Iron Making and Steel Making
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Module - 11
Lecture – 60
Ironmaking and Steelmaking in India (continued)

In this lecture, I am continuing from my last lecture on Iron Making and Steel Making in India. I have discussed about the global steel production and consumption vis a vis Indian scenario, and potential, challenges and major problems with iron and steel sectors. And in this lecture, we will discuss about the role of alternative routes of iron making in India's progress in steelmaking. And also I will talk about education and research of iron and steel in India.

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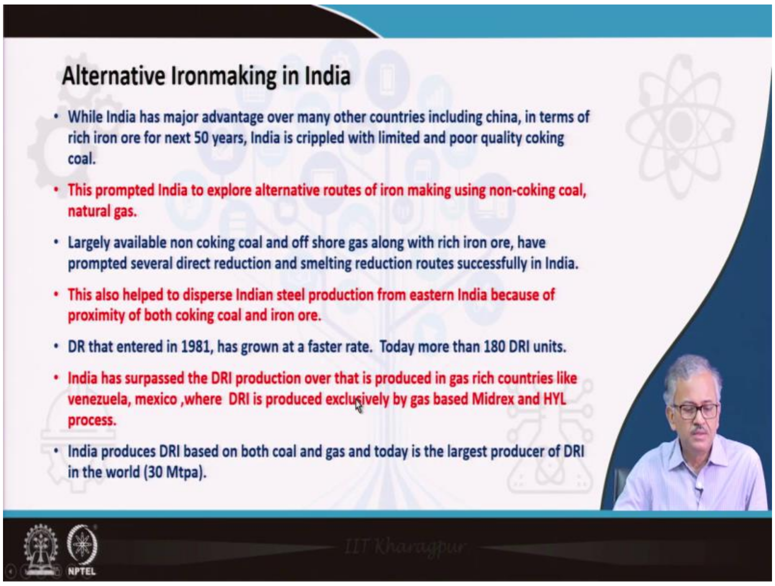

While India has major advantage over many other countries including china, in terms of rich iron ore for next 50 years, India is crippled with limited and poor quality coking coal.

This prompted India to explore alternative routes of iron making using non-coking coal, natural gas. Largely available non coking coal and off shore gas along with rich iron ore, have promoted several direct reduction and smelting reduction routes successfully in India.

This has also helped Indian steel production to disperse from eastern India, which was otherwise the only spot where steel industries grew due to proximity of both coking coal and iron ore. Direct Reduction process that has entered in 1981, has grown at a faster rate. Today more than 180 DRI units are there in India. India has surpassed the DRI production to that produced in gas rich countries like venezuela, mexico ,where DRI is produced exclusively by gas based Midrex and HYL process. India produces DRI based on both coal and gas and today is the largest producer of DRI in the world (30 Mtpa).

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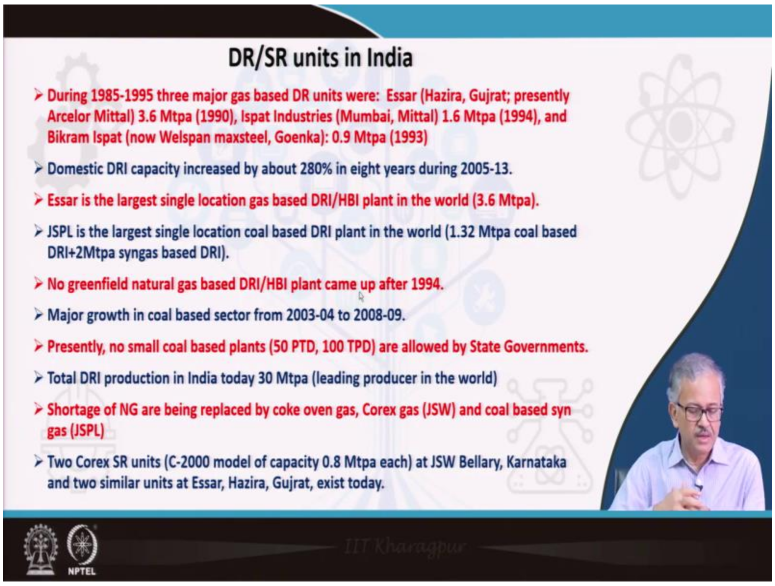

During 1985-1995 three major gas based DR units were established at Essar (Hazira, Gujrat; presently Arcelor Mittal) 3.6 Mtpa (1990), Ispat Industries (Mumbai, Mittal) 1.6 Mtpa (1994), and Bikram Ispat (now Welspan maxsteel, Goenka): 0.9 Mtpa (1993). Subsequently, domestic DRI capacity increased by about 280% in eight years during 2005-13. Essar is the largest single location gas based DRI/HBI plant in the world (3.6 Mtpa). JSPL is the largest single location coal based DRI plant in the world (1.3 Mtpa Rotary kiln coal based DRI + 2Mtpa coal based Midrex DRI). No greenfield natural gas based DRI/HBI plant came up after 1994 due to limited offshore NG availability in India. And major growth observed in coal based sector from 2003-04 to 2008-09. Given due consideration to environment, no small scale polluting coal based plants (50 PTD, 100 TPD), not adhering to the environmental norms are allowed by State Governments. Total DRI production in India today 30 Mtpa (leading producer in the world). Shortage of NG are being replaced by coke oven gas, and through coal based synthetic gas generation. JSPL Angul plant is a recent example where a midrex plant has been connected with Lurgi coal based syn gas generation.

Two Corex SR units (C-2000 model of capacity 0.8 Mtpa each) at JSW Bellary, Karnataka and two similar units at Essar, Hazira, Gujrat, exist today, where hot metal of blast furnace quality is being made using non-coking coal. The off gas is used either to produce DRI or generating power.

Some promising SR technology like HIsmelt, HISARNA could be very suitable where non coking coal, iron bearing solid waste and fines could be directly utilized, making the process less polluting and environmentally friendly.

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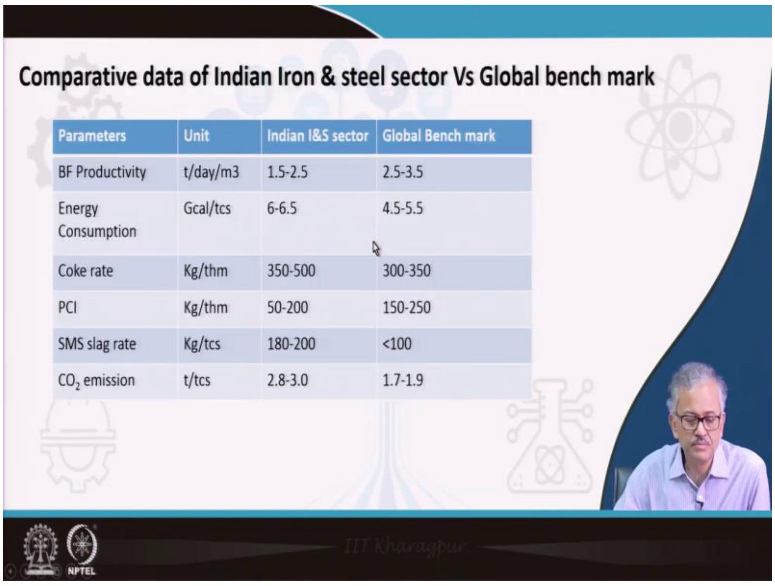

Parameters	Unit	Indian I&S sector	Global Bench mark
BF Productivity	t/day/m3	1.5-2.5	2.5-3.5
Energy Consumption	Gcal/tcs	6-6.5	4.5-5.5
Coke rate	Kg/thm	350-500	300-350
PCI	Kg/thm	50-200	150-250
SMS slag rate	Kg/tcs	180-200	<100
CO_2 emission	t/tcs	2.8-3.0	1.7-1.9

Some of the comparative data of Indian iron and steel sector versus global benchmark are given in the Table 60.1. If you see the productivity wise, a blast furnace productivity in terms of tonnes per day per meter cube, India is 1.5 to 2.5 compared to global benchmark of 2.5 to 3.5.

So, Indian production is quite less. For various reasons like lack of demand, inadequate quality, competitive price our plant sometimes runs with under capacity.

Energy consumption in Gcal per ton of crude steel for India is at 6 to 6.5 compared to the global benchmark at 4.5 to 5.5. It is due to outdated technology with new raw material and logestics in steel plant.

Coke rate in India is around 350 to 500 kg of coke per tonne of crude steel and global benchmark is 300 to 350 kg. PCI kg per tonne of hot metal in India 50 to 200, with some exceptional good updated plants where PCI is at 200 kg.

Table 60.1: Comparative data of Indian Iron & steel sector Vs Global bench mark

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BF slag are usable and saleable. But SMS slag remains unutilized and dumped and is an environmental concern. So, SMS slag should be produced as low as possible. Global bench mark is less than 100 kg/tcs, in India we produce at a rate of 180-200 kg/tcs. While the CO_2 emission (in tonne per crude steel) benchmark is 1.7-1.9, Indian steel plant emits at 2.8 to 3.0, which makes the process not sustainable. And India is desperately trying to reduce emission below 2.2, as deadline set by environmental protocol.

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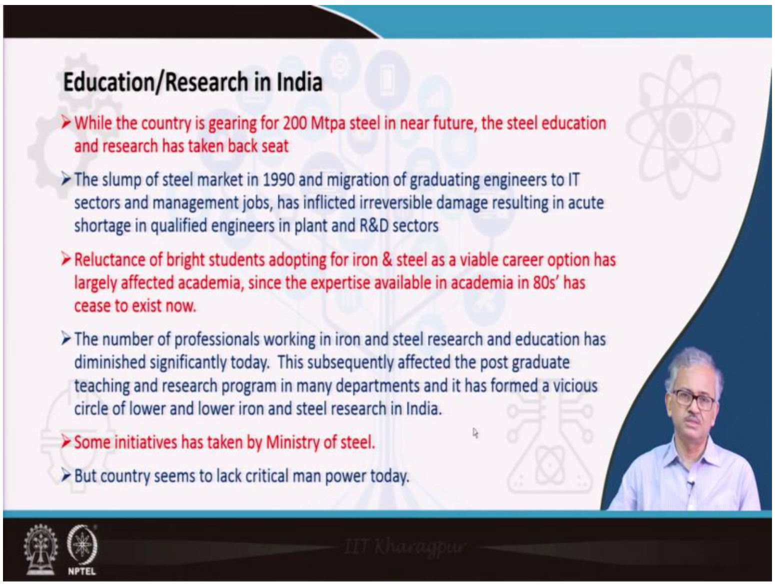

So, now I will talk something about the education and research in India.

While the country is gearing for 200 Mtpa steel in near future, the steel education and research has taken back seat. Today India need some indigenous cutting edge energy efficient technology technology for sustainable technologies. And for that Indian research and education has to be revamped for day to day innovation and for futuristic innovation of low carbon technologies.

The slump of steel market in 1990 and migration of graduating engineers to IT sectors and management jobs, has inflicted irreversible damage resulting in acute shortage in qualified engineers in plant and R&D sectors. Reluctance of bright students adopting for iron & steel as a viable career option has largely affected academia, since the expertise available in academia in 80s' has cease to exist now. The number of professionals working in iron and steel research and education has diminished significantly today. This subsequently affected the post graduate teaching and research program in many departments and it has formed a vicious circle of meagre amount iron and steel research in India. Some initiatives has taken by Ministry of steel. But country seems to lack critical man power today. When I visited International Conference in Japan and China, it was notable to see so number of people are working in different areas of iron and steel. I have seen some 50 researchers are there in the coal/coke related research only. Similarly, in other areas too. But India you can hand count the people who are doing research in iron and steel, especially in academic institutes.

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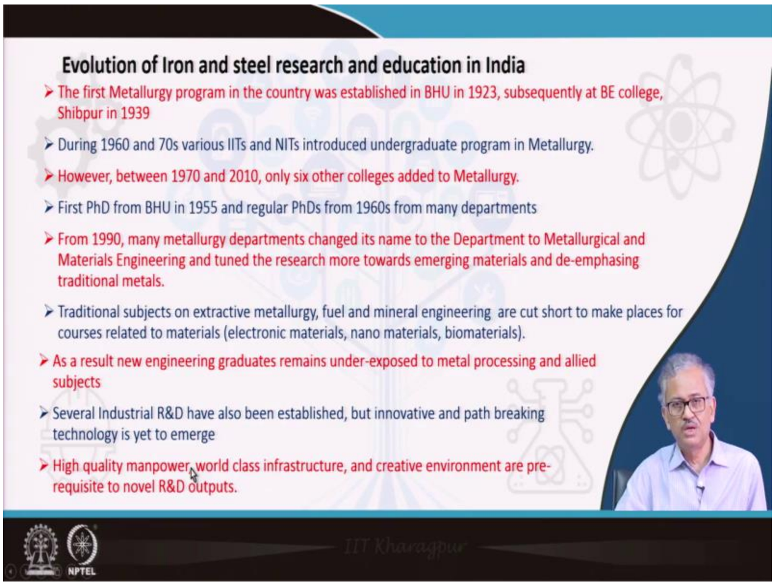

Evolution of Iron and steel research and education in India: The first Metallurgy program in the country was established in BHU in 1923, subsequently at BE colleage, Shibpur in 1939. During 1960 and 70s various IITs and NITs introduced undergraduate program in Metallurgy. However, between 1970 and 2010, only six other colleges added to Metallurgy. First PhD in metallurgy was awarded from BHU in 1955 and subsequently regular PhDs started to be awarded from 1960s from many departments. From 1990, many metallurgy departments changed its name to the Department to Metallurgical and Materials Engineering and tuned the research more towards emerging materials and de-emphasizing traditional metals. Traditional subjects on extractive metallurgy, fuel and mineral engineering are cut short to make places for courses related to materials (electronic materials, nano materials, biomaterials). As a result new engineering graduates remains under-exposed to metal processing and allied subjects.

Several Industrial R&D have also been established, but innovative and path breaking technology is yet to emerge. High quality manpower, world class infrastructure, and creative environment are pre-requisite to novel R&D outputs.

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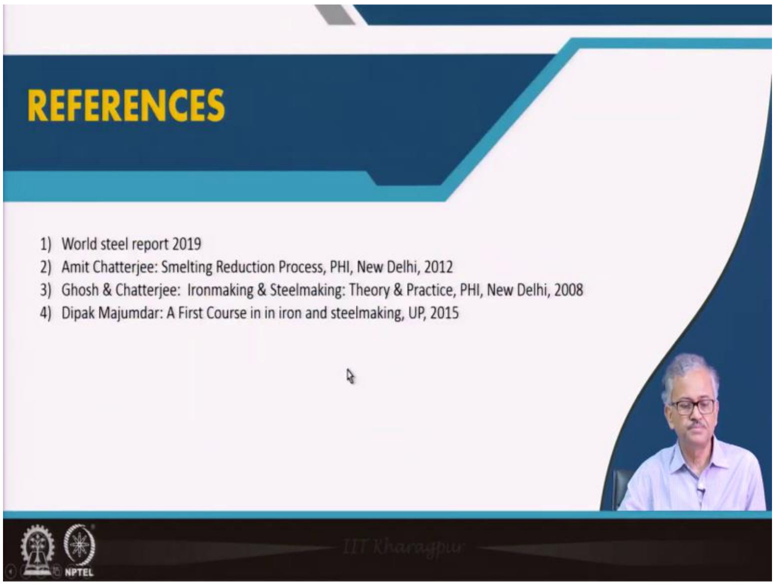

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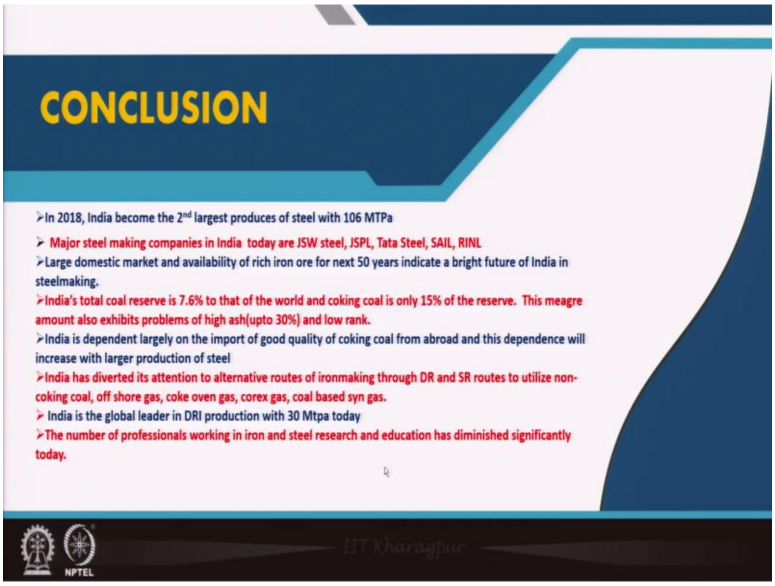

Conclusion: India become the 2nd largest producer of steel with 106 million tonne per annum. And major steelmaking companies in India today are JSW steel, JSPL, Tata Steel, SAIL and RINL. Large domestic market and availability of rich iron ore for next 50 years indicate a bright future for India in the steelmaking. But we have several bottlenecks also. In long-term India has to adopt alternative routes of ironmaking that does not require coke, and in short term Indian has to increase its capacity with conventional BF-BOF routes and has to find other cheap sources for good quality coal from abroad.

India has already taken a world lead in producing DRI at 30mtpa. India should continue with its existing DR and SR units and with further green and brown field projects to produce more and more iron from non-coking coal, the reserve for which is plenty in India. Eventually iron production in India has to shift to DR/SR-EAF technology.

The number of professional working in the area of iron and steel research and education has diminished significantly to make space for advanced materials education and research. This has reduced production of quality professionals in Iron and steel and subsequently iron and steel research has reached the bottom line. To save from this perilous situation, more emphasis has to be put on iron and steel research in India and develop world-class infrastructure and bright, innovative professionals to come up with the very novel technologies for utilizing raw material resources of . Ministry of Steel has taken some action but more emphatic steps are possibly required to alleviate the hard situation.