Challenges and Opportunities for Mining and Metals Industry

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Background

It is a well-established observation that 'the performance of base metals is an excellent way to gauge the economic activity around the world'. This is because base metals, such as iron & steel, copper, aluminium, zinc, lead, and tin, which are found in plentiful supply, are consumed as inputs, in many life-style-linked products and activities, such as material manufacturing, construction, power supply, as well as in many basic needs of civil life such as transportation, entertainment and FMCG. Mining and metals industry is at the front end of supply of building blocks for other sectors such as chemical, engineering, agriculture, automobiles, infrastructure, electronics, and others thus plays an important role in any economy.

The Challenge

While the importance of mining and metals industry is accepted, the industry faces many challenges. The important ones are:

Resource- Availability and Quality:

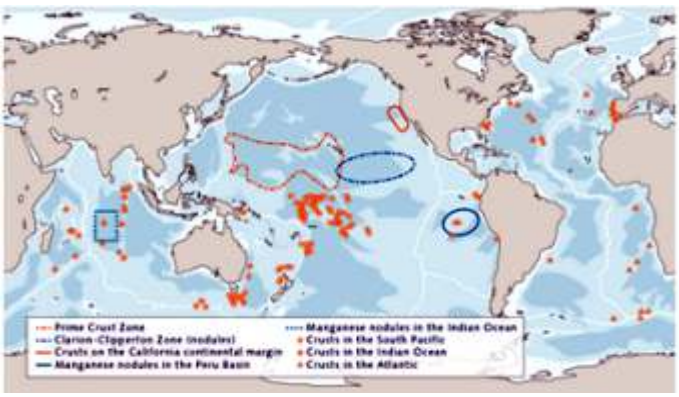
Mining and metals industry depends primarily on naturally available resources, which are widely distributed geographically. While the availability is abundant, the cost and means of transport, proximity to the processing & conversion plants, and issues related to overburden and tailings management, community disturbances, and water, depending upon the type of mineral handled has been increasingly becoming cause of concern and cost. Moves such as resource nationalism have been causing pressures for maximum value addition at the mine site. It is not therefore surprising that the state and the countries blessed with the best of mineral resources are also condemned with activism that makes economic utilization of such resources difficult.

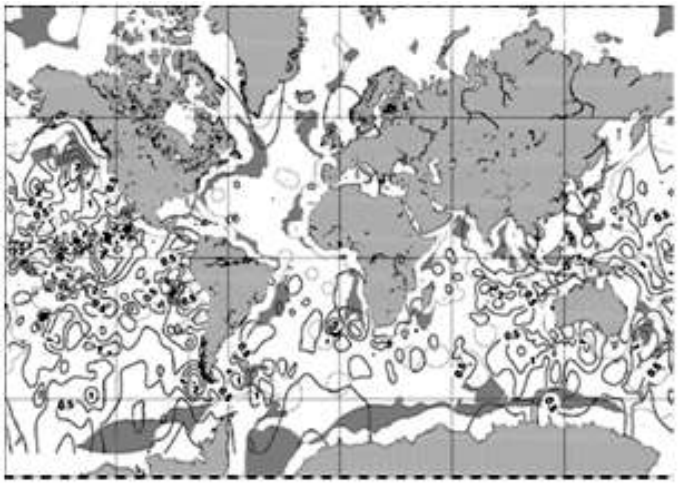
MINERAL RESOURCE MAP OF THE WORLD AND OF INDIA

Since demand for materials is increasing and the quantity available is ultimately limited, this has led to thinking out of box to identify and tap hitherto unknown resources of materials. Identification of metallic deposits under the ocean beds has been a new activity spurred by the developments in geo-informatics. The established mining technologies available for surface mining or underground mining are of little relevance to the mining of vast potential of metallic resources under the seabed, and the industry will need to tap technologies used for off-shore crude oil exploration to access these resources.

The environmental and manpower issues in accessing the sub-seabed mineral resources could

DISTRIBUTION OF POTENTIAL MINERAL RESOURCES UNDER THE OCEAN BED AND THE CASE OF NICKEL IN PARTICULAR





be totally different from those handled so far, and this is likely to give birth to the new science and technology of sub-sea mining.

Depleting quality of mineral resources is the next important concern of the industry. The general trends in quality of ores for many metals for selected countries clearly shows a steep decline in the ore grade post 1990s. This poses four important problems:

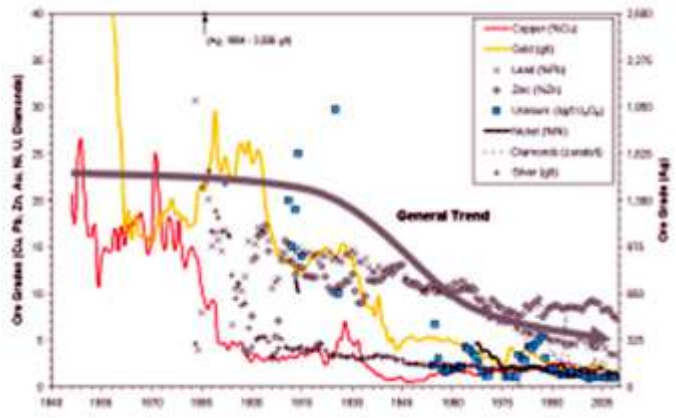
(i) The cost of processing for metal recovery goes up,

(ii) The amount of material to be processed, to produce the same quantity of metal shows a steep increase over the years. Since the mineral and material processing plants contain a significant portion of material handling, which has a capacity often based on a richer grade of the ore, the material handling capacity becomes the limiting factor in realizing the full capacity of the plant and hence the overall production capacity comes down. This also loads the product with a higher percentage of fixed cost.

(iii) Solid waste generated in the mineral processing plant, post mining, post chemical or metallurgical processing goes up with lowering of ore grade. This increases the disposal load and impacts the environmental footprint of the plant.

(iv) Lowering of ore grade also means a higher proportion of impurities. This is the possible level of impurity elements in the finished product is likely to increase, this affecting the application requirement.

Mineral and metal industry globally is faced with the challenge of adopting and adapting technology as tool with which the challenge of depleting ore grade can be managed.



Energy

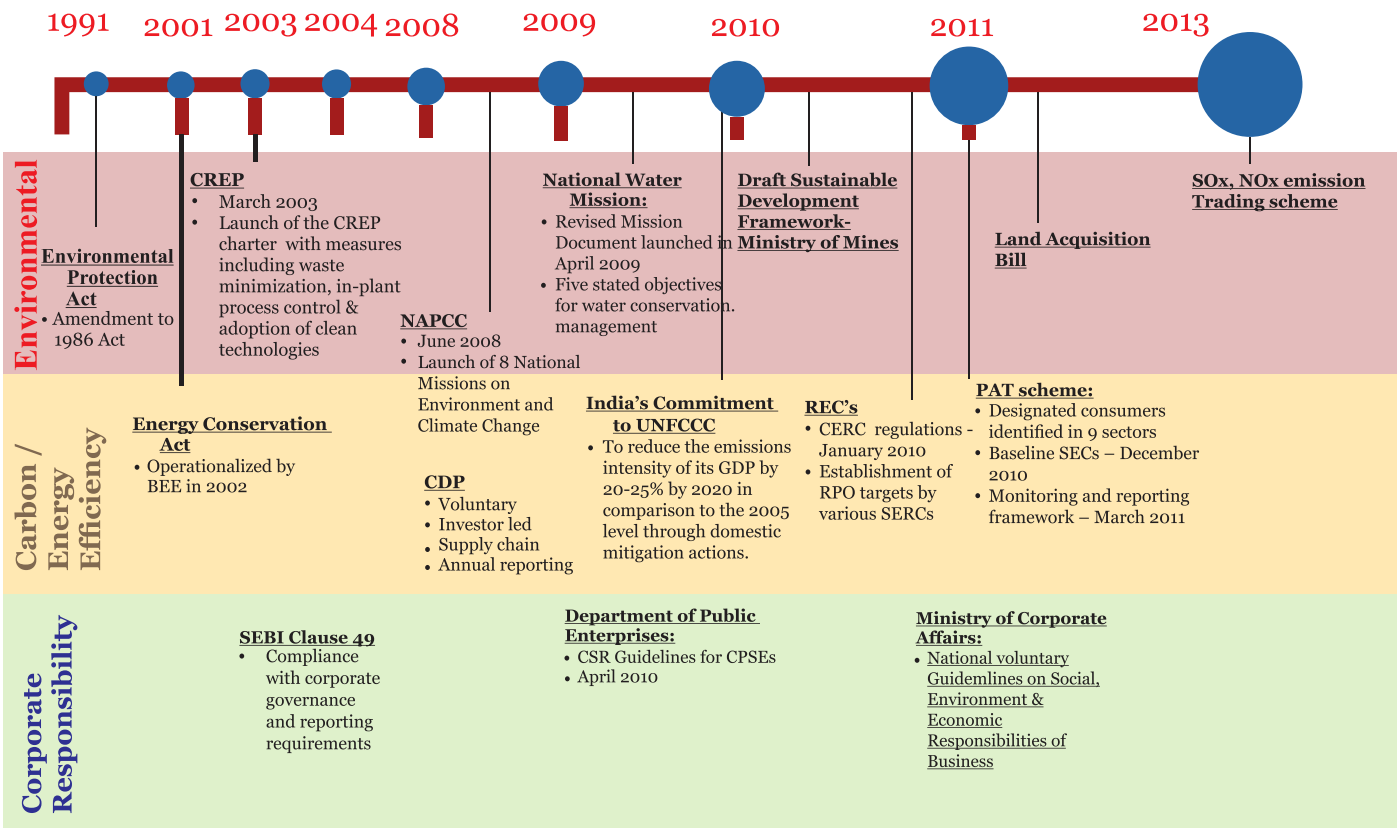
Metal industry is known to be energy intensive due to multiple factors, such as (a) the need to process a large volume of material for recovery of the end product metal, (b) pyro-metallurgical processes used for metal recovery, (c) chemistry of metal recovery that often involves a reduction step and (d) purification or refining step, that is characteristic of metals, and (e) Frequent use of coal or carbon in the processing. In recent years, with rising cost of energy, the mineral and metal industry has been faced with the problem of mandatory reduction in energy consumption both for the reasons of economics and statutes.

In India, the Pat (Perform-Achieve-Trade) initiative from Ministry of Power, lead by the Bureau of Energy Efficiency (BEE) had identified the top ten energy guzzle sectors in India, which are closely linked to the mineral and metal processing industry. These include, among other, steel, aluminium, cement, power and chlor-alkali, which utilize multiple minerals as input. BEE had mandated step reduction in specific power consumption for the top players in these industry sectors, as a part of PAT Cycle-1 that ended in March 2015. Being the first cycle, most industry participants are reportedly successful in meeting their targets, through energy improvement projects, through the monetization of the reduction is still awaited. It is anticipated that the targets for further reduction in specific energy consumption for the send Pat cycle will be more stringent, with less number of opportunities available for incremental improvement, or the low hanging fruits. Since it is well known that the mineral and metal processing industry is generally mature in terms of technology, and intensive in terms of capital cost, meeting the prospective targets will call for both engaging disruptive technology and investment in capital cost, over the coming years.

Environmental Regulations

Minerals and metals processing industry is one of the most affected sectors with the tightening environmental regulations in India. The chart below shows progress in Indian environmental regulations, covering all three aspects, viz. environmental (emissions, effluents, solid waste, water), carbon & energy (energy reporting, Pat, Renewable Power, Carbon) and corporate social responsibility.

Further advents in mandatory spending of 2% of three year average profits on CSR, in specified areas of work, water supply control priority list, online emission and effluent monitoring and on-line reporting to CPCB and state pollution control boards, potential carbon tax on resources in line with what some countries have already applied, add further stringent requirements on the already burdened industry. The



mineral resources are clustered due to the very nature of geology, and the processing industry often crowds around the sources to minimize the impact of transportation cost. The recent developments in cluster pollution studies and potential ban on any further expansion in the critically polluted areas, has posed serious concerns on long term growth and viability of the industry. It is fully agreed that all the above regulations are in line with good manufacturing practices and will improve the health of the industry over the coming years.

Clustering of Mineral & Metal Processing Industry in India and Issue of Sponge Iron Industry

Sponge Iron industry in India has grown multifold in last 25 years, building on availability of iron ore and low cost technology. However, clustering of the industry in concentrated geographies, poor concern for emission and tightening regulations have led to the death trap for this sunrise industry.

Technology

Minerals and metals industry being recognized as one of the oldest in the manufacturing sectors (compare crude oil and petroleum industry- started in the first quarter of 20th century, electronics industry- started in mid 1950s, plastics and polymers –started in 1930s, IT started as late as 19702, and escalated in mid 90s), is also disadvantaged with the fact that most of the technologies used for making metals and minerals as practiced today, are mature. For example, Aluminium technology's workhorse, viz the Bayer process for alumina and Hall-Heroult process for aluminium, invented in 1888 and 1886 respectively are already over a century and a quarter old, with no worthwhile challenging chemistry in site; the classical Portland cement process- the workhorse of construction industry, was invented in mid 1850s and is still running strong. While many incremental improvements in pig iron and steel making have happened in the last century, the basic blast furnace process is centuries old. The number of patents published in the area of process metallurgy is far outnumbered by the patents in organic chemicals, electronics and applications with little fundamental changes.

On the other hand it is well known that the two important tools of process science, viz instrumental analysis and modeling & simulation came into existence, much after the mineral and metal processing matured. The X-ray for mineralogical analysis, zeta potential meter, SEM and many other instruments are the products of mid -1970s. The modeling tools such as process simulators, computational fluid dynamics program, finite element modeling tools and molecular & materials modeling programs grew parallel with the advent of computer hardware and software. Application of these tools to the established mineral and metal processing routes offer tremendous opportunities for disruptive improvement and while steps have been taken by many, a vast portion of the work still needs to be done.

Markets and Application Developments

It is well known that as GDP increases and countries move up the development chain, the per capital material consumption increases. Metals and minerals, being feeders to the other manufacturing businesses and to the consumer product industries, go up in terms of per capita consumption. In this context, there are enormous opportunities and a few threats which need to be taken cognizance of.

Products - While majority of products will get copies or duplicated from the developed world, there is a need to condition these products for the specific needs of the country, characterized by its geography, its population base, living habits and culture. Since the infrastructure per capita (such as land area, road length, number of railway stations, livable space, water & power generation and distribution per capita, etc.) in developing countries vis-à-vis developed world shows a big gap, the material consumption gaps is difficult to fill, just by duplicating the products and uses of the materials. However making products, and hence materials and processes, to suit the needs of the developing world are essential. This offers both the need and opportunities for evolving new products and applications for the known materials. For example, in the area of power distribution, more cable length (and hence more Al or copper consumption) will not solve India's power distribution problems; since there is little space and money for HT cable tower; however, developing materials with step higher electrical conductivity will offer a way of using existing towers for higher distribution. Alternatively, distributed power generation offers another direction. Metals and materials industry needs to look at these perspectives.

Recycle of metals and materials is a huge opportunity; being addressed presently by the developed world. Reputed producers of materials for beverage cans, for example, have targets to meet 80% of their material needs through recycle, by the end of the decade. India or other developing countries will find it difficult to aim their recycle targets as high, because the material distribution in developing world is different, with more going to infrastructure (such as power generation and distribution), road and building construction, investment in consumer durables, etc, with a smaller percentage getting consumed in disposable, low life cycle products such as packaging. Such products consume metals & materials, but have longer life cycle, in the range of 10 to 25 years; hence what we can recycle today, depends upon what our consumption was 10 to 25 years back! Recycle business in India, though important to the developing world, has a different perspective, compared to the developed world.

Summary

Metals and minerals is an important infrastructure industry for all economics. India and many developing countries have been blessed with rich resources, high volume potential market and industry entrepreneurs, with ability to unlock the value from this god sent resource. A systematic look at this opportunity coupled with framework to operate within the value system offers a huge opportunity for this business, which can help ride the difficult years and set foundations for long term growth and prosperity.

Reference & Bibliography

(1) Pollution Prevention and Abatement Manual-World bank: 'Base Metals & Iron Ore', on www.ifc.org/wps/wcm/connect

(2) http://www.cdc.gov/niosh/mining/works/coversheet861.html, "Mining Product- Best Practices for Dust Control in Coal Mining", The National Institute of occupational Safety & Health.

(3) "Water requirement of iron & steel industry" on pubs.usgs.gov/wsp/1330h/report.pdf

(4) "Is 30$ per T of iron ore still a 'Fantasy Land'?, http:// marketrealist.com/2015/ 12/tipping-point-miners-near/

(5) "Fact sheet if Energy use in steel industry", on https://www.worldsteel.org/publications/fact-sheets / content / 02 / text_files / file0 / document/fact_energy_2014.pdf

(6) "Sponge Iron Industry- The Regulatory Challenge" CSE Report-2011, http://cseindia.org/userfiles/sponge_iron_layout.pdf

(7) "Lawyer kicking Posco, Vedanta, and many…", http://www.kractivist.org/tag/supreme-court/page/4/

(8) "CSE Media Briefing on Mining in India', http://www.cseindia.org/userfiles/Mining_in_India.pdf

(9) Long term perspectives for Indian Steel Industry, Dr A S Firoz, http://steel.gov.in/Long%20Term%20Perspectives.pdf, 2014

(10) Global steel industry outlook, http://miningontop/global-steel-industry-and-in-particular-china-future-outlook

(11) Using base metal as economic indicator, http://www.investopedia.com/articles/economics/11/base-metals-economic-indicator.asp

(12) Science-based targets, http://www.wri.org/our-work/project/science-based-targets-initiative

(13) https://www.accenture.com/us-en/~/media/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Industries_9/Accenture-Downstream-Value-Chain-Opportunities-Infographic.pdf

(14) http://users.monash.edu.au/~gmudd/sustymining.html