peaceful agitation in front of the Nepaz Metallic(P) Ltd. at Kuarmunda on issues of pollution and employment. Accordingly, a peaceful assembly of affected villagers who were mostly tribal was held on the 24th instant. But ironically enough, a police contingent arrived at the place and 'brutally attacked and arrested' the agitators. The police also beat up a 'pregnant tribal woman' and 'taking advantage of the night removed the sarees of another woman and outraged her modesty', which is 'a shameful insult to the tribal society'. Besides 'In the presence of SP and other district administrators (ADM), Sub-Collector, Tahsildar, OICs etc. of Panposh Division the security personnels of the Nepaz Metallic (P)Ltd. fired at the peaceful gathering of tribals by the bullets, which caused tension and panic". The petition continued, "Now the police is creating terror and horror in the neighbouring villages of Kuwarmunda. The police have forcefully taken the minor girls and kept them in the jail".

The petition also listed out the grounds of protest by the local tribals against the Nepaz Metallic (P)Ltd, which are as follows:

- i. The factory obtained NOC only from Sarpanch, which is not backed up by any Resolution of Gram Sabha/Palli Sabha;
- ii. The local people were not intimated about the proposed construction of the said factory;
- iii. Only after the construction was over the ADM, Sundargarh issued a formal notice for land acquisition, which was illegal and only an eye-was;

- iv. The location of the factory of Nepaz Metallic (P)Ltd, where it stood in Schedule-V area was completely illegal;
- v. The acquisition of tribal land for the said factory violated the law prohibiting the transfer of tribal land to non-tribal hands;
- vi. The presence, interference and over-action by the police in a Gram Sabha meeting held in Schedule-V area contravenes the letter and spirit of PESA, 1996;
- vii. Black dust emitted by the factory pollutes the surrounding areas including the grazing ground, paddy fields, water tanks, wells and rivers, which inter alia cause health hazards to human beings, animals and plants;
- viii. The assurance by the factory authorities to provide employment to local people remains unfulfilled; and
- ix. Both police and industry have violated the Scheduled Castes and Tribes (Prevention of Atrocities) Act, 1989 by perpetrating brutality on the tribals.

4.23 MoU or a Clean Chit?

The hostile attitude adopted by the administration at the local level towards the tribal movement against displacement and pollution, as we shall shortly see, originates from and is inspired by the kind of MoU (Memorandum of Understanding) signed at the top level between the Chief Minister of the State and the concerned Company. It is but natural that if the text of the MoU puts no obligation on the Company to honour the laws of the land and its people and rather binds the Government to subservise the Company in every respect, the latter shall behave sooner or later as a superboss of the local officials and mobilise and marshal them to ride roughshod over every trace of agitation by the local people, be they tribals, dalits or forest-dwelling community. It has been observed that all the recent MoUs signed by the Chief Minister of Orissa with various Companies including the sponge iron producing ones are, so to say, clean chits issued by the Government of Orissa in favour of these Companies to do whatever they like to the natural sources, ecosystem and even human habitation in the area where they propose to set up an industrial unit basically for their own profit.

4.24 Govt. of Orissa's MoU with Nepaz (P) Ltd.

Let us take for instance, the *MoU signed between Govt of Orissa and Nepaz Metallic on 1st of Oct. 2003* for the establishment of a Steel Plant (technically speaking, a Sponge Iron Plant) at Chadriharipur near Rourkela in Sundargarh. This two-phase project aimed at setting up a coal based DRI plant along with a captive power plant with an investment of Rs.202.50 crore in the first phase (within 3 years of MoU) and expansion of the DRI plant and power plant alongwith Ferro Alloys with the additional investment of Rs.197.50 crore in the second phase (within 7 years of MoU). In the said MoU, the project proponent provides no commitment on any count except its willingness to set up the Plant and its ancillary units by investing a total of Rs.400 crore in two phases, which is primarily and obviously meant to increase the coffers of the Company itself. But as against this projected ambition of the Company, the Government of Orissa offers unconditional guarantee for the following:

- (a). *Handing over of 200 acres of land including human habitations free from all encumbrances to the Company through IDCO;*
- (b). *Supply of Raw Materials like coal and iron ore from the mines of Orssa through OMC for a period of 25 years;*
- (b). *Supply of Water from Sankh river and/or other sources at the rate of 1250 Cum/Hr.;*
- (c). *Facilitation of the sale of additional power generated by the Company from its captive plant to others through GRIDCO;*
- (d). *Issue of NOC from State Pollution Control Board for the construction of the plant, housing colony, mines, pipeline, power project etc. ;*
- (e). *Facilitating the obtaining of all clearnces from the Central Government;*
- (f). *Assistance in preparation of Rapid Environment Impact (REIA) Report and Environment Management Plan (EMP) for the Company; and*
- (g). *Providing all incentives and concessions as available under Industrial Policy Resolution, 2001 of the State.*

The very language of the MoU smacks of a brazen surrender of the Govt of Orissa before a private company, which comes forward to set up its plant in the State, certainly not out any benevolent disposition towards the land and people of Orissa, but out of the sheer motive to garner super-profits in a record time by way of exploiting its cheaply available land, raw materials, water, power, wage labour and above all a pliant and gullible Government. For instance, at Para-4(E), the MoU says,

- “i. The Government of Orissa agree to assist NMPL in obtaining NOC through the State Pollution Control Board for the construction of the Plant, the housing colony, mines, pipeline, power projects etc.*
- ii. The Government of Orissa agree to assist NMPL in obtaining all clearances from the Central Government.*
- iii. NMPL will arrange to conduct rapid environment impact assessment (EIA) and detailed EIA study and prepare environment management plan (EMP) for the project. The Government of Orissa agree to assist NMPL in this regard during the time when EIA is being conducted and EMP is being prepared”.*

What does it all show? It implicitly says that Government of Orissa considers Orissa Pollution Control Board as a pocket agency, which shall be bound to issue NOCs to the concerned Company as and when dictated to by its master to do so irrespective of the Company complying or not with the concerned legislative and procedural requirements on pollution. And more ludicrous than this is the assurance by the Government of Orissa to get all the clearances obtained from Government of India in Company's favour. Does the law of the land allow the State Government to play such a hand-in-glove role for a private company vis-à-vis the Union Government? Can a State Government be a party to a private company in the matter of lobbying, say for instance, for getting environmental clearance from the Central Ministry of Environment and Forests in the favour of a Company? As is well known, it is usually the State Pollution Control Board which conducts a public hearing to record the objections and grievances of the affected public, if any on a proposed project, and the environmental clearance from the centre is issued only when a Company complies with all the objections/grievances so raised. But in a situation when the State Government is already committed to the issue of NOCs and clearances in favour of the Company, come what may, can the Board conduct a public hearing in an impartial and independent manner, as mandated by law ? If such assurances of the State Government in the matter of NOCs and clearances be read in conjunction with the assurance of the State Government to assist the Company in the matter of formulation of EIA and EMP, then it is established beyond any shade of doubt that the whole exercise starting from preparation of EIA upto the issue of NOCs and clearances shall be orchestrated by the State Government itself and the legal mandate for holding a public hearing shall be reduced to a grand farce only.

4.25 Questionable legitimacy of the MoUs signed by the State Government:

The Orissa Government's MoU with Nepaz Metalic (P) Ltd. loses its legitimacy on another important ground too. Knowing fully well that the proposed project site falls under Schedule-V area, that there is a general prohibition of the transfer of land from the tribal to the non-tribal persons and that no acquisition of land for any development project shall be attempted in such areas without holding prior consultation with the Gram Sabha, how is it that the State Government signed the MoU with a private company assuring them in advance the allotment of land and common property resources including the private land belonging to scheduled tribes in the interest of Company's project? Is it wrong to say that the State Government taking advantage of the poverty, illiteracy and innocence of the tribal people have taken them for granted? Does the State Government not violate the letter and spirit of the Schedule-V of the Constitution and other related laws of the land like PESA, 1996 by executing the MoU with private companies before letting the concerned populations to judge for themselves whether a project as proposed is at all required for their area? It is a question of paramount significance, on the basis of which all the MoUs so far signed by the State Government of Orissa with

domestic and foreign companies for projects in Schedule-V areas need to be reviewed in terms of their legitimacy and constitutionality.

4.26 Is there any space for ‘public purpose’ in MoUs?:

Quite often the MoUs are projected by the State Government to bring in handsome benefits to the State and its people in terms of enhanced revenue for the State, infrastructure development, employment generation, compensatory afforestation, R&R benefits for the displaced population and the like. But on a discrete analysis of the MoU signed with Nepaz Metallic (P) Ltd. we find two contradictory strands running at the same breath in its diplomatically configured text. On the one hand, when the State assures privileges, provisions and priorities etc. to the Company, the MoU uses a very clear, unequivocal and even mathematically exact language to convey its commitment, but in regard to the real issues of public interest, the MoU either keeps silent or resorts to vague and ambiguously worded expressions signifying nothing in specific. For instance, at Para-4(A), there is the specific mention of exact acreage of land i.e. 200 acres to be acquired by the Government for hand-over to the Company free from all encumbrances, whereas the obligation towards the displaced families has been disposed of in a single sentence consisting of such hollow words, “For rehabilitation of displaced families, Rehabilitation and Resettlement Package would be implemented as per prevailing guidelines and practices”. Next, the MoU at Para –4(B) assures to provide raw materials like coal and iron ore to the Company through the aegis of OMC to the extent required, but the MoU is conspicuously silent on what shall the State exchequer or the local people gain exactly in lieu of it? Again, at Para-4(C), the MoU assures the supply of water to the extent of 1250 Cum/Hr. from Sankh river and/or other sources for the use of the Company, but it abstains from mentioning what shall the Company or Government do to compensate for the depletion of such water resources from our State. Then at Para-4(E), the MoU categorically assures to facilitate the issuance of NOCs and clearances from all quarters including Central Government, but it carefully refrains from treating the issue of pollution likely to be caused by the Company. At Para- 4(F), the MoU commits to provide all the incentives and concessions to the Company allowable under State’s Industrial Policy Resolution-2001, but coming to the all important question of employment provision for the local people, the MoU at Para-(G)(a) offers such nakedly evasive words, “In terms of employment, preference will be given to the local persons subject to need and their possessing the necessary qualifications. NMPL will make every effort to improve their skill levels, if necessary, through specialised training”. All it means in plain language is that even if a local person possesses the ‘necessary qualification’, he may be refused the job on the plea that the Company has no ‘need’ for it; and reversely, where the Company has the ‘need’ for employing a person of certain qualification, the local person who comes forward to ask for the job can simply be refused on the plea that he doesn’t possess the ‘necessary qualification’. Besides a very queer strain runs all through the MoU. While the Government shall acquire the land from the public and hand it over to the Company, the Government nowhere commits to provide R&R entitlements or job or other benefits directly to the project affected people by itself, and instead surreptitiously passes on all these obligations to the Company, which is in no way accountable to the people as a lawfully elected Government is.

Even the said MoU has nothing to offer in terms of infrastructure like road, school, hospital, afforestation and drinking water etc. for the local populations. Above all, the MoU is completely silent on how the State Government or the Central Government shall be benefitted in terms of tax revenues or sale proceeds from the Company. In absence of such commitments, the MoUs like the one executed by the Government of Orissa with Nepaz (P)Ltd. can be described as the absolute and unconditional charters of rights granted to the private companies to rob the poor State of Orissa and its innocent people of their natural resource and manpower to accumulate superriches themselves and leave them at the end in a more miserable state than ever before.

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- *Rapid Environment Impact (REIA) Report and Environment Management Plan (EMP) for the Nepaz Metallic*
- *Industrial Policy Resolution, 2001 of Government of Orissa*
- *Various Memoranda signed between Govt. of Orissa and private domestic and foreign companies for establishment of Steel Plants/Sponge Iron Units in Orissa*

Tables

Table 4.1 India's Steel Production 2007

Table 4.2 Sponge Iron Industries Operating in Orissa

Boxes

Box- 4.1: Tata Company on Hazards of Sponge Iron Units

Figures

Figure 4.1: A Diagram on Process of Production of Sponge Iron