

# Mineral Processing

## The Way Forward for Sustainability in Metal Sector

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The National Steel Policy 2005 estimated domestic steel production of 110 million tonnes per annum (MTPA) by the year 2019–2020, which was revised by the National Steel Policy 2008, envisaging domestic steel production of the country to be 180 MTPA by 2019–2020. About 2.5 tonnes of iron ore or 1.7–2.0 tonnes of processed iron ore are required for one tonne of steel production. To meet the projected steel production of 180 MTPA by 2019–2020, the iron ore requirement have to be in the order of 500 MTPA which includes long term projected export contracts of around 100 MT. Raw materials are crucial in determining the competitive growth of steel industry as this is an input-intensive extractive industry. Situation calls for proportionate development expansion in adequate raw material supply to meet the demand of Indian steel industry. India is almost completely self sufficient with regard to iron ore but with future steel production envisaged, an adverse impact on the reserves, position is rather imminent. The existing reserves of hematite (averaging around 63 % Fe) are the only source of iron ore and as such, these reserves may not last beyond 25–30 years at the present rate of consumption. Hence, to meet the future and projected requirement, additional domestic resources have to be created. The ores and minerals are site specific, non-renewable and finite. It is a challenging task for iron ore producers to meet the demand as per the national steel policy. In order to meet the demand, the iron ore producers has to face challenges like increasing the resource base, increasing production and productivity, utilisation of low grade iron ores, beneficiation of low grade fines and slimes, overcoming the infrastructure bottlenecks like roads, railways, ports, power, capital and water, human resource, handling, storage and utilisation of slimes/tails, encouragement for R&D activities, adopting environmental friendly measures and land acquisition for setting up new plants. In this paper all the above aspects are discussed thoroughly.

### Iron Ore Reserves

India is endowed with large and rich resources of iron ores. Major iron ore deposits in India are distributed in several geographical locales which could be designated as “zones” on the ground of their geographical settings and based on their proximity to the existing steel plants and ports. World resources of iron ore are placed at 370 billion tonnes against which Indian estimates are at 22 billion tonnes constituting 5.98% of the world total.

As per the recently adopted United Nation's Framework Classification (UNFC) of Mineral Resources, the total 7 iron ore resources in the country are placed as 22,108 million tonnes, of which resources of hematite are 11,425.8 million tonnes and magnetite 10,682 million tonnes.

Out of the total resources, reserves of hematite are 6025 million tonnes and magnetite 286 million tonnes, thus total iron ore reserves being 6311 million tonnes. Iron ore in the country occurs in different grades in form of lumps and fines. As regards hematite's high, medium, low and other grades account for 921 million tonnes, 2200 million tonnes and 1279 million tonnes respectively. Resources of low and other grades are required to be beneficiated for the qualitative enhancement of the reserve base.

Further, all the iron ore deposits under leasehold category are mostly partially explored. If need arises, production capacities at the existing

deposits can be enhanced to meet domestic / captive demand and also to increase exports to new markets.

### Mineral Processing

There are strong reasons to expect from international experiences that increased investment in the mineral sector, especially in exploration, will lead to new reserves and resources. Further, the country will still have a lot of hematite iron ore below 55 per cent iron (Fe), not accounted for currently. These resources may be relatively costly but need not to be written off and ignored. At current prices of iron ore, these assets offer highly attractive conditions for extraction and merchant business involving them. At higher scarcity value, they will gain further

importance in future. At present, fines are being exported because there is no domestic demand for the same. This structural imbalance currently experienced in the Indian iron ore market will perhaps go away if the steel industry plans are to be considered. But plans indicate that India may have a problem exactly of the opposite kind with lumps turning surplus with shortages of fines. Of course, this situation will emerge only if the steel projects shape up as per plans.

At present, the progress in almost all the major greenfield projects has been insignificant. The estimates made in the study even under the most optimistic scenarios do not corroborate the rationality of the threat perception regarding iron ore availability. Exports will also be necessary to maintain a structural balance in the market between production and consumption of lumps and fines. Also, considering the specific problems of Goa / Redi region, exports from there will have to be continued. The bilateral agreements with countries like Japan and Korea would necessitate that such exports at the existing levels may be continued. Exports, thus, cannot be wished away. Exports of iron ore have been undertaken largely by merchant miners in the private sector. Any stoppage to exports could lead to closure of significant mining capacity as the volumes cannot be diverted to domestic use easily.

Closure of mines will involve naturally expected consequences involving loss of economic activities including jobs. A lot of investments made by the mining industry will also get into a jam. Further, at reduced domestic prices, the mining industry will not be able to mobilize enough resources for investment into this sector. This will leave not only the mining capacity constrained but also outdated with modernization backlogs kept unattended. The move to export restrictions and encouragement to captive mining will also lead to several competition issues in the market. The small and medium size steel makers will have to pay higher prices for iron ore compared to those who will reap the full benefits of low costs and supply security associated with captive mines. It needs to be recognized that captive mining rights are not available at market prices and freely. Also, any benefits for integrating mining and steel making businesses are valid only

when the iron ore prices are high in the market.

Globally, despite the huge interests of the steel industry to acquire iron ore or coal mines, the mining industry is getting more and more specialized with the high degree of technological advances. They have also been effective in lowering costs of mining with their investments in modernizing mining operations and developing infrastructure. This has provided significant economic efficiency to the system. If opportunities are restricted for the Indian mining companies, they will be deprived of the economies of scale and will remain inefficient forever in global comparison.

While iron ore mining companies in many countries took the opportunity to raise production quickly to meet the rising Chinese demand, India, a traditional exporter of iron ore, was better placed to grab the opportunities in the spot market due to freight advantage over



Brazil and 15 the underutilized capacities already in place in the mines. As a result, India turned a significant exporter of iron ore fines in the world market with almost the entire quantity going to China. In India, SAIL, Tata Steel, JSPL and JSW (through JV with Mysore Minerals), among the major producers have captive access to iron ore. In the case of JSW Steel their captive supplies account for only about 20-30 per cent of the total requirement whereas it is total in the case of others. There are several small and medium size iron and steel companies at the moment who have captive iron ore. Many more such units are coming up with captive resources. These units are completely or partially insulated from the dynamics of the iron ore market and have no reason to justify their pricing decisions blaming it on the cost increases on account of iron ore.

## Availability of Ore

To achieve the iron ore demand of the future, strategy should be changed for making available adequate iron ore resources by way of systematic exploration. The real necessity is for vigorous exploration and exploitation matching domestic requirements, export commitments, if any, value additions as well as infrastructure developments. India must have clear strategy for next 20-25 years for augmenting the resources with proper orientation of exploration in geologically potential domains keeping in view the exploitation of the existing established resources. In the Indian scenario, it has been observed in many places that along with mining, iron ore deposits are being discovered and explored which ultimately has augmented ore resources.

In 1980, the country had 17564 million tonnes of iron ore resources. The production of iron ore from 1980 to 1990 was 470 million tonnes but as on 1990 the resource stood at 22787 million tonnes and between 1990 and 2000, production was 656 million tonnes and in 2000 resources stood at 23588 million tonnes thus showing an increase in the iron ore resource. The resource increased even when the Geological Survey of India (GSI) was not carrying out any iron ore investigation during this period and the increase was 26 mainly due to the exploration activity carried out by public sector and other private sector agencies. From 2000-2005, production stood at 532 million tonnes and in 2005 the resources were 25250 million tonnes thus indicating constant increase in iron ore resources if exploration also goes along with exploitation. It is also worth mentioning that even after extensive mining the resource of hematite iron ore has increased by 3204 million tonnes in five years between 2000 and 2005. Even during this period reserves have also increased from 6025 million tonnes to 7004 million tonnes.

The exploration was conducted mainly in the leasehold areas by the mining Companies. Out of 14630 million tonnes of total resources of hematite iron ore resources are 7004 million tonnes which mean there is scope to convert 7626 million tonnes of remaining resources to reserve through detailed exploration and feasibility studies. Of the total resources of 10619 million tonnes of magnetite ore reserves



constitute only 206 million tonnes warranting immediate exploration to convert resources to reserve. The life indices of the high grade lumpy ore (hematite) as on 1.4.2010 will be 10 years and requires immediate attention. Besides controlled utilization of this high grade lumpy ores emphasis should be given for detailed exploration involving close spaced drilling for enhancing current resource position of 27 high grade lumpy ore in the potentially virgin areas and to probe depth continuity of ores in the freehold as well as leasehold areas. The effort should also be made through R & D for improving the manufacturing processes of sponge iron and also for using more and more medium grade lumpy ore. In addition, iron ore occurring in different geological formation, if assessed, will augment the iron ore resources of the country. Hence there is scope for assessment in new areas and reassessment in the areas where mining is under operation or under active consideration. The future exploration activities have to be carried out to augment resources over the known deposits which were not explored earlier in totality and in greenfield areas of geologically potential domains.

### Vision 2025

Wide reserves of iron ore is found in India which is the basic raw material for iron and steel industry. Draft National Steel Policy 2012 of India envisages the ambitious goal of the nation to reach a production capacity of 300 Mt/yr of crude quality steel by 2025 - 26. So the corresponding demand of iron ore containing 62 - 64 % Fe would be around 490 Mt (excluding our export requirement). To cope up with increasing global and domestic market demand and to achieve the goals of National Steel Policy, our steel industry is in need of large quantity of iron ore. Due to the high

quality of iron ore available in India, large deposits of Banded Haematite Jasper (BHJ) are left unused because of the presence of silica in unwanted quantity. ROM is put through washing to remove the clayey matter due to the presence of alumina and silica in iron ore leading to slime generation which is disposed off in tailing ponds. Slime in these tailing ponds contains iron values in the range of 45 - 60 %. Appropriate beneficiation process has to be explored to reduce the waste generation in mines and for the sustainable growth of the iron ore industry. In addition to this, depletion of high grade iron ore, stringent environmental regulations involved in opening of new mines, problems involved in handling, disposal of tailings (slimes), and utilizing of iron ore at 45% Fe as a cut-off fixed by Indian Bureau of Mines, it is the need of hour to effectively beneficiate low grade iron ore.

Apart from the reserves of low grade iron ore, the previous washing methodology adopted in mining industries which had discarded the slimes as well as fines containing Fe value between 45%-55% have added 10-15 Mt every year and have been dumped somewhere as a big heap or in tailing pond. It is required to utilize these lost minerals in main stream by making sinter/ pellet using advance techniques of beneficiation involving gravity, magnetic and floatation process, etc. This paper briefly outlines the necessity and the relevance of beneficiation processes in low grade iron ores to make them suitable for Pelletization in a techno economical and environmental friendly manner. Introduction India is bestowed with large and rich sources of iron ore in terms of quantity and quality with respect to world scenario. India occupies sixth position in iron ore resource base and ranks fourth with respect to world iron ore production.

The existing reserves of hematite (averaging around 63 % Fe) are the only source of iron ore and as such, these reserves may not last beyond 25-30 years at the present rate of consumption. Hence to meet the future and projected requirement, additional domestic resources like slimes and fines dumped elsewhere in mines have to be utilised, which are in abundance. The ores and minerals are site specific, non-renewable and finite. It is a challenging task for iron ore producers to meet the demand as envisaged in the draft national steel policy. In order to meet the demand, the iron ore producers has to face challenges like increasing the resource base, increasing production and productivity, utilisation of low grade iron ores, beneficiation of low grade fines and slimes, overcoming the infrastructure bottlenecks like roads, railways, ports, power, capital and water, human resource, handling, storage and utilisation of slimes/tails, encouragement for R&D activities, adopting environmental friendly measures and land acquisition for setting up new plants. In this paper, broadly all the above aspects have been discussed. Most of the washing plants located in mines generate lumps as well as fines. During this process, a large quantity of slimes is generated containing around 48%-60% Fe content which is discarded as tailings. According to the latest guidelines issued by IBM, the cut off grade for tailings is 45%.

### Way Forward

With the export duty on low grade ore stands at 15 per cent and high grade ore at 30 per cent, exports of iron ore have become unviable. Since the government aims to preserve natural resources, processing of low grade ore is the only option left which requires to be promoted by the government with proper policy support.