Indian Blast Furnace Industry and Prospects of Indigenous Manufacturing of Its Equipment - Role of MECON

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Abstract

India is expected to become the world's second largest producer of crude steel in the next 15 years, moving up from the third position, as its capacity is projected to increase to about 300 Mt by 2030.

The Indian steel sector is contributing to nearly 2% of the GDP (Gross Domestic Product). For India to scale up to 300 MTPA steel production, the primary technology route will have to be through the integrated steel plants with Blast Furnaces (BF). Therefore Indian Steel Industry's technology and innovation model has to be aligned around optimizing the BF route of production namely in terms of energy, raw materials, process and operations. There are three routes to achieve this production target - Integrated Steel Plant with large Blast Furnace, Installation of Mini Blast Furnaces and Up-gradation of existing Blast Furnaces. Many of technological equipments and many of the bought out items are being imported presently which needs to be manufactured in India by taking advantage of Government of India's Make in India and Start Up India and Stand Up India initiatives. These Government of India's initiatives will also encourages tie-ups with international technology suppliers to manufacture their equipments in India.

MECON, being the frontline Engineering & Consultancy organization, is well placed to play pivotal role in linking the startups with the Industry and indigenization of equipments. MECON already has its footprint in majority of integrated steel plants and Blast Furnaces of the country.

Key words: *300 MT production target, Blast Furnace, installation of ISPs with large BF, Mini Blast Furnaces, up-gradation of existing BF, start up and stand up, Startups for MBFs & manufacturing of imported equipments, Make in India.*

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India is expected to become the world's second largest producer of crude steel in the next 15 years, moving up from the third position, as its capacity is projected to increase to about 300 MT by 2030. Huge scope for growth is offered by India's comparatively low per capita steel consumption and the expected rise in consumption due to increased infrastructure construction and the thriving automobile and railways sectors.

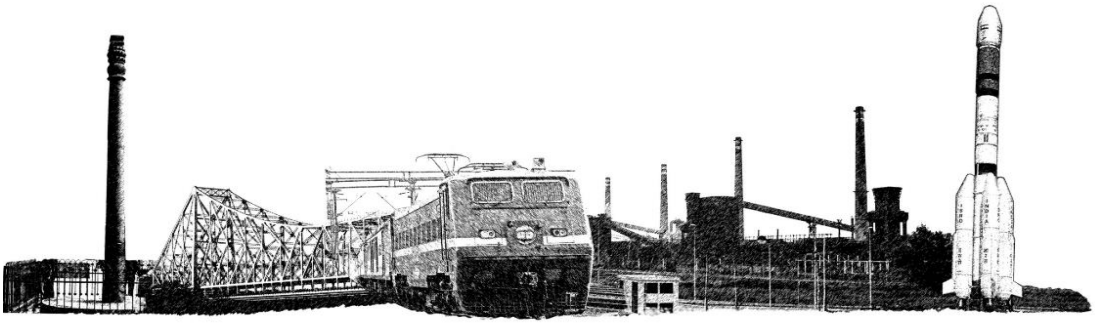


Fig -1 : pictorial representation of use of steel in various area

In 2015, crude steel production for FY 2015-16 was 89.315 MT registering a growth of around 7.9% over the previous year. Further, finished steel production registered a growth of 3.3% in FY15. Private sector production from Tata Steel, JSW Steel, JSPL, Bhushan and others grew at a CAGR of 7.22% between 2010-16. The steel sector contribute 2% to the GDP of the Nation and provides 6 lakhs jobs in the country.

In 2015, India stood as the largest sponge iron producer in the world, while the total crude steel capacity during 2016-17 by the private investors is expected to rise by 76.8 MT. SAIL is the leader in India's steel sector; in FY14, the company accounted for 12% of the country's finished steel production and 16.7 % in the country's crude steel production Tata Steel, another household name in the country, leads private sector activity in steel sector. During 2014, the firm accounted for 9% finished steel production and 11.2% in the Country's crude steel production.

Relevance of Technologies and Business strategies for Global Competitiveness to the Indian Steel Industry in Blast Furnace Iron Making Route :

For India to scale-up to 300 MTPA, the primary technology route will have to be through the integrated steel plants with Blast Furnaces (BF). Therefore Indian Steel Industry's technology and innovation model has to be aligned around optimizing the BF route of production namely in terms of energy, raw materials, process and operations.

Mega steel projects require rigorous planning, engineering and project management for success. Given the capital intensity of these projects at about a billion dollar/ million ton of steel, integrated engineering and project management play a key role in the financial and operational success of an integrated steel project.

Integrated Steel Plants with Blast Furnace installations having steel making process route are :

Company/ Works	Steel Making	Iron Making Facilities (Blast Furnaces)
SAIL, Bhilai	BOF/ THF	3 x 1033 m^3, 3x1719 m^3, 1 x 2355 m^3, 1 x 4060 m^3 (under implementation)
SAIL, Bokaro	BOF	4 x 2000 m^3, 1 x 2500 m^3
SAIL, Durgapur	BOF	2 x 1400 m^3 1 x 1800 m^3
SAIL, Rourkela	BOF	1x1710 m^3, 1 x 1658 m^3, 1 x 4060 m^3
SAIL, Burnpur	THF/ BOF	1 x 4161 m^3
Tata Steel, Jamshedpur	BOF	1 x 1070 m^3, 1x1011 m^3, 1 x 595 m^3, 1831 m^3,1x2650 m^3, 2 x 3814 m^3
Tata Steel, Kalinganagar	BOF	1 x 4300 m^3, 5850m^3 (Under implementation)
JSW, Toranagallu	BOF	1 x 2307 m^3 , 1 x 1681m^3, 2 x 4019 m^3
JSW, Dolvi	EAF	1 x 4330 in^3
RINL	BOF	2 x 3800 m^3, 1 x 3200 m^3
JSPL, Raigarh	EAF	1x686m^3, 1x 1681m^3
Bhushan, Meramandali	EAF/ EIF	1 x 1681 m^3, 1 x 3800 m^3
Bhushan Power & Steel LTD., Odisha	EAF	1 x 1000 m^3, 1 x 2015 m^3 (Under implementation)
Essar Steel, Hazira	EAF	1 x 2000 m^3
NINL	BOF	1x 1915 m^3

Growth Prospects of the Iron & Steel Industry in India

- *Expansion and installation of green field Steel plants*

India has finally emerged as a steel making location for global players. The global steel industry appears to be in a race to invest in high-growth zones, such as, India. The amount of activity in the

sector has picked up speed in the past few years. To enhance capacity by 488.66 million tonnes, 301 MOUs have been signed with states. 4 MOUs were signed at Dantewada, Chhattisgarh. Potential steel addition capacity would attract an investment of 83 to USD 166 billion USD. Most of the companies in the industry are undertaking modernisation and expansion of plants which are more cost effective.

SAIL has undertaken modernisation and expansion for its six plants for capacity augumentation through brown field route. SAIL has commissioned its RSP BF-5 of 4019m3 BF complex along with its downstream facilities in the year 2013 at Rourkela, Odisha. In the year 2014, SAIL has blown-in Kalyani, India's then biggest Blast Furnace on 30.11.2014 at ISP, Burnpur, West Bengal. At Bhilai, 4060m^3BF complex and its downstream facilities are in advanced stage of erection and expected to commission in the year 2016. The production capacity of SAIL is expected to increase from 13 MTPA to 50MTPA in 2025 with the total investment of USD24.88 Billion.

Domestic Private Steel producers has also lined-up their ambitious plans to set up new integrated steel plants in various parts of India. The existing capacities and their expansion targets are illustrated below :

PLANNED CAPACITY ADDITIONS BY 2016-17

Crude steel capacity addition plans up to 2015-16 (in mtpa) for private sector companies

Company	Existing capacity	Brownfield expansion	Greenfield expansion	Total capacity addition
Tata Steel Limited	9.7	0.4	10	20.1
Essar Steel Limited	10	1.46	0	11.46
JSW Steel Limited	14.3	3.8	0	18.1
Jindal Steel & Power Limited	4.5	1.6	7.5	13.6
Bhushan Steel Limited	5.6	0	3.9	9.5
Bhushan Power & Steel Ltd	2.5	0	0	2.5
Monnet Ispat & Energy Ltd	1.5	1.2	0	2.7
Electrosteel Steel	1.7	0	2.51	4.21
Visa Steel Ltd	0.5	1.0	0	1.5
POSCO India Project	0	0	4.0	4.0

Source: Ministry of Steel Annual Report, Joint Plant Committee
Note: MTPA - Million Tonnes Per Annum

- **Installation of Mini Blast Furnaces (MBFs)**

The Mini Blast Furnace (MBF) route of iron making is a proven technology and are ideally suited to small scale operations. A Mini Blast Furnace (MBF), which can be viewed as is a miniature version of conventional large blast furnace, also has a few additional characteristic features known for their simplicity and economy.

Smaller scales of operation allows the use of inferior grade of iron ore. Mini blast furnaces are becoming increasingly as an economic and reliable source of iron for foundries as well as for forward integration with steelmaking units in EAF / EOF (and sometimes even small BOF) based steel plants.

The limitation of mini blast furnaces is that coal injection is normally difficult and the higher specific heat requirement has to be met entirely by coke (normally purchased from external sources). In India, with the recent increasing demand of pig iron and steel, mini blast furnace technology has proliferated. MBF units are spread all over the country. If this trend continues,

which is more likely to happen, Mini Blast Furnace Technology would play an increasingly important role in the rapid and wide spread growth of iron and steel making capacity in this country.

- **Modernisation & Up-gradation of existing Blast Furnaces**

One of the key contributors to the envisaged growth in the volume of hot metal production by 2030 is through realization of the full potential of the present facilities and capacity enhancements of existing blast furnaces. Blast furnaces in India, which were mostly built in sixties & seventies, have undergone long campaign in different stages. Most of these furnaces are ageing, operating with old technology and require revamping and up-gradation thereby absorption of state of the art technology.

This technological up-gradation and capacity augmentation through capital repair route is reckoned as most effective, fast result yielding & economical and can be executed in short time schedule.

Installation of greenfield large blast furnaces call for huge capital investment, long gestation period and massive infrastructure facilities. In a nutshell, need of Modernisation & Up-gradation of existing Blast Furnace with capacity enhancement are as given below:

Scope for Business Start Up in the area of manufacture of equipments used in Iron Making

A typical 3 MTPA steel plant requires the following volume of work for installation :

Sl. No.	Activity	Unit	Est. Scope
1	Concreting (RCC+HRC)	cu.m	9,35,000
2	Building Structures	MT	2,00,738
3	Technological Structures	MT	62,362
4	Equipment (Mech, Elect.& Utility)	MT	1,74,693

And for a typical large Blast Furnace complex of about 4500m^3 shall have following volume of work :

Sl. No.	Activity	Unit	Est. Scope
1	Concreting (RCC+HRC)	cu.m	110,000
2	Building Structures	MT	30,000
3	Technological Structures	MT	13,000
4	Equipment Supply (Mech, Elect.& Utility)	MT	13,000
5	Refractory	MT	35,000

The state-of-art furnaces being built across India require a variety of equipments, many of which are available only through Import. The cost of imports is in the range of 25-30 % of the total project cost. With the governments' initiative, such equipments may be manufactured in India. A major list of items currently being imported which can be considered for manufacturing and for Start ups in Iron Making area in India, is listed below:

Sl. No	Item/System	Source of Import
1.	Top Charging Equipment (Bell Less Top Equipment)	Europe/ USA
2	Special Steels (Hot Blast Stove Shell)	Europe/ China
3.	Cast House Equipment (Clay Gun, Tap Hole Drilling Machine & Trough Cover Manipulator)	Europe/ China
4.	Pulverised Coal Injection System (PCI)	Europe/ China
5.	Checker Supporting System	China
6.	Technological Valves	Europe/ China
7.	BF Refractories	Europe/ Japan/ China/ Korea
8.	Waste Heat Recovery System	Europe/ China
9.	Copper Items (Tuyere & Tuyere Cooler)	Europe/ Japan/ Korea/ China/ Brazil
10.	Copper Items (Copper Staves/ Plate Coolers)	Europe/ China/ Brazil
11.	Top Recovery Turbine (TRT)	Europe/ Japan/ China
12.	Torpedo Ladle Car (TLC)	China
13	BF Top Monitoring System (Amanoscope, BF Top Camera, Profilometer, Burden Probes, Radar SLI, etc.)	Europe/ Japan/ China

Manufacturing Opportunities

The above table reflects the opportunities of investment in multiple areas. A category-wise

assessment is made below:

1. **Refractories:** A modern Blast Furnace complex requires a wide assortment of refractories having different configurations. However, presently most of them are being imported. Such refractories include : Graphite Refractory, Micropore Refractory, Carbon Refractory, Self flowing castable, SiC Ramming Mix, Graphite Ramming Mix, Ceramic Cup, Stove Dome Silica , Stove Insulation Bricks, Stove Burner Bricks, Stove Dense Bricks. Considering that the amount of refractory required in building a Blast Furnace Complex of size ~4000 m3, is of the tune of ~35,000 MT, it costs a huge amount of exchequer to import the refractories. With the help of strategic technical tie-ups , manufacturing for these refractories can be set up in India.

2. **Automation & Instrumentation Systems :** Modern Blast Furnaces employ a range of instrumentation system to monitor and operate the Furnace at the optimum level. The range and complicatedness of the instruments have steadily increased over time. Therefore, in addition to the above burden probes and Stock Line Indicators, other instrument systems deployed onto the furnace include : Short in-burden Probe (SIBP), Pressure Probes, Stockline Recorders, Fixed RADAR ProfileMeter , Infra Red Thermal Image Camera for BF Top & PCI Injection. The indigenous manufacturers in India are already manufacturing a variety of instruments for Blast Furnace Complex. However, with the adoption of large blast furnaces newer instrumentation systems have arrived. MECON can be a partner to the indigenous manufacturers in-house design and development of these systems. It is also pertinent that collaborations between engineering houses like MEON and manufacturers are important in the indigenous developments. It may be of no surprise to know that in China such tie-ups have paved the way for manufacturing of high –end technological goods.

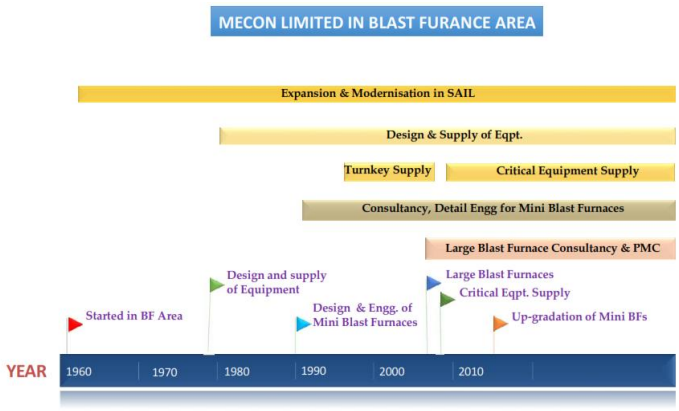
3. **Mechanical Items** : India is already home to leading industrial houses of international repute. However, it is about time that the manufactures adopt to newer technologies being implemented in modern large Blast Furnaces. To name a few mechanical items that are still imported are : Copper / stave Cooling Plates, Tuyeres & Tuyere Coolers, Checker Support system, Technological Valves, Stove Pilot Burners, Heavy duty hydraulic cylinders, CH Equipments- Clay Gun, Drilling Machines, Trough Cover Manipulators, Furnace Top Charging Systems. Although some of the items indicated above are already being manufactured in India, but upgradation in technical specifications is required. With support of Indian Steel Industry in adoption of indigenous mechanical items, we can achieve complete self-sufficiency in these items. Also, the foreign suppliers of the above items can be taken on board in forming manufacturing alliances that will also help in the transfer of technology. MECON with it's own in-house knowledge and data regarding the technological parameters of these items is ready to play its part in the alliance between industry and manufacturers to achieve the Make In India aim.

4. **Technology :** Blast Furnace complex comprises a number of inter-dependent technologies that help in improving the productivity & efficiency of the Furnaces. These technologies include : Pulverised Coal Injection Systems(PCI), Gas Cleaning Sysems GCP), Slag Granulation Systems and Top Recovery Turbine. Since these are complete turnkey systems, deep technological understanding and research is required to indigenize these systems. However, MECON with its own in-house research & development is ready with its own design for PCI systems and for integrated large Blast Furnace Complex. In the year 2015, MECON has successfully designed modification in PCI system at BF-2 of JSPL, Raigarh which is running smoothly. With support

from the industry and manufacturers, we are confident that we shall achieve self-sufficiency in all areas in modern large Blast Furnaces.

Role of MECON in the Indian Steel Industry

MECON has contributed significantly in Indian Steel Industry in their expansion, refurbishment and modernization. MECON engineered several integrated steel plants and mini blast furnace complexes are working successfully in various steel plants of public sector enterprises viz, SAIL, RINL, NINL and in private sectors viz. Essar, Jindal, Bhushan, Tata Metaliks, Usha Martin, Sunflag, Adhunik, SLR etc. Internationally, MECON has made its presence felt by providing quality design, engineering & consultancy services for about 130 projects in different countries.



MECON's Footprint on almost all Blast Furnaces of India and commissioned 19 BFs of its own in the last 15 years

MECON is the only Indian Technology Supplier with a comprehensive range of Blast Furnace design. MECON has also executed on Turnkey basis the reconstruction of Blast Furnace No.7 at SAIL-BSP and Blast Furnace no. 3 at Durgapur Steel Plant in record time. Moreover, MECON has made significant contribution to the mini-blast furnace sector with its design of indigenous mini-blast furnaces and the only Indian organization which has successfully developed its own indigenous in - house design of BF proper, hot blast stoves, fully flat & covered cast house & auxiliaries. MECON is presently developing indigenous engineering and design for large Blast Furnace. This shall help to establish MECON firmly in the family of large BF designers with indigenous technology base & offer very competitive pricing

MECON has shared its expertise in consultancy and engineering services with a host of private companies manufacturing vital iron and steel products. A shining example is the Jindal South West Limited's (erstwhile JVSL) Steel Plant set-up up at Torangallu in Bellary district of Karnataka. This Steel Plant is the first steel plant in India based on the COREX technology, ushering in a new era in the country's steel industry. MECON has designed and engineered a 1250 m3 Blast Furnace at JSW, Torangallu, which has been operating successfully at a productivity of >2.0t/m3/day for the last 10 years. MECON is providing consultancy and PMC services for India's largest Blast Furnace of 4506 m3 being constructed at NMDC-NISP, Nagarnar. Additionally MECON is significantly contributing in reconstruction and up-gradation of existing Blast Furnaces for which MECON has rendered engineering and consultancy services for mini blast furnaces for Usha Martin, Tatametaliks, JSPL, KIC Metaliks. Presently, MECON is involved in up-gradation of blast furnaces in JSW, Toranagallu, JSW-Dolvi, Sesa Goa.

Å Complete know - how & technology provider, concept to commissioning services & developed

engineering base

- Executed projects in the size range of 150 m^3 - 4,500 m^3
- Trusted engineering & EPC partner and supplier of critical MECON designed equipment
- Executed BE capital repair, revamping & upgradation projects (alongwith increase in BF volume) on EPC basis
- Exposure to contemporary benchmarked designs
- Experience of working with global technology suppliers

Conclusion

For India to scale to 300 MTPA, the primary technology route will have to be through the integrated steel plants with Blast Furnaces (BF). Therefore Indian Steel Industry's technology and innovation model has to be aligned around optimizing the BF route of production namely in terms of energy, raw materials, process and operations. There are three routes to achieve this production target - Integrated Steel Plant with large Blast Furnace, Installation of Mini Blast Furnaces and Up-gradation of existing Blast Furnaces. There is an ample scope for increasing indigenous manufacturing of various equipments w.r.t. Blast furnace complex, which are now being imported. Consolidated efforts by the Consultants, manufacturers and the Government shall definitely increase the manufacturing of all the equipments in India which is in-line with the Make in India initiative. MECON is well poised to support all the routes for capacity building in Iron Making including rendering Project Management Services and designing of various equipments.

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Disclaimer

The views expressed in this paper are those of the authors only and do not necessarily reflect the views of the company.

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