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"Sponge Iron Industry in Chhattisgarh : a Perspective "

KEYWORDS

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ABSTRACT *Sponge Iron Industry in recent years has witnessed growth in India as well as globally. Chhattisgarh blessed with abundant natural resources is one of major producers of Sponge Iron in India. The alternative route for steel making using sponge iron as substitute of scrap has increased significantly and is major contributor to world steel production. With increasing use of steel in different industries, the demand for steel and sponge iron is also likely to grow. According to Ministry of Steel, the demand for steel is expected to grow at an average annual rate of 10% in the coming years.*

Introduction

Sponge Iron is an intermediate product used for the production of steel. It is also referred to as Direct Reduced Iron (DRI) or Hot Briquetted Iron (HBI). The HBI is the compact form of DRI produced for easy handling, shipping and storage purpose. The different routes for manufacturing steel are through Basic Oxygen Furnace (BOF), Electric Arc Furnace (EAF) and Induction Furnace (IF). The BOF route requires high capital investment, steel scrap and coking coal as input. The increasing price of coking coal, limited availability of steel scrap and environmental issues has prompted the production of steel using alternative route of Electric Arc Furnace or Induction Furnace using Sponge Iron.

Sponge iron is produced by subjecting iron ore to a reduction process using either natural gas or coal. The iron ore is often in the form of pellets or lumps. The reduction process removes oxygen from iron ore leaving behind the porous or spongy mass therefore called as Sponge Iron. It is further melted in electric arc furnaces (or induction furnaces) to produce liquid steel. This methodology enables steel to be produced without using coking coal and steel scrap. In modern times, sponge iron has been mostly used as substitute of scrap for steel making. Sponge iron is highly metallized, have balanced carbon content, low sulphur and phosphorus contents and negligible tramp elements. This makes it ideal input for making steel. With the global increase in demand for steel, the demand for Sponge Iron also has picked up in recent years.

Objectives of the Study

Steel Industry is important for every developing economy like India. Indian Steel Industry contributes nearly 2% to country's GDP and provides employment to more than 6 lakh people. Consumption of steel is considered to be the indicator of economic development. Sponge Iron Industry is vital to the growth of Steel Industry as Sponge Iron is used as substitute of scrap in Steel Industry. The present study evaluates the Sponge Iron Industry in Chhattisgarh with focus on different process used by Sponge Iron plants in Chhattisgarh.

Hypothesis

- Sponge Iron Industry plays an important role in economic development of Chhattisgarh and India.
- Sponge Iron Industry needs to be modernized.

Research Methodolgy

The proposed research work is purely based on secondary data. The data was collected from books, journals, websites and annual report of Ministry of Steel of 2014-15.

Overview of Sponge Iron Industry

The global production of Direct Reduced Iron in 2003 was 49.45 which has steadily increased to 74.55 MT in 2014. India is the largest producer of Sponge Iron since 2003 with production growing from 7.67MT in 2003 to 17.31 MT in 2014 accounting for 23% of world's production. The first commercial sponge Iron plant was set up by Sponge Iron India Limited (SIIL) in Paloncha district of Andhra Pradesh in 1990 with capacity of 30,000 tons per annum. Post liberalization, there is rapid increase in the number of sponge iron plants.

TABLE 1: Comparison of DRI Production: INDIA vs. WORLD
(In Million Tonnes)

S.No	Year	World's Production	India's Production	Share of India (%)
1.	2008	67.95	21.20	31.20%
2.	2009	64.33	22.03	34.25%
3.	2010	70.28	23.42	33.32%
4.	2011	73.21	21.97	30.01%
5.	2012	73.14	20.05	27.41%
6.	2013	74.92	17.77	23.72%
7.	2014	74.55	17.31	23.22%

Source: Annual Report of Ministry of Steel 2014-15

At present there are 446 Coal based and 3 gas based Sponge Iron plants in India including some unreported plants. The leading states producing Sponge Iron are Andhra Pradesh, Chhattisgarh, Jharkhand, Odisha and West Bengal. Odisha has most (110) Sponge Iron plants followed by Chhattisgarh with 85 and Jharkhand with 65 plants. We can see from the graph below that India's DRI production has gradually increased with recent decline attributed to sluggish demand for steel and dumping of cheap steel scrap from China.

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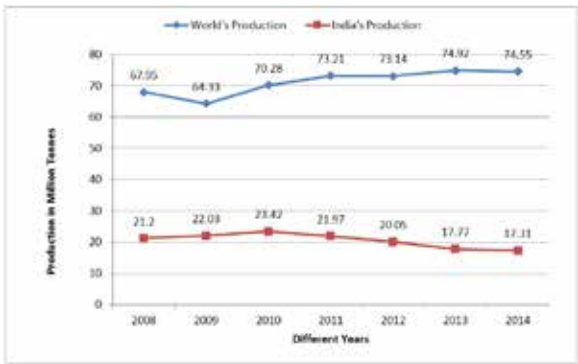
Figure 1: Comparison of DRI Production between India and World

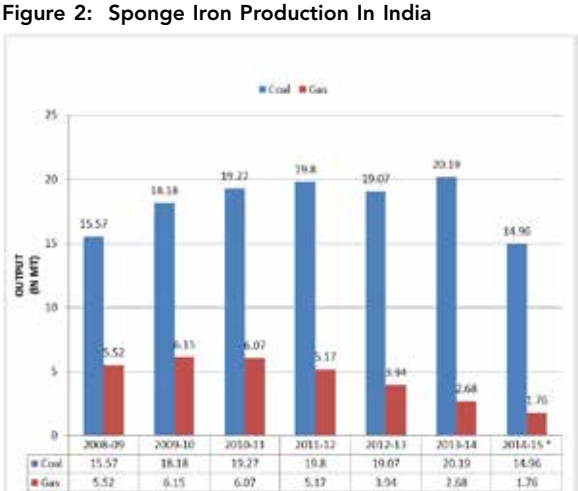


Source: www.midrex.com

Production Process of Sponge Iron

Sponge Iron can be produced using either coal or natural gas as a reductant. Over past few years, Coal based processes contribute nearly 80% of total Sponge Iron production in India. This is basically due to easy availability of coal and other raw materials required for production of Sponge Iron and lack of availability of gas. The graph below clearly shows that production of Sponge Iron by coal based processes has increased while there is decline in production of Sponge Iron by gas-based plants.

Figure 2: Sponge Iron Production In India



Source: JPC *Provisional

Coal based processes can be further classified on the basis of types of reactors used for direct reduction. Different types of reactors used are rotary kilns, rotary hearth and tunnel process. There are various coal based processes using rotary kilns but only few have got success like SL/RN, Krupp Codir, ACCAR, DRC and also some customized process are used by JINDAL, TDR and Poppuri Engineering etc. All the plants in Chhattisgarh use rotary kiln for direct reduction.

Direct Reduction using Rotary kiln

Direct reduction of Iron ore is usually carried out in a refractory lined rotary kiln inclined at 2.5% slope. Non coking Coal, Iron ore and dolomite (or limestone) are input into the rotary kiln from the top. As the kiln rotates, the materials fed from the top end gradually moves down towards the lower end with certain stirring and mixing. The slope of the kiln also affects the speed at which materials move down. Hot gases passes along the kiln occasionally in the same direction as the process material (co-current), but usually in the opposite direction (counter-current). There are two zones in the kiln the pre-heat zone and metallization zone. The pre-heat zone temperature is maintained at about 900-1000 °C and metallization zone at about 1000-1050 ° C. The coal and iron ore input into the rotary kiln first passes through pre-heating zone where moisture is removed and thermal decomposition of coal takes place releasing hydrocarbons and hydrogen. Iron oxide gets oxidized to ferrous oxide.

$Fe_2O_3 + CO = 2FeO + CO_2$

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. Highly reactive coal is preferred to make this conversion faster.

$FeO + CO = FeO + CO_2$

$CO_2 + C = 2CO$

A finer fraction of coal is also introduced from the discharge end of the kiln to complete the reduction in solid state itself. By the time charge travels 75% of length of kiln very little coarse coal is left to complete the last stages of production. This finer coal is injected using air as carrier to complete the reduction. The product is finally discharged from lower end into the cooler at about 1000 ° C. Sponge Iron is cooled to below 120°C in the cooler by indirectly spraying water. After cooling, 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. Sponge Iron is also screened as per size less than 3 mm and 3-20 mm. The heat from hot gases is recovered in the boiler or after cooling in the gas conditioning tower (GCT) is then let off into the atmosphere through Electro-Static precipitator (ESP) or stack.

Types of Process Technology

The different types of process technology used in Sponge Iron Plants in Chhattisgarh are:

SL/RN (Outocompu): It was originally developed by the **S**teel Company of Canada (Stelco), **L**urgi Chemie, **R**epublic Steel Company and **N**ational Lead Corporation in 1964. The process was owned by Lurgi and the present owner is Outokumpu. Iron ore used can be in the form of lumps or pellets. Different varieties of solid fuels like anthracite, lignite or charcoal can be used. The process has optimized facilities for countercurrent coal injection.

Krupp-Codir Process- It is similar to SL/RN process. The majority of coal is injected from the discharge end of the kiln. The rotary kiln temperature is maintained at 950-1000° C. The counter current injection of coarse coal can be of size of 5-25 mm.

Direct Reduction Corporation (DRC) – The raw material passes through first pre-heating zone and then reducing zone. The combustion air is supplied by fans using internal air tubes.

Customized/Indigenous Technology: The change in direct reduction process in minor ways is called customized or indigenous process. This change can be in feed ratio of charge, change in dimensions of kiln etc. Some of the customized processes used in the state are Jindal, TDR and

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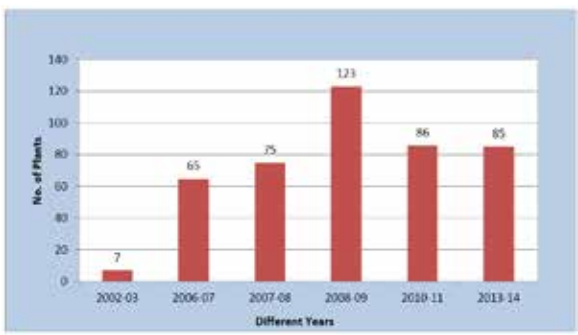
Popurri Engineering.

Growth of Sponge Iron Industry in Chhattisgarh

Chhattisgarh is the largest producer of Sponge Iron as it accounts for 26% of India's production followed by Odisha, West Bengal, Jharkhand and Andhra Pradesh. Chhattisgarh has 85 Sponge Iron plants with capacity of 8.0 Million Tons per annum. All the Sponge Iron Plants in Chhattisgarh are coal based as gas is available mostly in western parts of country. Jindal Steel and Power limited, the world's largest coal based sponge iron plant is in Raigarh. It has production capacity of 3.0 MTPA.

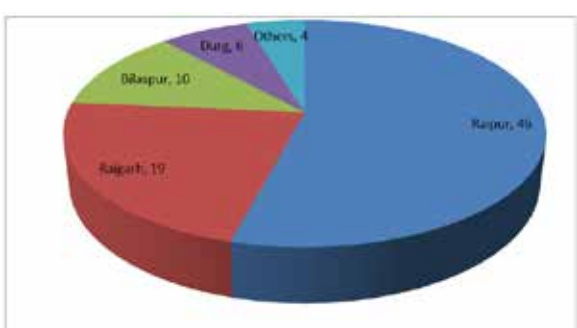
Figure 3 Growth of Sponge Iron Plants in Chhattisgarh



Source : www.cseindia.com

Most of the Sponge Iron plants are in Raipur, followed by Raigarh and Bilaspur district. Few plants also exist in Champa-Janjgir and Durg district. Sponge Iron plants in Raipur district are mostly in Silatara and Urla clusters. Major producers of Sponge Iron in Raipur are Godawari Power and Ispat limited, Bajrang Power and Ispat ltd., Monnet Ispat etc. The graph below shows the sponge Iron plants in different districts:

Figure 4 : Sponge Iron Plants in Different Districts of Chhattisgarh



Source: www.chhattisgarhmines.gov.in

Reasons for Growth of Sponge Iron Industry

Many steel plants like Jindal Steel and Power limited, Prakash Industries, Monnet Ispat, and the state owned Bhilai Steel Plant exists in Chhattisgarh. With gradual increase in production of Steel through alternative route, these steel plants require sponge Iron for producing steel. This has forced some of the plants for backward integration and produce sponge Iron for their steel plants. Different factors responsible for growth of Sponge Iron Industry are as follows:

Easy Availability of Raw Materials: Raw materials required for production of Sponge Iron are Iron-ore, Coal, and dolomite or limestone. Chhattisgarh has rich mineral reserves as it accounts for 17.42 % of coal reserves, 18.67% of iron ore reserves and 11.24% of Dolomite reserves in country.

Better Infrastructure: Major districts of Chhattisgarh like Raipur, Durg and Raigarh have good infrastructure and transport facilities. All these districts are well connected by roadways and railways with major cities of India.

Easy Expansion: The no. of rotary kilns installed can be increased easily in order to increase the production capacity and the payback period is also less.

Subsidy and Tax Hoildays: According to Chhattisgarh Industrial Policy 2014-2019, the state Government provides direct incentives for Industrial investment in the form of Interest subsidy, Fixed Capital Investment Subsidy, Electricity Duty Exemption, Stamp Duty Exemption and several other non fiscal facilities are also provided for industries in core sector.

Growth of other Industries: The demand of steel from other industries like infrastructure, construction, automobile etc. has also increased the demand of sponge Iron.

Advantages of Sponge Iron Industry in Chhattisgarh

- Provides the raw material for Steel Industry
- Provides employment to local people of Chhattisgarh directly and indirectly.
- Helps in proper utilization of abundant mineral resources of state.
- Major contributor to the manufacturing sector of Chhattisgarh.
- Vital for the growth of other allied industries

Conclusion

The Sponge Iron Industry in Chhattisgarh has grown over the years and will continue to grow. India is the third largest producer of steel in world but per capita consumption of steel is 52 kg way behind the world average of 203 kg. So if the per capita consumption of steel grows, the demand for steel will increase. This will in turn increase the demand for Sponge Iron. Most of the Sponge Iron plants in Chhattisgarh are still using old technologies. They need to be replaced by new technologies which are environment friendly and more efficient than present one. The Government should also encourage use of new technologies and take appropriate measures to ensure availability of necessary raw material for Sponge Iron plants.

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