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In The Issue

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VIEW OF AUDITORIUM OF DELHI CHAPTER

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INDIAN LEAD BATTERY INDUSTRY – RECYCLING CHALLENGES

Shri L Pugazhenthy
Executive Director, India Lead Zinc Development Association &
Past President, The Indian Institute of Metals

Led by economies, lead recyclers in India currently process about 0.8 million tonnes of scrap lead-acid batteries per annum. Here L Pugazhenthy, from India Lead Zinc Development Association (ILZDA), explains how regulation and monitoring is clamping down on the country's informal recycling industry.

Over the years, lead batteries have become an integral part of our lives in India such that the numbers today are just mind-boggling. As a result, used lead battery recycling has become so huge, which is good considering the need for sustainable development. At the same time recycling of used lead battery also faces numerous challenges.

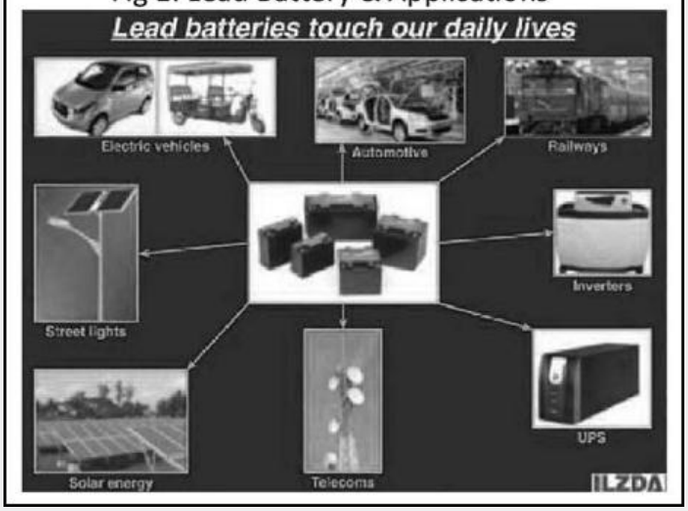
Evolution

In the 1960's and 70's lead batteries were used in the forklifts on shop floors and warehouses as well as in miner's cap lamps. During the above period, a very small number of cars, two wheelers, trucks and buses were also manufactured in India. The eighties saw the entry of Suzuki of Japan joining hands with an Indian outfit, Maruti, to roll out a very small compact car. A large number of Indians showed keen interest in these cars, with the result there was a long waiting time of several years before delivery. This enterprise, Maruti Suzuki subsequently brought about a churning and a revolution in India's automobile story.

Battery and applications

Today India has all the well-known global players in the automobile segments such as passenger cars, commercial vehicles, two and three wheelers, SUVs, buses, trucks, tractors etc. A few years ago, India displaced Germany as the fourth largest automobile producing country in the world and is poised to become No. 3 in the coming years. Severe power cuts during the summer months across the country resulted in the rapid growth of lead battery powered inverters as energy backups. This has been followed by the arrival of the computer era which again led to the massive penetration of lead battery powered UPS. Mobile phones brought along the necessity of telecom towers, at the base of which you have a bank of lead batteries in air-conditioned cabins. Lead batteries are also used in railway coaches, defence communication, submarines etc.

Fig 1: Lead Battery & Applications



After the 2015 United Nations Climate Change Conference in Paris, France, India is investing heavily in the renewable energy space, both solar as well as used for energy storage purposes. In order to meet the fresh challenges due to climate change as well as to bring down the imports of crude oil, India has recently launched the National Electric Mobility Mission, by which electrification of vehicles will be accelerated; the lead battery powered e-rickshaws and electric two in the coming years. As a result of all the above developments, lead-acid batteries practically touch our daily lives in several ways (Fig 1).

Lead consumption

Approximately 85% of the lead consumed in India goes for manufacturing lead-acid batteries. The current lead battery market size

s estimated at $7 billion. At present India's consumption of lead, as per industry estimates, is put at 1.2 million tonnes of which about 225,000 comes from primary lead produced by Hindustan Zinc. About 800,000 tonnes of lead comes from the secondary lead industry, both formal (70%) as well as informal (30%). The balance accounts for imports by India.

Crude Smelting

From the sixties, India was recycling used lead batteries- though very small quantities, in a crude manner – with low recoveries and more emissions, due to lack of appropriate technologies awareness. Because of the serious environmental and health risks, the Supreme Court of India banned imports of used lead batteries and other hazardous wastes in 1996. As a result, the lead battery sectors as well as the lead industry were in doldrums affecting transport, power, telecom, defence, railways etc.

Legislation and Green Recycling

In order to help the ailing lead industry, ILZDA organised an 'International Conference on Lead and Zinc Recycling – Technology and Environment' in Delhi on 17-18 Dec 1998. The conference deliberations decided to create an appropriate framework for ensuring a 'close loop' arrangement for an effective collection and environment-friendly recycling of used lead batteries. As a result the Ministry of Environment and Forests (MoEF), government of India setup a 'core group' of various stakeholders, including actions and strategies in India's interest. This ultimately resulted in the following steps:

1. Regulating lead battery auctions
2. Launching Battery (management and handling) Rules 2001
3. Registration of eco-friendly lead recyclers
4. Strict implementation of the norms and rules
5. Monitoring/fine tuning for improvement

In the earlier years, the auctions by bulk consumers were attended by middlemen. Scrap merchants etc. and they were picking up the used lead batteries and feeding informal or backyard recyclers. Therefore, the new regulation stipulated that only registered / authorised lead recyclers could participate in such auctions (dissuading the middlemen, traders etc.) so that the led recyclables went to the eco-friendly recycling units only.

Extended Producer Responsibility

After a series of 'CORE GOURP' meetings for two years, the MoEF brought out 'Battery (Management and Handling) Rules 2001' B(M&H)R, which included 'Extended Producer Responsibility' and covered all stakeholders such as manufacturers , dealers, importers (of new batteries), battery assemblers, reconditioners, auctioneers , individual consumers and bulk consumers; the main aim was to collect the old battery against the sale of the new battery on a 'one-to-one' basis and to ensure that they were all processed by registered eco-friendly lead recyclers only. B(M&H) also mandated that battery manufacturers should file returns with the State Regulatory Boards on the number of old batteries collected as well as new batteries sold. State Regulatory Boards were requested to send these returns to the MoEF so there was a clear picture on the national inventory. The B(M&H)R also encouraged setting up collection centres across the country for used lead batteries. The battery collection targets fixed in the rules were:

Ultimately the aim was India should collect back 100% of used lead batteries and send them for environment-friendly recycling only.

Year 1 (2002)	50%
Year 2 (2003)	75%
Year 3	90%

Fig 2: Recyclers Shifting to Rotary Furnaces

A registration or authorisation committee consisting of experts including ILZDA, which used to go through the applications of lead recyclers, visit the plants for effecting improvements and finally gave registration/authorisation to such eco-friendly units, on a case-to-case basis. Units using blast furnaces, which showed leakages here and there, later on shifted to close door operations like rotary furnaces (Fig 2)

Dealer Registration

Even after the implementation of the B(M&H) R, the backyard lead recyclers were thriving and active because the battery dealers were diverting the collected batteries to the traders and backyard recyclers. In order to check this trend, the battery dealers in the country were asked, through an amendment in 2010, to get themselves registered with the respective State Regulatory Boards and to file returns. The returns would indicate the number of batteries sold as well as collected batteries and also its pathway, i.e. they are being sent to registered environment-friendly recyclers only.

Likewise, all the importers of new lead batteries were also mandated, through the same amendment in 2010, that they should also get registered with the State Regulatory Boards and file returns providing information on the number of batteries imported as well as collected; and sending the collected old batteries to the registered lead recyclers only. In the same year, 2010, MoEF / Central Pollution Control Board shifted the responsibilities of the Registration Committee for Hazardous Wastes to the State Pollution Control Boards, for implementation at the state level.

Way Forward

India has introduced an excellent package of initiatives for an organised collection and environment-friendly lead battery recycling. From now on, we should take those initiatives to their logical conclusions by taking the following measures:

- Voluntary industry initiative
- Strict enforcement / monitoring by State Regulatory Boards
- Focus dealer and importers
- Dissuade role of traders
- Tighten backyard smelting
- Encourage collection clearance (imports)
- Continue awareness programs provide incentives for green recycling
- Provide incentives for green recycling
- Introduce cleaner recycling technologies
- Implement occupational exposure precautions
- Recognise and motivate clean operators

The above measures should make India a country capable of adopting green technologies for the organised collection, safe storage and transportation as well as eco-friendly lead recycling, in the true spirit of Sustainable Development.

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Brief on Various Schemes for Stressed Assets

Shri K K Mehrotra, Chairman, IIM Delhi Chapter delivered a talk on "Restructuring Schemes for Stressed Assets " on 30.11.2019.

Many capital intensive industries / Projects as well as projects with long gestation period were facing crisis due to increased amount of debt because of various reasons resulting into lesser profitability & stress in its account. Inspite

of their best efforts and intentions, sometimes corporates find themselves in financial difficulty because of factors beyond their control and also due to certain internal reasons In view of this, some companies were not even able to service the interest portion of the debt. Non-payment of interest to banks/ financial institutions has resulted into a stressed assets. Over a period of time Stressed Assets and Non-Performing Assets (NPA) have increased considerably in the manufacturing sector and other entities. For the revival of the corporates as well as for the safety of the money lent by the banks and FIs, timely support through restructuring in genuine cases is called for. Realising the need for the same, RBI has formulated and worked out various schemes under which the borrower should return the loans under various categories.

At the outset, he stated that distressed assets in the context of banks loan is inability of the borrower to pay the interest and principal in time. It was informed by him that RBI has constituted a body named "Central Repository of Information on Large Credit (CRILC). Banks report credit information to CRILC about their borrowers where the exposure of loan is Rs. 5.0 crore and above. Banks also report about Special Mention Account (SMA) status of the borrowers to CRILC. This status is denoted as SMA-0, SMA-1 and SMA-2 which correspond to default of payment of interest within 30 days, 31-60 days and 61-90 days and above respectively.

It was mentioned by him that the steel industry was suffering from major portion of distressed assets. RBI has come out with a number of schemes to deal with the problem of distressed assets. Banks are advised that as soon as an account is reported by any of the lenders to CRILC as SMA-2 category, they should mandatorily form a committee called Joint Lenders Forum to explore the possibility of resolving the stress in the account. Lenders have also the option of forming a JLF even when the account is reported to be of SMA-0 or SMA-1 category.

The various schemes from time to time introduced by RBI are as under:

1 Corporate debt restructuring system.

This scheme was introduced by RBI in 2001 to restructure corporate debt outside the purview of debt recovery tribunal and BIFR. This scheme was implemented by bank and financial institutions for realisation of debt. This is a three tier system for resolution of debt.

- CDR Standing Forum is the top most tier: Representatives of all Banks / FIs chief Executives, self-empowered body which lays down policies & guidelines which is being followed by CDR Empowered Group (EG). Reviews the decisions EG & CDR Cell.

- Empowered Group (EG): is second tier structure, decides cases & have EDs of FIs / Banks. Consider preliminary report of all cases whose request is made by CDR Cell. If found that CDR is potentially viable then frames the package
- CDR Cell is the third tier work in conjunction with Bank / FIs for framing report.
- Strategic debt restructuring (SDR)

This scheme was introduced by RBI in 2015 helping banks to recover the loan by taking control of distressed companies. Under this scheme, banks who has given loans to a corporate borrower gets the right to convert full / part of their loans into equity shares.

Basic purpose of SDR is to ensure more stake of promoters in reviving stressed account & providing bank with enhanced capabilities to initiate change of ownership in case company fails to achieve agreed critical conditions & viability milestones.

Scheme for sustainable structuring of stressed assets.

This scheme was introduced in 2016. It is about restructuring large borrower account where project is in commercial production under the scheme.

Under this scheme, lenders are required to separate a sustainable loan from unsustainable loan.

Banks convert unsustainable debt into equity / equity related instruments. As a result on one hand debt burden of borrower is substantially reduced & on other hand promoter equity stake is also reduced.

This scheme applies to entities where aggregate amount of loan including interest is more than 500 crores.

5: 25 Flexible restructuring scheme

This scheme was introduced in 2014 and applies to infrastructure / core industries projects with a long gestation period and need large capital investment. Under this scheme, lenders are allowed to fix longer amortization period for loan to project in infrastructure & core industries sector for 25 years based on economic life or concession period of the project with periodic refinancing every 5 years.

The talk was attended by about 25 participants. There was a lively question-answer session after the talk.

The programme concluded with lunch.

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Brief Report on Presentation on Industrial Revolution 4.0

A presentation was organized by our Chapter on Industrial Revolution 4.0. The presentation was made by Shri K R Krishnakumar, Life Member of IIM-DC and former Chief General Manager, SAIL on the topic "Industrial Revolution 4.0" (IR 4.0) on 11.1.2020. He briefly covered the topics such as Historical Background of IR 4.0, What is IR 4.0, What are the Drivers, What are the Mega Trends expected, Deep Shifts happening in IR 4.0, Market Value of IR 4.0 and its implementation in various industrial sectors. A brief of the presentation is given in the succeeding paras.

1.0 What is Industrial Revolution 4.0?

Fourth Industrial Revolution can be defined as a fusion of physical and virtual systems of manufacturing, so as to enable absolute customization of products and creation of new operating models.

Unlike earlier three revolutions the IR 4.0 will create a wider scope affecting the entire society. To understand IR 4.0 it is essential to see the full value chain which includes suppliers and the origins of the materials and components needed for various forms of smart manufacturing, the end-to-end digital supply chain ***and the final destination of all manufacturing, regardless of the number of intermediary steps and players: the end customer.***

2.0 History of Industrial Revolutions

The first industrial revolution that began in the second half of the 18th century and spanned from 1760 to 1840. This marked the transition

from muscle power to mechanical power, evolving to where today, with the cognitive power augmenting human power. The first industrial revolution helped to build Rail line network, steam engine and mechanical production. The second industrial revolution, which started in the late 19th century and into the early 20th century, made mass production possible, fostered by the advent of electricity and the assembly line. The second revolution introduced powerful electrical drives, transport mechanisms and mass production. The third industrial revolution began in the 1960s. It is usually called the computer or digital revolution because it was catalysed by the development of semiconductors, mainframe computing, etc. IR 3.0 was catalysed by the development of semiconductors, mainframe computing (1960s), personal computing (1970s and 80s) and the internet (1990s). IR 4.0 began at the turn of this century, a term coined at the Hannover Fair, Germany in 2011, to describe how this will revolutionize the organization of global value chains. IR 4.0 builds on the digital revolution. It is characterized by a much more pervasive and mobile internet, by smaller and more powerful sensors that have become affordable and by Artificial Intelligence (AI) combined with Machine Learning. This can be summarized as below:

First Industrial Revolution	Second Industrial Revolution	Third Industrial Revolution	Fourth Industrial Revolution started in early 20th Century
Based on the introduction of mechanical production equipment driven by water and steam power e.g., first mechanical loom in 1784	*Based on mass production achieved by division of labour concept and the use of electrical energy, e.g., first mechanical conveyor belt in Cincinnati Slaughter House in 1870*	*Based on the use of Electronics and IT to further improvise automation and production, e.g., first Programmable Logic Controller (PLC), Modicon 084, 1969*	*Based on the use of Cyber – physical systems, digitisation and integration of all automated processes,* ***IR 4.0 was introduced in 2011***

3.0 Industry Revolution 4.0 – Drivers - There are three main drivers of IR 4.0 as agreed to by most experts.

- The first one is digital and integrated processes in a company, i.e., these are vertical integrated and horizontal integrated products. This means that Industry 4.0 is not only about manufacturing, it's about integrating everything from product development to purchasing to manufacturing and then to logistics. Only by having this holistic view of the enterprise, Industry 4.0 can actually deliver benefits to the customers.
- The second driver is the digital product and the in-service offerings , i.e., with the trends you don't necessarily sell a product, but you sell an ecosystem around it, ensuring most amount of value to their customers, while generating the most amount of revenue for the Company.
- The third driver is the digital business model where companies need to optimize customer interaction and offer a complete end to end solution.
- From the manufacturing perspective, one key aspect of Industry 4.0, starts with the smart operator as an enabler, i.e., now everything is very much people centric, be they are, customers, people that use the end products and services and the employees.

4.0 Major shifts expected out of 4th Industrial Revolution

- Changes will be very fast and swift, likely to last less than 30 years.
- More complicated and integrated, with complete Automation made possible by Machine Learning and Artificial Intelligence (AI)
- Will enter into all the areas of Society, even mundane things such as everyday use items such as soaps, tooth pastes, perfumes, etc. will be customized and it is surprising to know that the 4th IR is already under way, in many areas of our lives, e.g. Transport Services, Travel Arrangements, Medicines, Groceries, etc.
- Mega Trends expected /about to / already happening are in Physical (in the areas of Artificial Intelligence & Machine Learning, Robotics Process Automation, 5G Networks, Autonomous Vehicles, 3D Printing, New Materials, etc. ; In the area of Economy (Growth, Employment, Nature of Work, etc.) ; Business (Enhanced Consumer Expectations, Data Enhanced Products, Collaborative Innovation, New Operating Models, etc.); At National and Global Level (Government Functioning, Countries, Regions and Cities, International Security, etc.); Society (Inequality and the Middle Class, Community, etc.); The Individual (Identity, Morality and Ethics, Human Connection, Managing Public and Private Information, etc.)

5.0 Practical applications of IR 4.0: All the mega trends listed above shall be translated into many practical applications and they are going to affect us in all possible areas of our day to day life. Some of the related developments that are going to become reality by 2025 are:

Cloths connected to Internet, leading to breakthrough in medical counselling, etc.

- Internet connected Reading Classes for virtual education, entertainment, etc.
- Commercial availability of Implantable Mobile Phones
- 90% ownership of mobile phone by global population (& regular access to Internet)

- Robotic Pharmacists and Robotic Agriculture
- Production of 3D printed Spare Parts, Machines, Houses, Bridges, etc.
- Replacement of Census by Big Data Sources by Governments
- Driverless Cars replacing at least 10% of Taxis on the road
- First transplant of 3D printed Liver
- First AI machine on Corporate Board of Directors

6.0 Industry Revolution 4.0 for Manufacturing Sector- Some of the Key components of IR 4.0 in manufacturing sector are explained below. Manufacturing sectors in particular, may have to keep their basics ready before they embark on implementing IR 4.0 in the industry. The major components are:

- **Cyber-Physical Systems:** are electro-mechanical devices with connectivity and digital communication capabilities.
- **Internet of Things (IoT):** is the network of physical objects that use sensors to capture data and embedded connectivity to exchange it over the internet. Typically, the Internet of Things refers to consumers' products which are often not equipped with actuators (as a Cyber-Physical System)
- **Industrial Internet of Things (IIoT):** is the declination of Internet of Things to the manufacturing world.
- **Internet of Services:** refers to the usage and combination of IoT devices and applications

to provide services to end users and to other components of the ecosystem.

7.0 Adoption of Industry 4.0 by Sectors. Following table gives an idea of the level of adaptation of IR 4.0 principles and digitalization of their processes now and expected level of digitisation and integration of all processes i.e., IR 4.0. Electronics industry, Defence and Industrial Manufacturing are likely to lead IR 4.0.

Now	Sector	By 2025
45%	Electronics	72%
32%	Aerospace and Defence	76%
35%	Industrial Manufacturing	76%
32%	Chemical Industry	75%
38%	Forest Products, Paper Industry, Packaging	72%
28%	Transport and Logistics	71%
30%	Engineering and Construction	69%
41%	Automotive	65%
31%	Metals	62%

8.0 Challenges ahead in implementing IR 4.0:

It is easy to misinterpret Industry 4.0 and think about it as a beautified, internet-based IR 3.0, but there is a fundamental difference. While IR 3.0 focused on automation and simplification of processes, IR 4.0, aims to integrate all such digitized processes. Some of the challenges that lie ahead in implementing IR 4.0 are:

- Making everybody agree to the definition of a strategy (for Industry 4.0) will be the challenge number one.
- Change management, so often overlooked, which would decide the future course of the Success in IR 4.0 culture.
- Information management in a context of relevance, innovation and timely availability for any desired business, employee and obviously customer requirements.
- Cyber Security and the related privacy of data needs to be addressed urgently. The increasing number of attacks in the Industrial Internet of Things (IIoT) are a fact and this is one of the main reasons which holds back the IIoT initiatives are concerns regarding security and IIoT is, as said a key component of Industry 4.0.

The most important challenge to overcome is related to the human challenge (i.e., conviction of individual, talent, future of work, employment, uncertainty of jobs, etc. …..) This needs to be addressed in a critical manner for effective implementation of IR 4.0.

10.0 Conclusion: The market value of the Industrial Revolution 4.0 has been estimated to be around US $ 152.31 Billion, which is likely to materialize by 2022, with Industrial Robotics contributing the largest share of the IR 4.0 market. With such an economic incentive and taking into account the various definitions and academic arguments of field experts, it may be safely concluded that IR 4.0 has started taking roots in many industrial and social sectors in India and is likely to spread its wings at a phenomenal speed encompassing every aspect of our lives.

The presentation was attended by about 20 members of the Chapter. There was a lively interaction after the conclusion of presentation. As a token of appreciation, Shri Krishnakumar was given a memento by Shri K K Mehrotra, Chairman.

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JSW Steel expects to be a 50 million ton company by 2030: Seshagiri Rao

EPS is going to be better as we are hearing from other steel companies as well. They have reduced inventories and their sales were better

in the last quarter. This is the trend we are seeing which is expected to improve further in the third quarter compared to the second quarter. We expect the second half would be much better.

If we compare the peak steel prices in India last year vis-à-vis the current prices after three hikes, and compare it to landed cost of imports, there is a scope for further increase in price in the domestic market, says **Seshagiri Rao**, Joint MD & Group CFO, **JSW Steel**. Excerpts from an interview with ET NOW.

- **Can you explain the dynamics of the steel industry? We are going through a tough time with profitability levels falling. Would you attribute the steel price fall to the slowdown that the Indian economy is currently witnessing?**

  It is a result of global as well local factors. For steel industry to be understood, one has to see what is happening globally because it is a globally traded commodity. Almost one-third of the steel is traded globally. The trade dispute which arose between China and the US was the starting point which led to an overall slowdown in the global economy and that has impacted the steel industry.

  The steel consuming sectors -- construction, infrastructure, real estate, manufacturing, auto -- have seen slowdown globally and that has an impact. Global developments contributed to a bigger slowdown in India. The slowdown in government expenditure and credit flow to the industry together had a very serious impact in the overall fall in demand and also fall in prices. At the same time, raw material prices have not fallen in the same proportion.

  All these together put pressure on margins and that is why the industry went through a severe pain in the first half of this financial year. Over and above what happened in the industry in India, the FTA countries like Japan, Korea and Asian countries continue to export steel into India because it has zero percent duty. It has gone up from around 58% last year to 77%. That also contributed to the fall in steel prices in India. The fall in steel prices in India is much steeper than what happened globally.

  But we have seen a bit of recovery starting from October. So in this quarter which we ended, EPS is going to be better as we are hearing from other steel companies also. They have reduced inventories and their sales were better in the last quarter. This is the trend we are seeing which is expected to be better in the third quarter compared to the second quarter. We expect the second half would be better.

- **Finally some uptick in steel prices is coming in. On an average, what kind of price appreciation have we seen?**

  Prices started going up from November 2019. Otherwise, the domestic prices are at a discount to the landed cost of imports in India. In November, December and January, we have hiked prices. Taking all the three hikes together, if I compare the landed cost of imports vis-à-vis domestic prices, the latter are still at a discount. But prices are picking up and that is a positive news stemming from revival in domestic demand.

- **Would you be looking to increase prices as early as January?**

  International prices used to be $430. Today, it is close to $520. Rupee depreciation has happened in India. So there is a scope for increase in domestic prices. But if we compare the peak of steel prices in India last year vis-à-vis the current prices after three hikes, and compare it to the landed cost of imports, there is a scope for further increase in price in the domestic market.

- **Will the buyers accept this increase in price because previously when you tried to increase prices in August and September, there was resistance at the buyer level?**

  At that time, global prices were falling and the domestic prices followed a trend like we saw in the first half of the last financial year. The inventories have been used instead of buying new material and that has caused more pressure on the producers for reducing prices. That is why no price increase was possible.

Now the international prices have started going up and in line with that, local prices have started increasing. Now, everybody has come back to the market for restocking and that is also one of the reasons why we are seeing the price increases which we have done is sticking, number one.

Number two, as you know we increase the price every half year. So, whatever price fall has happened in the first half of the financial year, has been renegotiated for the second half. The prices in the second half in the auto sector were much lower than the current prices. This is one of the reasons why the price increase other than auto sector will be better in the second half of this year over the last year because nobody is expecting global prices will fall below these levels so in line with that the local prices also will increase.

- **We have seen two takeovers because of IBC. You have acquired one large asset, the Tata's have acquired one large asset which means more than greenfield, big players have updated existing capacities. Do you think for the next two to three years there is enough capacity in the country and large players like JSW Steel may not be looking at large greenfield expansion?**

  We are seeing consolidation through IBC. These companies are existing operating companies. The capacity utilisations in these companies are at reasonably higher levels. Even after change of control through IBC, I do not think a very big capacity or incremental production would come into the market. Considering the total capacity of the steel industry of 540 million ton in this year, we will be producing 110 million ton. So, the capacity utilisation is reasonably high in this industry. If we continue to grow even at a rate of 5% on a 100 million ton of steel consumption, every year we need 5 to 6 million ton of incremental steel demand.

  For that, new investments have to be done -- either brownfield or greenfield -- to meet growing demand. The acquisitions are only change of control. I do not think that will contribute to the capacity or incremental production in the market.

- **You have significantly increased your capacity in the decade gone by you have significantly increased your capacity vis-a-vis 2010. In 2010, you said India's steel demand will always grow in line with India's GDP. Now that India's GDP has come below 5%, do you think in the next 10 years the steel demand will also come down because a) there is disruption in auto demand, b) delay in housing demand and c) falling demand globally due to trade war?**

  As far as India is concerned, steel demand will be driven by mostly infrastructure construction and real estate. The national infrastructure pipeline which has been announced for investment of Rs 102 lakh crore in that the roads, energy and urbanisation will contribute close to 60% of the total infrastructure build in India. Out of the 60%, they are mostly steel consuming industries where steel demand is quite positive for this pipeline of national infrastructure which has been announced. Over and above, FY20 versus FY21, outlay was Rs 13.5 lakh crore in FY20 including central, state and the private sector. In FY21, the number is Rs 19.5 lakh crore, which is 43% more than FY20. That is the kind of outlay on infrastructure the Government of India is planning, taking all the three segments together.

  If that is the kind of infrastructure investment which is going to happen in India, then steel is the immediate beneficiary of the infrastructure spend. That is why we are quite positive as regards to the steel demand in India, going forward. The 2030 ambition of becoming a 300 million ton steel industry for India is not unrealistic.

- **Where do you see the HR price band moving in 2020? Currently it is in $450-500 band. Do you see them going up internationally?**

  In the past, when steel prices were in the $500-520 range, we have to see what were the raw material prices? You can take scrap

price, iron ore price or coking coal price. Iron ore prices were significantly higher than what it should be. $60 to $65 was the price in the past which has gone up to $120 and then came down to $90.

Iron ore prices are higher by $25 in the market. For every one tonne of steel, you need 1.6-1.7 times of iron ore. Therefore, today the cost of steel production because of iron ore prices being at elevated level are higher by close to $40 to $50 per tonne. If this is the cost pressure, the margins for steel companies even at the current prices will be under pressure. Therefore, steel prices have an upward bias going forward. The only one qualification is demand. Whether demand continues to pick up going forward. The World Steel Association has been guiding for incremental demand of 1.7% in 2020, which is 30 million tonne extra over 2019. Of this 30 million tonne, 10 million tonne approximately is contributed by China.

The World Steel Association is expecting some revival in the overall demand scenario for certain sectors, particularly the manufacturing sector, which has seen the lowest levels in July and August picking up. So, capital goods, engineering, manufacturing sectors will contribute for incremental demand over and above some revival in construction, real estate and infrastructure sectors. There will be some revival in demand other than China considering that steel price has an upward bias in 2020 and over $520 is what we are seeing right now.

- **With heavy capex outlay plus acquisitions, how are you going to manage your cash flows, debt positions, etc? I am sure at the backend, strategic plans are lined up?**

  We are very cautious on the brownfield expansions that we have been doing as also the positioning of those expansions. The demand for steel in India is expected to look up from here on. JSW Steel is the only company which has been bringing in new capacity of 5 million tonne in the next financial year.

  We will have a 5 million tonne coming up from JSW Steel fold in FY20-21. And at the same time, we are expanding downstream capacity by 4 million tonne, This downstream capacity is in highly value-added products. The expansions are very well timed. The 18 million tonne capacity will go to 23 million tonne. I do not think we need to worry about our financial ratios but we have kept in mind 3.75 debt to EBITDA and 1.75 debt to equity ratios, considering that we have been calibrating our capex programme.

  As regards the acquisitions, whenever we have acquired any company which is under financial stress, we have placed that company in SPV until turnaround happens. After turnaround is done, within two to three years' time, we have merged into JSW Steel. That is the model which we have followed. Thereby, balance sheet of JSW Steel is not stretched or stressed. That is what we have done in the case of Siscol, Ispat Industries which we did in 2010. The IBC came into place in 2016. We did one acquisition of Monnet Ispat. It is a similar structure we followed.

  We are in the process of turning around this company. In two to three years' time from the date of acquisition, we will turn around this company. It is same story in the case of Bhushan Power and Steel. Even though JSW Steel is the sole bidder and has submitted its bid in its own name, our idea is to follow a similar pattern like in the case of Monnet. We will place this company in an SPV until turnaround happens, thereafter we will merge it into JSW Steel. That is how we are planning our inorganic growth story. We are very cautious about the overall financial profile of the company.

- **Any other IBC company that is on your radar?**

  The assets that are available are not beyond a million ton. If at all, there are smaller assets but we have some interest in the downstream cases. We are one of the preferred bidders in the case of Asian Colour. As and when

the approval comes from NCLT, we will complete that. That is the only company we are right now in the steel space.

- **Between 2000 and 2010, if Indian companies were expanding and if they were increasing their debt to equity ratio, markets were rewarding it because that was considered growth debt. In the last 10 years, every time companies have expanded and debt has gone higher, markets have punished those stocks. It has forced most of the corporate companies to start reducing debt. Are you comfortable with these debt levels or could you think of reducing your debt levels dramatically?**

  We always look at relative ratios, we do not look at the absolute amount of debt. So when the company is 18 million ton, we cannot say we will reduce our debt to the level of 2002 that is not workable. We are comfortable with 3.75 ratio for a company which has grown from 1.6 million tons in 2002 to 18 million tons today. In the next one and a half, two years' time, we will be close to 28 million tons including the acquisitions through IBC. If that is the kind of growth, we are quite comfortable with this 3.75 and 1.75 ratios.

- **In the next 10 years when will you become a 50 million ton company? Would it be in 2024 or 2025?**

We are 15-16% of today's installed capacity. Even if we assume that we maintain that kind of market share in the overall installed capacity, if 300 million ton is India's capacity by 2030, we will be in the range of 45 to 50 million ton by 2030. Considering the pace of growth in India, if this 300 million ton is expected to be achieved even earlier than 2030, we will also grow at the same pace. We want to be 45-50 million ton player in the 300-million-ton total play in the steel industry in India in the next decade.

Source: The Economic times

Steelmakers fear iron ore supply disruption once leases expire next March

Steel producers are staring at a bleak future in iron ore supplies after the lease tenures of merchant mines lapse on March 31, 2020.

Steel manufacturers, especially those without captive leases, fear supply disruptions in ore for 24 to 36 months following the expiry of non-captive mine leases. Since they depend on merchant supplies, the expiry of the leases would shut off 66 per cent of market supplies of iron ore.

"The supply disruption in iron ore is inevitable as the transition from existing to new lessee is not going to be as easy as anticipated. Besides environment clearance (EC) and forest clearance (FC), the mines need over 20 statutory approvals to continue operations. And, the demand-supply imbalance can further jeopardise the already precarious financial health of many steel companies," said a steel industry source.

The domestic steel industry is largely dependent on iron ore produced in Odisha, which churns out the largest quantum of the mineral. In the last fiscal, the state produced 114 million tonnes (mt), or more than half the nationwide output of 207 mt. Odisha's iron ore is strategically important since it primarily feeds the steel and other end-user industries, unlike Karnataka and Goa, where exports have held sway.

Iron ore-rich states have already kicked off the process of online auctions of lapsing iron ore blocks. In Karnataka, four blocks put up for online auctions have elicited favourable responses. Odisha has issued Notices Inviting Tender (NIT) and model tender documents for 20 iron ore and manganese leases. It has also notified nine virgin or freehold iron ore

blocks. For the first lot of 10 iron ore blocks, the state has received 176 bids from over 60 companies.

But iron ore prices and supply balance will hinge on how swiftly these mines recommence production after expiry of their lease tenures. While the government believes the change in ownership will be seamless and swift as the new leaseholders can carry on with both EC and FC, extended by two years, the steel industry has contested this claim. Steel producers believe mere extension of EC and FC is not the right remedy as mines need an array of clearances beyond EC and FC to stay operative.

Leading industry bodies such as the Indian Steel Association, Federation of Indian Chambers of Commerce & Industry (FICCI), Associated Chambers of Commerce & Industry (Assocham) and Confederation of Indian Industry (CII) are learnt to have made representation to the Prime Minister's Office to amend the Mines and Minerals- Development & Regulation (MMDR) Act to avert supply disruptions in iron ore.

According to a report by Acuite Research & Ratings, India's steel sector, particularly sponge iron and secondary steel producers, may face a short-term disruption in their iron ore supplies with the leases of 232 merchant iron ore mines due to expire by March 2020. The expected impact is estimated at 25-30 per cent of the aggregate domestic iron ore supply in H1 of FY21. This will push up lump ore prices, increase working capital requirements and hit the EBITDA (earnings before interest, taxes, depreciation & amortisation) margins in the steel sector which are already under pressure due to subdued domestic demand.

Source: Business Standard

SAIL's Bhilai Steel Plant to enhance production capacity

Even while it is consolidating its current round of expansion, SAIL's Bhilai Steel Plant (BSP) is looking to commence documentation work and undertake feasibility study for the next phase of expansion.

The BSP had recently undergone modernisation and expansion, raising the plant's production capacity to approximately 7 million tonne (mt) from 4 mt at an estimated investment of around Rs 17,000 crore. According to Anirban Dasgupta, Chief Executive Officer, BSP, plans are afoot to enhance the production capacity to 10 mt by 2030. Work on the next phase of expansion is likely to commence by 2024-25.

"For the next three to four years, the focus will be on consolidating the current expansion, but we will start working on the documentation part of the next phase of expansion, which includes undertaking feasibility study, preparing detailed project report etc," Dasgupta told BusinessLine.

BSP will explore the possibility of roping in a partner to bring in the required investments and for providing technological support. It would offer its prospective partners certain "enablers" such as land bank, raw material linkages, marketing network and its existing workforce. The expanded capacity (10 mt) is likely to come into force by 2030 by which time the country's demand would have grown and there would be a market to absorb the additional capacity, he said. The plant is the producer and supplier of rails for Indian Railways, including 260-metre long rails. It also produces large variety of wide and heavy steel plates, structural steel and specialises in products such as wire rods and merchant products. For the financial year-ended March 31, 2019, BSP contributed to nearly 25 per cent of SAIL's total turnover of Rs 66,967 crore. The segment revenue had grown by around 3 per cent to Rs 17,018 crore for the year-ended March 2019 compared with Rs 16,497 crore the same period last year.

According to SAIL's latest annual report, BSP has planned a capex of around Rs 4,000 crore for FY20.BSP is in the process of phasing out some of its older technologies which used twin

hearth furnaces, ingot casting blooming mills since those involved higher cost of production and higher energy consumption.

"There are old facilities in the country which are not energy-efficient and environment-friendly, so we need to phase out those and replace them with newer technologies which are doing better in terms of techno-economic parameters, energy parameters and environment friendliness," Dasgupta said.

The EBITA-to-turnover ratio, which is 14-15 per cent, should improve to close at 24 per cent once the complete benefits of modernisation and expansion starts kicking in.

Source: Metal Junction

Steel sector growth to slow down on weak auto, manufacturing order: Moody's

India's steel demand will slow down on account of weak auto and manufacturing order, but will remain strongest in Asia, Moody's Investors Service said recently. India will remain the world's second-largest steel producer behind China after having overtaken Japan in 2018, it added.

"India's steel demand growth pace will slow because of weak auto and manufacturing demand... India's demand growth, remains strongest in Asia even as growth pace slows," the US-based agency said in its outlook report titled 'Asia: Steel - 2020 outlook'. The country's steel output will increase on higher capacity utilisation as demand grows.

"India's strong demand will keep imports high, but protectionist measures such as import taxes and anti-dumping duties will safeguard domestic steel producers," it said. The US tariffs will have a limited impact on rated producers' sales. But the prolonged US-China trade disputes will have a spill-over impact through weaker macro conditions, the agency said.

Soft demand from the property and manufacturing sectors will limit Chinese steel demand growth. Korean demand will soften because of the sluggish construction and auto sectors.

Demand will weaken in Japan largely driven by the falling needs from the manufacturing sector, it said.

Source: Business Standard

Steel output to taper off in 2020

China's steel consumption is expected to hit a record in 2019, and this would then be followed by a slight decline in demand in 2020, a new report by the China Metallurgical Industry Planning and Research Institute released recently. The report added that the country's crude steel output is also expected to fall in 2020 from 2019.The country's steel consumption is estimated to hit 886 million metric tons this year, higher by 7.3 percent year-on-year, while demand is forecast for 2020 is seen at 881 million tons, down 0.6 percent from the level in 2019.Crude steel output in 2019 and 2020 are expected to reach 988 million tons and 981 million tons, respectively."

The unexpected steel consumption growth in 2019 is mainly due to an increase in real estate and infrastructure investments, while downstream industries such as machinery, energy, and home appliance also contributed to the growth under the background of a stable growing domestic economy," said Li Xinchuang, president of the institute.In 2020, demand from some downstream industries including construction, automobile and shipbuilding is seen to likely fall. Demand from the machinery sector is likely to remain stable, while demand from the energy and home appliance sectors is seen rising, he said. The report predicted steel consumption in the construction industry would be 475 million tons in 2020, down 0.6 percent from this year. The figure for 2019 is seen hitting 478 million tons, up 11.2 percent year-on-year.

The automobile industry is expected to consume 50 million tons of steel in 2019, down 7.4 percent

from 2018. Demand in 2020 is seen slipping further to 48.2 million tons, down 3.6 percent year-on-year. Demand from the shipbuilding sector is expected to see the sharpest year-on-year decline of 11.5 percent. The industry is expected to consume 11.3 million tons of steel this year, up 3.7 from last year, but the figure is expected to slide to 10 million tons in the following year due to the impact of trade disputes and geopolitical uncertainty.

The machinery industry is estimated to consume 142 million tons of steel in 2019, an increase of 1.4 percent year-on-year, and is forecast to maintain that demand in 2020.The home appliance sector's demand for steel, however, is estimated to climb 3.7 percent year-on-year to reach 14 million tons next year. Consumption this year is estimated to increase 8 percent from last year to stand at 13.5 million tons. Demand from the energy industry is also forecast to grow about 1.5 percent year-on-year to reach 34.5 million tons in 2020. The estimated consumption of the sector in 2019 is 34 million tons, higher by 3 percent year-on-year.

The report predicted iron ore demand in China at 1.225 billion tons in 2020, compared to 1.264 billion tons in 2019. Pig iron output in 2020 and 2019 is seen at 775 million tons and 800 million tons, respectively. Qu Xiuli, deputy head of the China Iron and Steel Association, said at an industry forum in November that China will continue to rein in unwanted steel capacity, especially metal that is substandard and contributes to pollution.

Source: Metal Junction

Breakout year? Steel players hope for demand surge, better prices in 2020

Driven by 'Make in India' initiative, slashing imports, keeping a tab on domestic prices and exploring alternate overseas sources for coking coal are set to top the government's agenda for the steel sector in 2020 while players expect a "break out year" for the industry.

After 2019 saw the domestic market grapple with surge in imports, increased dependence on imported coking coal from select countries, the steel ministry will be focusing on managing availability of iron ore as leases of a clutch of mines are scheduled to expire in March next year. A few rating agencies and merchant miners have expressed concern that the country may face a short-term disruption in supply of iron ore used in making steel due to the transition phase.

"Managing iron ore availability will be among our targets. We will monitor this (situation) as iron ore is a requirement of our industry. It will be a major task for us. We will keep a watch that prices do not go up and iron ore is made available at a competitive rate to the industry," Steel Secretary Binoy Kumar told PTI.

India would see a clutch of mining leases for coal and iron ore expiring by March 2020 and under the amended Mines and Minerals (Development and Regulation) Act. These leases will not be renewed, which means fresh auctions will be done.

In efforts to reduce dependence on select countries for coking coal, Kumar said the government is already in talks with Russia and Mongolia. Currently, it is dependent on few nations like Australia, the US and Canada.

"We will also continue to look for alternative sources to make coking coal available which will reduce dependence on select countries, and exploit the coking reserves in the country," he said.

Kumar said the priority will also be to reduce imports and increase exports of steel. Around 7-8 million tonnes of steel is imported annually.

Indian Steel Association (ISA) Assistant Secretary General Arnab Hazra said the new year will be the year of hope for the Indian steel industry - "the breakout year" for the sector - and stressed that resilience of the industry will stand out.

The industry is hoping 2020 will see increased demand for steel, better prices and development of new products.

Jindal Steel and Power (JSPL) Managing Director V R Sharma said iron ore prices are expected to go up again in January 2020 by Rs 1,000 to 1,500 per tonne.

Terming the country's steel market as "one of the most promising steel markets in the world", ArcelorMittal said it would to contribute to India's expansion in infrastructure and urbanisation in the coming decades.

Steel magnate L N Mittal's ArcelorMittal, which recently completed the takeover of Essar Steel, will work on its plans of expanding business in India.

Jayanta Roy, Senior Vice-President and Group Head, Corporate Sector Ratings, Icra, said the current fiscal has seen margin pressures being faced by the domestic steel players, given weak demand conditions and a sharp fall in realisations.

"For the next fiscal FY2021, demand revival will largely depend upon infrastructure investment by the union and state governments. Moreover, there could be cost pressures because of iron ore, if auction of iron ore mines in Odisha and subsequent operations of those mines are delayed significantly, negatively impacting availability," he noted.

A Tata Steel official said the industry hopes 2020 to be better, particularly the second half as compared to the second half of 2019 when the industry faced a slowdown in the auto sector which impacted the steel sector as well.

"The first half of 2020 will be better with the new Budget and start of new projects and the second half, we anticipate, will be very good," the official said.

Noting that slowdown in growth was quite visible in the latter part of 2019, Seshagiri Rao -- Joint MD and CFO of JSW Steel and Group said the main reasons behind it were the lack of credit from the banking system as well as cut in government expenditure.

"There have been some green shoots of recovery in October and November 2019. We expect the first quarter of 2020 to be better than the December quarter as we are seeing demand coming back on the retail side and in government projects.

"The demand for steel from the auto sector has improved. India's spending on infrastructure is expected to drive the steel industry's growth in 2020. Activity is restarting in areas like pipelines, bridges, construction, and metros," Rao noted.

Pankaj Malhan, CEO of Electrosteel Steels Pvt Ltd said the company is extremely bullish on the New Year where India is poised to grow strongly banking on the structural reforms and the rebounding economy, thereby leading to higher capacity utilisation.

"The reforms in the coal mining sector along with linkages in the iron ores will further strengthen the sector and will help raise its contribution to GDP from 2 per cent in the near future, creating thousands of jobs. The sector will also look forward to new product development, to create a differentiation for the commodity, make it more retail oriented and make India a hub for low cost, high grade steel," he said.

Source: Business Standard

Shifting Needs for Steel Materials with the Rise of 5G Telecommunications and Smart Cities

Effect of 5G technology in Workplace and Society

The advent of 5G technology heralds an era in which humans finally transcend time. We can now overcome any lag in the receipt or transmission of information anywhere around the world. Such time lags will vanish with the advent of 5G telecommunications.

When autonomous robots detect an error and halt operations at a plant, there is a time lag before the signals detected by the sensors can be processed and transmitted to the control unit. Arithmetic units and programs must be installed in equipment to address this issue, causing the size and cost of equipment to rise. When equipment is managed online using

the cloud, the size and cost of the equipment required can be reduced significantly. Time matters in this case. If equipment can become quicker than human reaction time, this would be an important breakthrough.

Generally, the control centre must be placed within a steel plant to allow it to control the process without a time delay. However, if signals can still be transmitted faster than human reactions, the control centre does not have to be located within the steel plant itself. In fact, one control centre could oversee several plants of the same type. What about meetings in the workplace?

These days, many companies hold remote meetings. Although theoretically feasible, remote video conferencing can still become inconvenient when the transmission speed for video and sound cannot support a reasonable time delay. This issue can be addressed through 5G technology.

With video conferencing, people might feel like they are talking to one another face-to-face without any time lag. If this can be combined with three-dimensional holographic imaging, it will feel like talking to a real person even if they are actually on the other side of the world.

The commercialisation of 5G technology will bring rapid changes to people's lives. The first might be an expansion of shared offices. As shared offices are now generally used only for specific businesses, the impact of shared offices has been relatively minimal. If large companies and public institutions install shared offices near residential areas serving their employees, shared offices could have a significant impact on society.

In major cities like Seoul, Tokyo, and Beijing, workers will no longer have to spend as much time on the road. They can go to shared offices near their homes and hold remote meetings through holographic communication with their headquarters. Today, it is common to share desks at a workplace. It will not take much time to transition from desk sharing to office sharing. People will enjoy greater business opportunities as they encounter people from different teams or companies. The declining number of commuters will reduce traffic volumes. Fine particulate matter, recently a hot-button issue in South Korea, can also be mitigated to some degree.

Fewer people will buy cars as they perceive less need to own them. This is evidenced by the fact that car sales are slipping in New York, Tokyo, and other large cities. Even the number of drivers' licenses being issued is falling. With the spread of 5G technology, autonomous cars will become ubiquitous and shared cars will emerge as a norm, transforming the landscape of the automotive industry.

Autonomous cars are already a future realised. Autonomous cars collect traffic information to find optimal routes and detect road risks by monitoring the movement of nearby cars with active sensors. Intelligent autonomous car technology will advance with the significant improvement in the speed of telecommunication to cloud servers responsible for processing information using big data. 5G technology will help complete the real-time intelligent driving control systems required for autonomous cars.

Development Need for New Materials

Changes over the upcoming years or decades will be more significant than those that occurred during the last century. People's ways of life will alter. Such changes in society will disrupt the order of conventional production and consumption and result in a new order. This new arrangement will in turn generate new demand. The question is who will seize this opportunity first. In the materials industry, companies that take a pre-emptive approach to this new order will certainly take the lead. On the other hand, the Korean Institute of Metals and Materials (KIM) has selected five future materials-related issues and suggested promising materials for development.

Future Materials-Related Issues and Development Need for New Materials

Their five issues are:

- **Adaptation to a new climate regime:**
  Materials adaptable to climate change are needed in order to realise a more sustainable society and protect nature by addressing climate change and meeting Greenhouse gas emission reduction targets.

- **Preparation for a super-aged society:**
  Wellness bio-materials are required to ensure a sound and healthy society that can address the issues of an aged society, low fertility rate, entering the super-aged society phase, and curing climate diseases.
- **Disaster prevention:**
  Safe materials are needed to keep society secure by helping to counter natural and human-caused disasters, contagious diseases, and terrorism.
- **Continuous economic growth:**
  Key materials used for automobiles, airplanes, and display panels should be sustainable and recyclable to allow multiple uses.
- **Hyper-connected society:**
  Smart materials are required to create hyper-connected society through the key enablers of the Fourth Industrial Revolution, including AI, big data, IoT, and sensors.

  KIM has proposed types of materials to suit these five issues:
- Materials adaptable to climate change,
- Wellness bio-materials,
- Safe materials,
- Sustainable materials,
- Smart materials.

For the steel industry, future materials adaptable to climate change, safe materials, and sustainable materials will all rise in importance. The changes in society triggered by 5G technology are closely related to the construction of smart cities using the future materials.

The rise of future metropolitan cities

With the construction of smart cities, several factors will impact the steel industry: the rise of large cities; the establishment of new logistics systems; and the construction of sustainable urban systems. The following needs will arise spurring the development of new materials.

Metropolitan cities are essentially comprised of business are residential districts. In the morning, people travel long distances from residential to business areas and reverse the trip every evening. Such long-distance commuting will disappear if shared or co-working offices become commonplace near public transportation terminals. In Korea, numerous knowledge industry centres have already been established near subway transfer stations to be used as shared offices. People could go to shared offices in the suburbs near their homes, creating new business opportunities through interaction with people from other companies. Unlike in the past when people worked with the same group of persons in the same office, they can encounter others from diverse fields of business, helping them become more creative. Time once spent on commuting can instead to used for self-development and leisure. Sports and entertainment facilities, including theatres, indoor sports centres, and tennis courts, will expand, and small businesses will flourish as they serve community residents.

Such towns will require different types of buildings, and reconstruction projects refurbishing old town centres will gain ground. Once again, steel will present itself as the most suitable material for construction to proactively adapt to a rapidly changing society. The mandatory 52-hour workweek, rising labour costs, and burdensome environmental restrictions in the construction field will provide steel an opportunity to regain the position as the favoured construction materials that it lost to concrete. In Great Britain, where steel is widely used for building, it is easy to procure steel components for construction. However, this industrial structure is less mature in Korea and other Asian countries where concrete buildings can easily be built due to low labour costs. This is one of the main reasons why it is essential to develop new steel construction materials in various types. Moreover, the steel industry should carefully consider how to inform consumers about the advantages of steel as a construction material: providing safety and convenience with resistance to both natural (typhoons, earthquakes, tsunamis etc.) and human-caused disasters (war, terrorism attacks, fires).

Establishment of new logistics systems

Although human mobility may decline, the volume of cargo transport is projected to increase.

The flourishing of e-commerce businesses such as Amazon has ensured that the logistics industry will become one of the most important industries in the future.

SoftBank Chairman Masayoshi Son, who has gained remarkable returns from his investment in the Chinese web retailer Alibaba, has recently invested in Korea's e-commerce firm Coupang, underlining the importance of the e-commerce field. To suit the rise in both dual-income and single-person households in Korea, even fresh products can be now delivered to homes. For rapid delivery of major volumes of fresh vegetables, fruit, and dairy products, it is necessary to develop new kinds of transportation systems that connect farms and cities.

What is important here is how we can improve energy efficiency and reduce fine particulate pollution in a future where massive logistics becomes the norm. The best way to improve energy efficiency is to reduce the weight of the given transport mode.

Materials development in transportation, including cars, trains, ships, and airplanes as well as drones, is primarily focused on weight reduction as a means to improve energy efficiency. Steel has long been advantageous compared to other materials, but it is being challenged by other lightweight materials. Especially for the automotive industry, improved fuel economy has become a pressing issue under increasingly strict environmental standards. The US government plans to require US vehicles to achieve fuel economy of 23.9 km/l by 2025, while Europe and Japan have set fuel economy targets of 26.5 km/l and 20.3 km/l, respectively, by 2020. Korea also plans to meet the fuel economy target of 24.3 km/l by 2020. This means that the automotive industry must improve fuel economy by more than 50% on average by 2025.

The steel industry is preparing for this situation by developing next-generation automotive steel. One example is high-strength Fe-Mn Al-C lightweight steel, which is made over 10% lighter than conventional Fe-Mn-C steel through the addition of 5-10% aluminium content, and thereby becoming more competitive than aluminium on its own. Lightweight steel commonly has a disadvantage of having less than 1 GPa grade tensile strength. In order to overcome this, precipitation hardening martensite steel is being developed, and analysis is underway on the utilisation of retained austenite.

Aluminium is one of the fastest growing materials for use in vehicles, and carbon fiber reinforced composites and titanium are increasingly being applied as aerospace materials.

Steel is used for aircraft landing gear, but the scope of application of steel is falling. To reduce the weight of high-speed trains, the share of the steel frame in railway rolling stock is declining and high-strength aluminium extrusion alloys and aluminium plate are on the rise in lightweight frames.

Recently, extensive research has been conducted for saving weight in frames and internal materials using ignition-proof magnesium alloy. The TGV Duplex is the first high-speed train using AZ91 magnesium alloy for seat components, and it has reduced body weight by 16.7% compared to conventional aluminium alloys. Korea's high-speed train KTX also uses magnesium alloy for seat components to achieve a weight reduction of up to 35.6%. In the shipbuilding industry, steel is increasingly being replaced by corrosion-resistant aluminium alloys in both high speed and leisure vessels. For the logistics industry, when the cost of energy for transporting a certain volume of cargo exceeds the cost of the materials in the transport, a wider range of choices of materials will be available. Under these changing trends, aluminium, magnesium, and titanium had growth rates of 9.2%, 8.0% and 6.3%, respectively, in 2014, according to the market research firm, Markets and Markets.

In an effort to reduce fine particulates, transport modes that burn fossil fuels within cities may be edged out of the logistics industry. A so-called hyperloop, which is a future high-speed transportation concept first proposed by Elon Musk, could be used for long-distance travel while electric vehicles (EVs) or drones could be applied for short-distance travel and rapid delivery.

Due to their considerable battery weight, weight reduction is an important issue for EVs. The steel

industry is actively working to meet this need with advanced high strength steels (AHSS). Steel pipes seem to be the most suitable material to create a hyperloop for cargo transport.

Although a hyperloop designed to carry passengers may require alternative materials to ensure psychological relief for passengers as they may feel uncomfortable inside opaque steel tubes, steel is the most competitive option in terms of cost for a hyperloop for cargo transport. Eco-friendly container vessels or transcontinental trains can be used for transport of transnational and transcontinental cargo. The Korea Railroad Research Institute has recently developed foldable containers to improve logistics efficiency. These types of efforts will continue to become increasingly visible in various areas of logistics.

Sustainable Urban Systems

Older cities around the world share one thing in common: they have difficulty raising the massive funds required for urban regeneration. As buildings have a life cycle spanning more than 100 years, reconstruction costs are not generally included when calculating their construction costs, passing the buck down to future generations. As a result, major cities around the globe are experiencing fatigue. For a more sustainable urban system, regeneration costs must be considered from the start. Urban design should take the optimisation of urban energy consumption and recycling into account. Steel is clearly the most competitive material for sustainable urban design. As nearly 80% of a steel house is recyclable, steel can be considered the base material most suitable for sustainable cities.

If materials development puts its highest priority on energy reduction and resource circulation, the reduction of the weight of high strength steel can be a solution.

POSCO A&C, a comprehensive architectural service company fully financed by POSCO, has recently developed modular housing and other structures, but the high price tag of the design in its early stages is keeping consumers at bay. The development of modular buildings would require a dramatic shift, for example, by adopting new steel materials such as printed colour steel sheet. Such newly developed steel materials should be resistant to earthquakes, typhoons, and fires. Further technological advances should be pursued to address problems at a competitive price, including floor noise and thermal insulation.

Needs for innovation of steel materials

Historically, the advancement of scientific technologies has resulted in social transformations. It was only after the Industrial Revolution that workplaces became separated from places of residence. Apartments, the most common residential spaces in Korea, have been built to accommodate ballooning numbers of urban workers. The Industrial Revolution has brought profound changes to lifestyles that had been stable for centuries.

In the First Industrial Revolution, steam engines created value through mass production. In the Second and Third Industrial Revolutions, the introduction of electricity and IT-based automation technology resulted in breakthroughs in production.

Mass production cut costs and eventually expanded markets and increased sales. However, at the same time, it led to the reckless use of energy and resources, giving rise to several environmental and social issues.

The Fourth Industrial Revolution, known for its data revolution, will also drive seismic changes in the lives of people with the advent of 5G telecommunications that can better apply the full value of data. Customised mass production is fundamentally addressing the issue of the resources wasted in mass production, while at the same time changing ways of life. The previous industrial revolutions separated work from places of residence, but the Fourth Industrial Revolution will return workspaces to residential areas. Perhaps the distant and even broken relations among families and neighbours can be restored. New communities can be created. Novel opportunities will arise for some of the sectors of society overlooked in the past. The issue is now a matter of who will react pre-emptively to these changes. Time is running out: A seismic change in society is just around the corner.

The steel industry's capacity to adapt to this change will be tested. The industrial revolutions of the past have transformed the lives of

people, and those well prepared for such transformations have seized the opportunities they created.

Source: Steel Tech

Hydrogen Plasma Smelting: An Alternative and Sustainable Technology to Produce Green and Clean Steel

Abstract

India has become the second largest producer of steel with 106.5 Mt in 2018, which clearly indicates the increase in per capita consumption. The Government of India also plans to increase the total production to 300 Mt by 2030. It has been estimated that around 3 tonnes of CO_2 is being generated per tonne of crude steel production, which will be ~900 Mt by 2030. This level of CO_2 emission is highly alarming, which calls for quick adoption of alternative technology that could diminish the overall carbon footprint. However, the conventional method of making steel using carbon is still in practice at large that further makes the situation challenging. For inclusive growth and environmental sustainability, researchers worldwide are in constant search for an alternative reductant that could reduce iron ores to produce steel with minimum emission of CO_2, thus naming the product as green steel.

Putting the right foot forward, CSIR-Institute of Minerals and Materials Technology, Bhubaneswar, Odisha, India has developed a state-of-the-art technology to produce steel with minimum/no emission of CO_2 which is called as "Green Steel" by hydrogen plasma smelting route. As this steel contains low carbon and detrimental elements such as sulphur, phosphorous in low level, it may also be called as "Clean Steel".

Moreover, water is produced as a by-product, which can be recycled during the production of steel in commercial scale. It is possible to produce iron of 99.54% purity by this process with low sulphur, low phosphorous content. In this paper, efforts have been made to produce green and clean steel from iron ore by employing a Hydrogen Plasma Smelting technique. This one-step process is 100% environmental-friendly and the only by-product produced is water. This water can be recycled for gainful use in the commercial stage.

Introduction

The Iron and Steel industry of any country is considered as the backbone of the economy of that country. It helps in the growth of GDP and uplifts the economy of the nation. Per capita consumption of iron and steel is proportional to the development index of a country. The production of steel by blast furnace – basic oxygen furnace (BF-BOF) route will continue to dominate the world scene for quite a long time. The alternative routes for steel production is gaining importance over the time based on smelting reduction process with focus on reducing CO_2 emission. The technology that will completely eliminate CO_2 emission will rule the iron and steel industries. Technology is the buzz word, technological excellence will bring mileage to the iron and steel industry in the world.

Annual Production of Crude Steel in World

As per the report by the World Steel Association (world steel), the Global crude steel production in 2018 was 1,808.6 Mt that is shown in Figure 1. China leads the steel production with 51.3% of the total global production of steel in 2018.

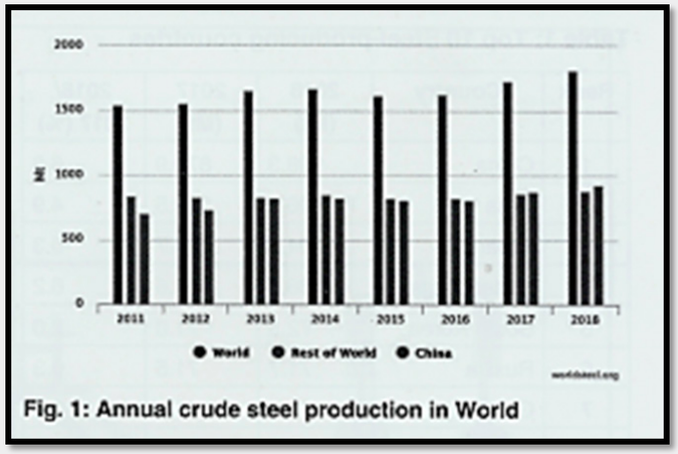

Fig. 1: Annual crude steel production in World

The share of the world's steel production during 2017 and 2018 is represented below in Figure 2. It is observed that China is a major player in steel production in the world contributing 51.3% to the overall global steel production followed by India, Japan, US and others.

Annual Production of Crude Steel in India

The top 10 steel producing countries have been shown in Table 1. China being the first steel producing country in the world produces 928.3 Mt of steel, which is 6.6% more than the production in 2017. India following China is the 2nd largest steel producer at 106.5 Mt in 2018,

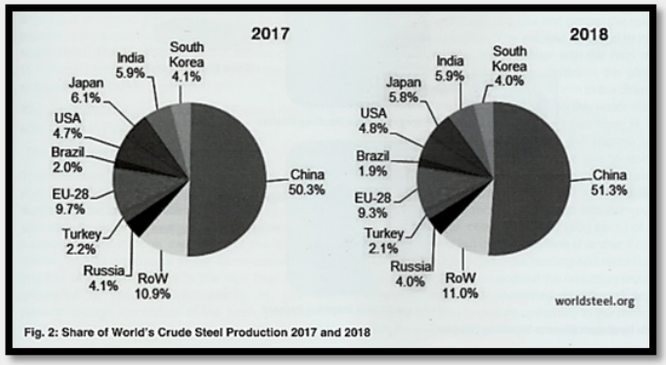

Fig. 2: Share of World's Crude Steel Production 2017 and 2018

which is 4.9% more than its production in 2017. The Steel Ministry is estimating to increase the production of Steel up to 300 Mt by 2030. The trend of the steel production is continuously increasing every year as the demand of steel in developing countries is going up.

Table 1: Top 10 Steel-producing countries

Rank	Country	2018 (Mt)	2017 (Mt)	2018/ 2017 (%)
1	China	928.3	870.9	6.6
2	India	106.5	101.5	4.9
3	Japan	104.3	104.7	-0.3
4	United States	86.7	81.6	6.2
5	South Korea	72.5	71.0	2.0
6	Russia	71.7	71.5	0.3
7	Germany	42.4	43.3	-2.0
8	Turkey	37.3	37.5	-0.6
9	Brazil	34.7	34.4	1.1
10	Iran	25.0	21.2	17.7

The per capita consumption of steel in India is very low as compared to China. It is approximately 10 times less than that of China. The demand of steel in our country will compel to go for higher production, which will increase the CO_2 emission in the World. The CO_2 production in the World has been shown in the Table 2. It is observed from Table 2 that the world's CO_2 emission is more than 45261 Mt, of which China contributes 12454 Mt to CO_2 emission and India 2379 Mt of CO_2 emission with 27.51% and 6.43% of the total global CO_2 emission respectively.

Table 2: List of Countries by 2018 emissions estimates compared against 2017

Country	GHG emissions ($MtCO_2e$) 2017	Level of global total (%) 2017	$MtCO_2e$ 2018[2]
World	45261.2516	100.00%	
China	12454.7110	27.51%	12700
United States	6673.4497	14.75%	6570
European Union (28)[3]	4224.5217	9.33%	
European Union (15)[4]	3374.0348	7.45%	
India	2379.1668	6.43%	2870
Russia	2199.1173	4.86%	2670
Japan	1353.3473	2.99%	1310
Brazil	1017.8745	2.25%	1050
Germany	894.0570	1.98%	910
Indonesia	744.3403	1.64%	

Materials and Methodology

Raw Material

a) **Iron Ore:**

Iron ore from Joda mines, Keonjhar, Odisha India was taken for the study as the major raw material. The chemical analysis of the same is presented in Table 3

b) **Hydrogen:**

Hydrogen gas of 99.99% purity was employed in the process as the reductant.

Experimental

The iron ore fines were mixed with flux and were granulated. The granulated material was taken into the water-cooled copper crucible

Table 3: Chemical analysis of Iron ore

Compound	Fe_2O_3	Al_2O_3	SiO_2	MgO	CaO
%	84.6	1.62	12.11	0.57	0.36

of the reactor. The crucible is then lifted up by hydraulic press to fit into the reactor chamber. The plasma torch is lowered down to the level of the contact rod for sparking. The argon gas is passed through the plasma torch and the plasma is produced by removing the contact rod at the spark point. The Hydrogen Plasma

Smelting Reactor (1 kg scale) and furnace (7 kg scale) with the products obtained are shown in Figure 3

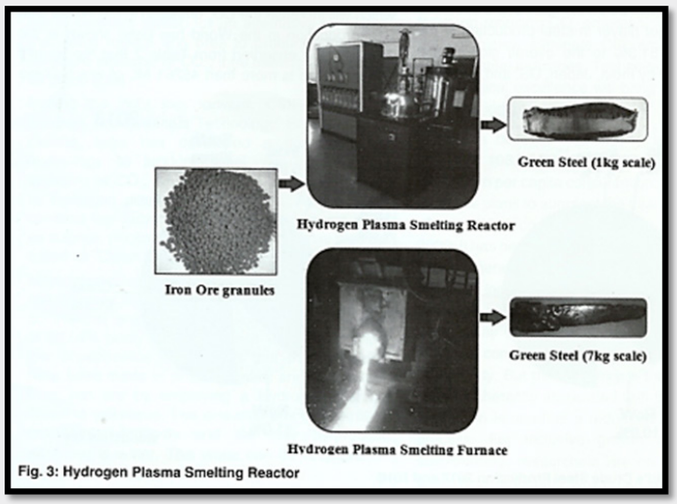

Fig. 3: Hydrogen Plasma Smelting Reactor

The schematic diagram of Hydrogen Plasma Reactor is also shown in Figure 4.

The Experimental Procedure

The reduction of iron oxide was carried out in a Hydrogen Plasma Smelting Reactor. The schematic diagram of the same has been shown in **Figure 4**. The plasma was generated with the help of plasma torch, passing Ar gas through the centre of the torch. The melting of iron ore occurs in the water-cooled copper crucible of the reactor due to the high heat (20000C) generated by plasma. Subsequently, H_2 gas was passed through the nozzle of the torch, which acted as the reductant to reduce molten iron from its oxides.

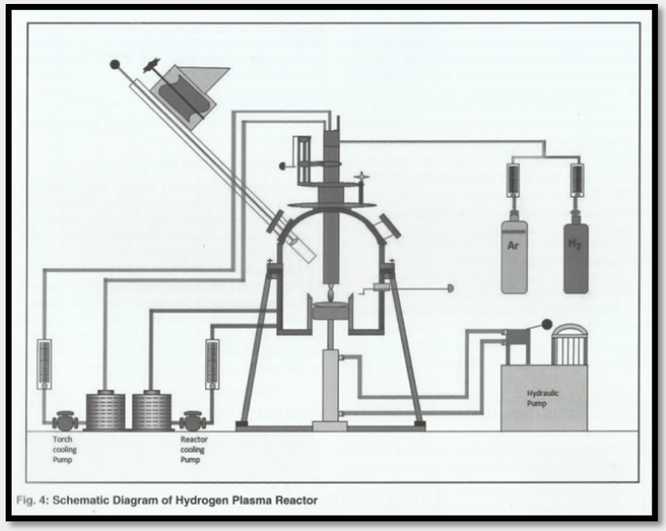

Fig. 4: Schematic Diagram of Hydrogen Plasma Reactor

A typical experimental campaign consisted of loading 50g of iron ore/oxide sample (1-6 mm size) initially into the water-cooled copper crucible and getting the reactor ready for the operation. The arc was checked to ignite plasma into the reaction chamber with the help of Ar gas that is passed through the centre of the plasma torch. After passing the Ar gas at 10 lpm to the chamber for 1 minute, the iron ore present in the water-cooled copper crucible was melted. During that time, H_2 gas was passed through the nozzle of the plasma torch at the flow rate of 5 lpm along with Ar gas to start up the reduction process of iron ores/oxides. The power supply was maintained around 10-12 kW to facilitate the melting and the reduction process simultaneously. During the course, other 3 batches (50g each) of iron ore samples were fed into the reaction chamber through the feeder to ensure complete melting and reduction of 200g iron ore. While carrying out the reduction process, the plasma torch was positioned at different angles (XxYyZ directions) to ensure uniformity in the reduction of iron ores. The plasma torch was also made to rotate on its own axis as and when required. To support better agitation of the molten metal with hydrogen, the electromagnetic stirrer was attached to the bottom of the water-cooled copper crucible. After the reduction was

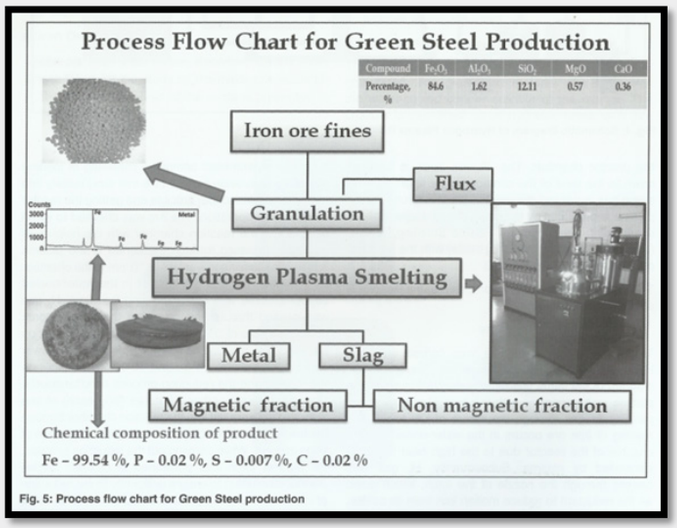

Fig. 5: Process flow chart for Green Steel production

observed for complete 50 mins, the molten iron was brought down to room temperature. The iron sample was then sent for carrying out chemical as well as mineralogical

characterisation. The metal and slag products were separated. The slag sample was ground to 0.2 mm (200 micron) size and subjected to magnetic separation.

The experimental conditions are furnished below:

1. Argon gas flow : 10 LPM (liters per minutes)
2. H2 gas flow : 5 LPM
3. Scale : 200 g

The flow sheet of the process has been shown in Figure 5.

Based on the optimisation of the experimental parameters in 200g scale, the experiments have been successfully carried out in 1 kg scale at CSIR-IMMT, Bhubaneswar. The optimisation data in 1 kg scale has been verified in 7 kg scale M/S TARA International, Ahmedabad as shown in **Figure 3**.

Results and Discussion

Thermodynamically principles of iron oxide reduction

Thermodynamics at low temperatures

Bauer-Glaessner diagram shows the equilibrium between the iron oxide and H_2 O/H_2 mixtures with respect to temperature in Figure 6. CO/CO_2 equilibrium is also presented. The two leftmost equilibrium lines shown in the diagram represent the metallic iron / wustite equilibrium (reaction 3), whereas the two rightmost lines represent the hematite/magnetite equilibrium (reaction 1). The Bauer-Glaessner diagram provides two key properties describing the interaction between solid and gas phase in the shown reactions. Firstly, the equilibrium gas concentrations calculated for the reactions of the investigated gaseous species with different iron oxides can be directly derived from the equilibrium lines shown in the diagram. Secondly, the relative position of the input gas concentrations indicates which equilibrium can be achieved at a certain reaction temperature.

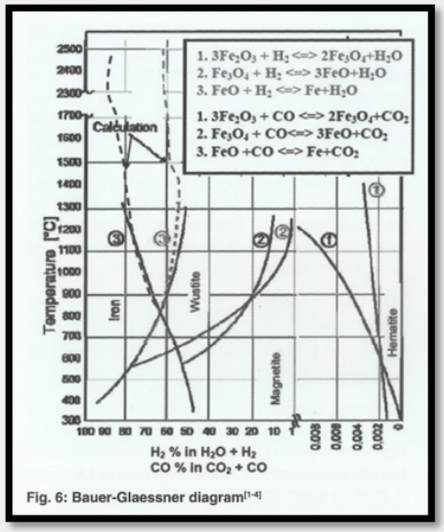

Fig. 6: Bauer-Glaessner diagram[1-4]

For instance, at a temperature of 13000C, the equilibrium gas concentrations achieved in reduction from wustite to iron would be 52% H_2 / 48% H_2O and 82% CO/ 18% CO_2 respectively. In other words, gas yields (degrees of gas utilisation) of input hydrogen and input CO of 48% and 18% are respectively obtained, and an input gas having a H_2/H_2O ratio less than 52/48 and a CO/CO_2 ratio less than 82/18 will, therefore, not reduce wustite. Extrapolating the equilibrium lines of FeO and H_2 / CO in **Figure 6** at higher temperature (with molten phases) via calculations using Fact Sage program indicates a constant degree of utilisation of H_2 of approximately 40% up to 25000C. Moreover, a slight variation between 10 and 15% in the case of CO utilisation degree was found. It should be mentioned that above 25000C, further extrapolation of the equilibrium lines was not possible due to the significant evaporation of Fe and FeO. However, by conducting equilibrium calculations of FeO and H_2 at higher temperatures (26000C – 29000C), an evolution of higher amounts of H_2O with respect to equilibrium at lower temperatures is obtained. It should be noted that this increase in H_2O amounts is not attributed to a change in the hydrogen reduction behaviour, but to the shift of FeO from the liquid to the gas phase and its subsequent reaction to the existing molecular hydrogen to produce H_2O and gaseous Fe.

Thermodynamics at Plasma Temperatures

Fundamentals

In plasma metallurgy, hydrogen can be chosen as a reducing gas for ore reduction purposes. Hydrogen under ambient temperature exists only in its molecular form, H_2, where the covalent bond between the two atoms is secured by a shared electron pair. At higher temperatures, H_2 starts to dissociate, as shown in Figure 7, where the amount of H exceeds that of H_2 at approximately 35000C. Increasing the temperature furthermore leads to the ionisation of H into H_+. H_+ exceeds H at a temperature of 155000C. The Ellingham-Richardson diagram (Figure 8) was explained in details in previous work. The importance of

the Ellingham-Richardson diagram in any set of compounds, such as oxides, is the possibility to readily determine the thermodynamics of all possible reactions.

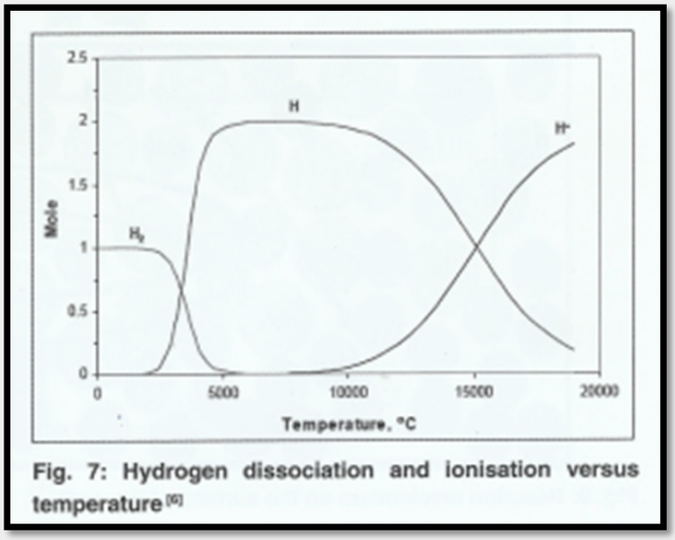

Fig. 7: Hydrogen dissociation and ionisation versus temperature [6]

Important reactions and equilibriums can, therefore, be separated from those which are not important. Furthermore, the diagram can be used to quantitatively estimate how changes in temperature, pressure, and composition affect the relevant chemical equilibrium.

The standard free energies of formation of various metal oxides, ΔGo, are represented in Figure 8 as a function of temperature. For temperature at which the H_2/H_2O, CO/CO_2, C/CO equilibrium lines lie below the oxide lines, the corresponding reducing agent can reduce the oxides to their sub-oxides or elements. Furthermore, the ratios of H_2O/H_2 and CO_2/CO in equilibrium with any of the metal-metal oxide systems are easily determined using the right-hand side scales as shown in the diagram.

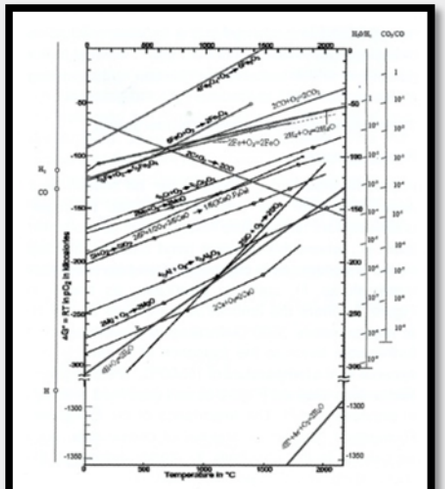

Fig. 8: Free energy of formation of various oxides, based on Ellingham - Richardson diagram,[7,8,9]

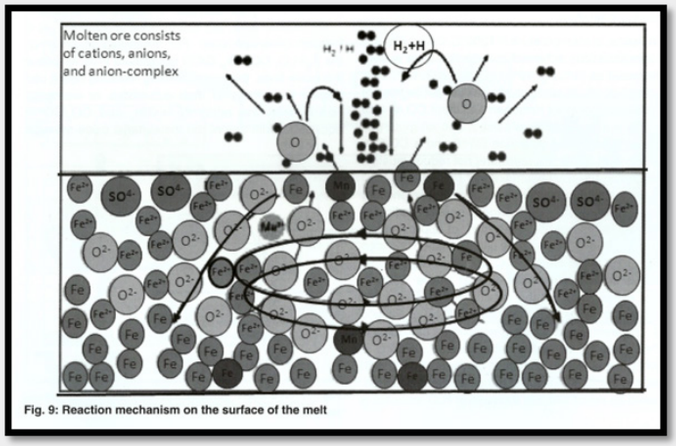

Fig. 9: Reaction mechanism on the surface of the melt

At higher temperatures up to 20000C in the case of plasma application, where the existence of H_2, H and H+ is possible, a potential reduction of extremely stable oxides, from the thermodynamically point of view, is obtained. In other words, the use of plasma shifts the ΔGo values further towards the negative domain. This is evident from the shown free energies of formation of H_2O by means of H and H+ with respect to H_2. However, practically speaking, in plasma metallurgy, homogeneous reactions (single phase) could not be guaranteed unless the processed material converts to a plasma state as well. The reaction Mechanism at the surface of the Melt is depicted in Figure 9.

$2H_2(g) + O_2(g) \leftrightarrow 2H_2O(g)$

$\Delta G\ 0298 = -474.38$ [kJ.mol-1] (1)

$4H(g) + O_2(g) \leftrightarrow 2H_2O(g)$

$\Delta G\ 0298 = -1287.55$ [kJ.mol-1] (2)

$4H+(g) + O_2(g) + 4e \leftrightarrow 2H_2O(g)$

$\Delta G\ 0298 = -6512.24$ [kJ.mol-1] (3)

Typical Experimental Findings

The photographs of final product obtained from different sets of experiments in 200 g, 400 g, 600 g are shown in Figure 10 (a) and in 1 kg and 7 kg are shown in Figure 10 (b) and (c) respectively. The experiments in 1 kg scale to produce green and clean steel by hydrogen plasma smelting route have been repeated for consistency and the chemical analysis of the final product is shown in Table 4. The XRD analysis of the final product is shown in the Figure 11, which shows the distinct peak of Fe, hence confirming the purity of the product.

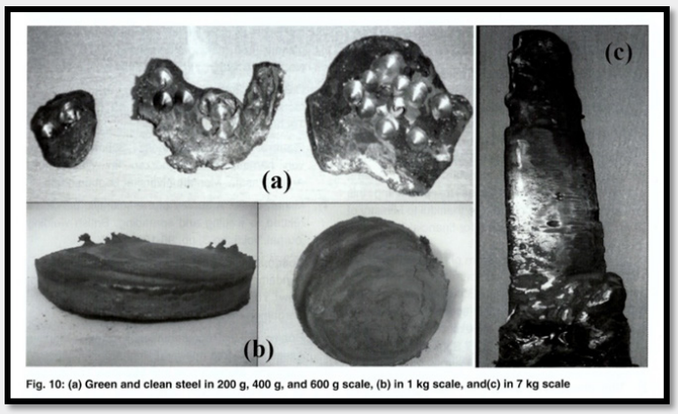

Fig. 10: (a) Green and clean steel in 200 g, 400 g, and 600 g scale, (b) in 1 kg scale, and(c) in 7 kg scale

The experiments in 1 kg scale to produce green and clean steel by hydrogen plasma smelting route have been repeated for consistency and the chemical analysis has been shown in Table 4. The XRD analysis of the final product is shown in the Figure 11, which shows the distinct peak of Fe, hence confirming the purity of the product.

Table 4: Chemical Analysis of the Final Product

Case Study	Elements	Fe	C	Si	P	S	Al
1	Wt.%	99.54	0.020	0.083	0.020	0.007	0.026
2	Wt.%	99.44	0.021	0.091	0.015	0.005	0.023

Conclusion

The following conclusions could be made of the present study such as:

- It has been convincingly shown that Hydrogen Plasma Smelting process for reduction of iron ore not only eliminates CO2 emission, but also shows a futuristic path for producing green and clean steel without any carbon source, which is depleting at a faster rate.

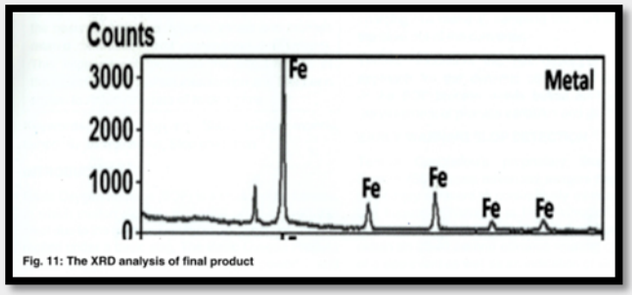

Fig. 11: The XRD analysis of final product

- The green and clean steel produced by this process contains 99.54% Fe with a reduced percentage of detrimental elements – sulphur (0.005%) and phosphorous (0.015%) respectively.
- Water generated as a by-product of this process could be recycled when the technology is implemented in commercial level.

Acknowledgements

The authors are grateful to Prof. S. Basu, Director, CSIR-IMMT Bhubaneswar for his constant encouragement, support, and granting permission for publishing this manuscript. The authors are also thankful to Ministry of Steel, the Government of India for financial assistance under project head.

Source: Steel Tech

Steel: A Material of Choice Surpassing Others

Use of Steel

Steel has long been the backbone of human civilisation – from the skylines of our cities to the vehicles that crisscross the globe, steel is universal. Steel leverages the natural abundance and low cost of iron to produce a wide variety of properties and performance. Its properties can be varied from low strength high ductile material to ultra-high strength material for very critical applications. As a result, steel and its alloys have dominated the materials used in transportation, oil & gas, infrastructure, utensils, musical instruments and in many other day-to-day applications since the middle of the 19th century. Other than construction, steel finds application in most of the transportation modes like road transpiration, shipping, hyperloop and even in a spaceship as its skin made of stainless steel. Steel is used in the fuel and oxidiser tanks of the launch vehicle and the infrastructure around the rocket Chandrayaan-1 and Chandrayaan-2. In the case of renewable energy too, steel is required for installation of solar, wind energy, etc.

Sustainable Material

Steel is the only material that is fully recyclable and that has the best environmental performance over its entire life cycle compared

to alternatives. The steel used in constructing home saves trees. It is non-toxic and creates 100 percent recyclable waste. Using recycled steel to frame a home is much better for the environment than cutting down trees. Buildings and infrastructure account for over half of the global steel market. Steel products are extremely durable and last approximately 40 years.

Other materials, like carbon fibre and aluminium, have sought to make inroads by steeping into that gap. But while adoption of these alternatives has increased for certain markets and applications, steel's prevalence, strength, recyclability, low production cost and significant capacity continue to make it the preferred and dominant choice for the industry.

Yet, as elemental and ubiquitous as steel remains today, progress never stops and new challenges demand step-change improvements in performance capabilities. Steel is now expected to meet new material properties and performance capabilities.

New Generation of Steel

Nano Steel's mission is to commercialise new generations of steel that will allow this venerable material to re-invent itself in the face of increasing demand so that it can remain the material of choice for the next two hundred years. Nano Steel's research has resulted in the creation of progressive generations of Nano-structured alloys from surface coatings to sheet steel.

Future Mobility – 6 Reasons Why Steel will Meet the Challenge

The trend toward connected, self-driving, shared and electric vehicles is quickly moving from concepts to commercial viability. Self-driving vehicles will introduce a new kind of freedom both for the driver and its occupants. Vehicles will no longer be designed around the driver, but designed to serve the needs and comfort of the occupants.

With the rise of mobility services such as Uber, Didi, and a host of others, it will become more and more appealing to subscribe to a monthly ride share service for all transportation needs instead of owning a vehicle.

In this new interconnected world, will steel still be the material of choice? To answer this question, let's take a moment to look at why steel should gain favour with car owners, manufacturers and designers.

1. Durability and cost advantage

Fleet owners who provide ride sharing services will need to manage the total cost of ownership. To be profitable, they will want durable, lasting vehicles that are affordable to own. Steel is cost-effective and lasts a long time.

2. Environmental advantage

In a world where climate change is at the forefront of people's concerns, autonomous vehicles will meet the highest environmental requirements. Steel is the only material that is fully recyclable and that has the best environment performance over its entire life cycle compared to aluminium and carbon fibre.

3. Safety protection

Because it will take some time before all vehicles on the road are fully connected, the need for passive safety will remain for the foreseeable future. Steel will still be needed to provide the unique properties of both crash energy absorption and deflection. Battery housings made from steel will provide structural integrity for crash management, while also preventing battery pack damage and leakage.

4. Flexibility of design

Steel's design flexibility and unique formability help designers use their creativity to the full. With the removal of the steering wheel, foot pedals and conventional dashboard, designers will have more space to use their creativity.

Steel can provide the needed strength while keeping the material thin, which leads to more room in the passenger cabin for new seating arrangements. Steel will manage the loads associated with passengers in multiple and diverse seating configurations.

5. Light weighting

Light weighting will continue to be important to balance smaller battery sizes with maximum range. The steel industry has been and will continue to develop products, such as the ever-

growing family of Advanced High-Strength Steels (AHSS), to meet both the mass reduction and the safety targets, affordably.

6. Steel's strength

Today, the strength of steel in a vehicle's body structure can reach 1,700 Mega Pascals. This is over 9 times stronger than 50 years ago.

7. Electrical steels

Electrical steels are essential material in the construction of generators and motors for electric vehicles. In fact, there would be no electric mobility without steel. For all these reasons, steel will be central to this revolutionary change due to its durability, strength and environmental advantages.

New Areas of Usage

Steel Underpins Infrastructure at World Cup in Japan

As 20 nations prepare to compete for the World Cup in Japan, steel will be crucial in the structure of the venues. Fans will utilise Japan's 16,976 km of steel railway to travel between the stadiums, taking advantage of one of the world's fastest trains, the Shinkansen, which can reach speeds of up to 360 kph largely on high-strength steel rails.

Several of the magnificent World Cup venues are reliant on steel, such as Oita Stadium, which has Japan's biggest retractable roof containing 12,500 tonnes of steel, or the Sapporo Dome with its 53,000 m2 roof made entirely of stainless steel and retractable pitch.

The largest stadium in use is the International Stadium in Yokohama, with a capacity of 72,327. Its enormous steel roof has been specially designed to reduce the effect of wind on the playing area and prevent noise pollution. Even the official tournament goalposts are reinforced with stainless steel bolts, and sockets.

Maraging Steel delivers World's Finest Fencing Blades

Due to its strength, flexibility and extreme toughness, professional fencers will only compete using swords made from maraging steel.

Maraging steel is a high-strength alloy made with around 18% nickel and lesser amounts of cobalt, molybdenum, titanium and aluminium. This combination of alloying elements stops titanium carbide precipitates from forming during heat-treatments as part of the manufacturing process. This in turn preserves the alloy's amazing impact strength, ductility and toughness. Thanks to its chemical composition, the blade typically lasts four times longer than a carbon steel version, so straight away it reduces the chance of injury.

When microcracks inevitably form on the blade during swordplay, maraging steel slows the cracks from spreading. This slow propagation of cracks preserves the steel's rare combination of high strength and toughness, which for fencers is critical.

Regular steel blades could also break suddenly with a sharp angle that was very dangerous for the fencer – maraging blades don't do this.

Steel helps Unlock Sanitation in India's Schools

India's steel industry, and steel itself, are indispensable in providing the sanitation facilities that the country's sustainable development requires.

The clean India, Clean Schools Programme, Swach Bharat, Swach Vidyalaya in Hindi, is a nationwide campaign that aims to install hygienic and durable sanitation facilities in all Indian schools by 2nd October 2019, the 150th anniversary of Gandhi's birth. India's steel producers, prominent among them Tata Steel Limited, have been manufacturing and installing toilets, sinks and piping to schools in need of improvement across the country. Sanitation and school attendance, particularly among girls and young women, have dramatically improved, thanks to their efforts.

There are two key aspects in which the steel industry is involved in the Clean India, Clean Schools Programme. One is to get the water supply continuously to the facilities. For this, steel pipes are being used, which are anti-corrosive and last a long period of time. Steel Companies have also been involved in digging bore wells to ensure a reliable supply of water to installed facilities in rural areas, all of which, of course, involves machine tools themselves made of steel.

Source: Steel Tech

India to be net exporter of steel for years: Pradhan

Steel Minster, Dharmendra Pradhan said that in the next two-three years, India will be in a position to remain a net exporter of steel for years. Currently, India has a production capacity of about 140 million tonne and produces over 100 million tonne of steel annually, he said. According to the Minister, India produces saleable steel; and sometimes become importer and at other times, India turns into an exporter. At present, the country is net importer, importing about 2-3 million tonnes. Within the next two-three years, India would remain a net exporter of steel for years. There would be no import the minister expressed.

Domestic steel demand, global sentiment may improve in H2: Crisil

Domestic steel demand and global market sentiment are likely to improve in the second half, but a weak first half is expected to lead to a 5-6 percent contraction in realisations for steel makers this fiscal, ratings agency Crisil has said in its latest research report on the sector. Falling spreads on earnings before interest taxes depreciation and amortization (Ebitda) will weigh on steel sector capex, the report said, adding that the industry is yet to see a recovery in prices despite a run-up in raw material costs. "Global steel prices dropped 13 percent in the first eight months of 2019 due to weak demand, unseasonal jump in global inventory levels of upto nearly 35 percent through August and trade tensions," the report said. This was despite a whopping 56 percent run-up in global iron ore prices during the same period. "Steel prices in India mirrored the trend, falling 10 percent from Rs 42,000 per tonne in January to Rs 38,000 per tonne in August 2019," the report added. Not surprisingly, Indian steel manufacturers' earnings before interest, tax, depreciation and amortisation (Ebitda) spreads contracted 420 basis points (bps) on-year in the first quarter of fiscal 2020.

Govt. allows SAIL to sell 25% of its iron ore from captive mines

The government has allowed SAIL to sell 25 percent of its iron ore produced from captive mines and dispose old stock of 70 million tonnes of low-grade iron ore mines and ores lying at mine heads across the country. The ministry of steel has stated that more than 162 million tonnes of low-grade iron ore are available at mine heads in India, as the regulations do not permit SAIL to sell these materials to domestic end-use companies. The move by the ministry through two separate notifications on September 16 is seen as an effort to reduce concerns regarding the expiry of mines. Thirty-one working mines of iron ore are expiring on March 2020. SAIL has the capacity to enhance iron ore production from its captive mines by around 8 million tonnes in 2019-20 and 12 million tonnes by 2021-22. According to a tweet by the ministry of steel, the government had given permission to sell 70 million tonnes of sub-grade minerals in the captive mines of SAIL. In order to increase evacuation from captive mines, the government has allowed SAIL to offload in a year, up to a quantity equivalent to maximum 25 percent of total iron ore production in the previous year. For this, the company will have to get clearance from state governments. The government expects the move will help SAIL in meeting its own requirements and also meeting the expected shortfall in domestic iron ore market.

RINL posts Rs. 96.7-crore profit in FY19

The Visakhapatnam Steel Plant (Rashtriya Ispat Nigam Limited) has earned a net profit of Rs 96.71 crore on a sales turnover of Rs 20,844 crore, according to sources of the Company. The 37th Annual General Meeting (AGM) of RINL was held here recently P.K. Rath, Chairman and Managing Director, chaired the Meeting and Neeraj Agarwal, Director, Ministry of Steel, attended the AGM. Rath, addressing the shareholders of RINL/VSP, explained the position of the company and said it could improve its market share from 8.60 percent to 8.80 percent during the year. The turnover of Rs 20,844 crore including sale of trail run production of Rs. 506.32 crore recorded growth of 25 percent over the previous year. Despite the pressure on realisations in the second half, the net sales realisation for the year as a whole registered a growth of 17 percent over the corresponding period last year. The company earned a net profit of Rs 96.71 crore compared to a net loss

of Rs 1369.01 crore in the previous year. The company hit a growth of 11-12 percent in major areas of production during the year such as hot metal, liquid steel and saleable steel. The best ever annual performance was achieved on important techno-economic parameters such as labour productivity, pulverised coal injection and specific energy consumption. Initiatives were taken to maximise production and sales of value-added steel rounds from new units SBM and STM and maximising medium carbon (MC) and high carbon (HC) grades. High carbon WRC sales touched a new peak with a growth of 33 percent over previous year.

JSW Steel to plough ahead with Rs. 50k-cr capex plan

Although steel prices have come off by a good 20-22 percent over the last one year and demand remains somewhat subdued, JSW Steel doesn't plan to slow down. MV Seshagiri Rao, joint managing director and group CFO, says his firm will not recalibrate capex plans of close to Rs 49,000 crore by FY21. Should the acquisition of Bhushan Power and Steel go through, the steelmaker will have a total capacity of 21 million tonne, making it the country's biggest producer. According to Rao there were not many players expanding capacity. So, if one can create capacity by the time the industry looks up, maybe after 2-3 quarters, they would be fine. Despite the "over cautious" leading environment, Rao believes he will be able to fund the expansion through a mix of debt and internal accruals. The tight regulations, he pointed out, were making it difficult for companies to borrow from banks. Moreover, the paucity of options in the corporate bond market had made it impossible to raise 10-15 year money. Whether it's insurers, mutual funds or pension funds they do not have cash flows to lend beyond three years, Rao said, adding the severe restrictions on ECBs were also making it hard to tap the overseas markets. JSW Steel is looking to produce as estimated 16.95 million tonne in FY20, only 1.5 percent more than the previous financial year. With production having been trimmed, global steel prices are unlikely to fall further though prices of iron ore could correct further. Consequently, there's unlikely to be much more margin pressure, Rao said, since producers, including those in China, are losing money.

Source: JPC Bulletin

EU imposes tariffs on import of steel wheels from China

The European Union has imposed tariffs on imports of steel wheels from China. The rates of the provisional anti-dumping duties are 50.3 percent against 19 specifically named Chinese exporters including Zhejiang Jingu and Xingmin Intelligent Transportation Systems and 66.4 percent for all others. The levies will last six months and may be prolonged for five years. The anti-dumping duties represent the preliminary outcome of a probe opened in February on the basis of a dumping complaint by the Association of European Wheel Manufacturers. EU has 11 manufacturers of steel road wheels, which took the unusual step of declining to identify any of them on grounds of a fear of retaliatory measures by some of their customers. Chinese exporters' combined share of the EU market for steel road wheels doubled to 5.3 percent last year compared with 2015.

South African steel pipe producers Robor shuts shop

Once one of southern Africa's largest suppliers of steel, 90 year old Robor tube and pipe, will close its doors. Tiso Blackstar, which holds a stake of almost 48 percent in Robor, blamed its demise on the weak state of the economy and cheap Chinese imports, among other factors. In addition, delays in the signing of Independent Power Producer agreements with the South African Government and the well-publicised financial demise of Eskom have caused systemic harm to both production and revenue generation in South Africa's steel tube and pipe manufacturing sector. It also said that new US import duties on imported steel, hurt Robor's sales of specialised steel pipe into the US oil and gas industry, previously a lucrative export market. Tiso also blamed government for not extending import duty and tariff protection to downstream industries, "thereby exposing steel fabrications to huge margin erosion to compete with imported steel-manufactured goods". Germiston-based Robor has seen a

sharp slump in volumes over the past 18 months, and despite restructuring, cost-cutting and new deals with credit providers, have not been enough to stop the company's decline.

New Danieli Large Bloom Caster in Operation at Valin Xiangtan

The brand new, 14-m five-strand bloom caster was started successfully after less than 13 months from the contract signature. A joint effort of Valin and Danieli site teams made possible machine erection in just 38 days, limiting the cold tests to just 11 days. Presently the caster is producing a wide range of steel grades, including high-alloyed and high-carbon spring steels in square and rectangular sections, 280x280 and 350x430 mm. Many performance activities have been accomplished and full commissioning will be completed very soon, with Valin's satisfaction. This is the first caster in the world operating with different withdrawal units along the line performing simultaneous soft and hard reduction, to further optimize internal quality – particularly on high-carbon grades- which tend to exhibit higher porosity and segregation.

NLMK La Louviere launches a 150 million Euro hot strip mill upgrade to produce premium steel

NLMK La Louviere, one of the leading producers of flat steel coils in Belgium and a company of NLMK Group, has embarked on a 150 million euro project to revamp its hot strip mill, expanding production of thinner, stronger and more environmentally friendly steel. The investment is a part of the NLMK Group Strategy 2022. With this upgrade NLMK La Louviere will increase production from 1.7 mt to 2.2 mt by 2022 with a bigger share of the niche HRC market in the EU. The extensive upgrade includes installation of the state-of-the-art automation system, three new and three upgraded roll mill stands, new drives and motors as well as new run-out table, modernized cooling and water systems. The project will enable the mill to expand production of high strength thin hot rolled coil (down to 1.2 mm), increase the range of high-strength products beyond 1000 MPa yield strength and provide customers with best-in-class surface and dimensional tolerances. The first phase of the mill transformation is scheduled for early 2020, for completion in 2021. The contract has been awarded to Primetals Technologies, a leading supplier of solutions for the metals industry. The company has finalised basic engineering and launched production of the equipment.

Source: JPC Bulletin

Steel industry reels from poor demand and wafer-thin margins

Until each department made a commitment to how exactly it would contribute towards cutting costs by Rs 3,500 a tonne at a meeting of Steel Authority of India's (SAIL) IISCO Steel Plant recently, no one was allowed to leave the room.

That's the measure of how serious IISCO CEO A V Kamlakar is about slashing costs.

In a sluggish market, cutting costs is the only way to maintain margins. Net sales realisation has fallen by Rs 10,000 a tonne over the past year, said Kamlakar. In the last quarter alone, it's dipped by Rs 4,000-5,000 a tonne.

Steel is one of the most important raw materials for infrastructure and the auto sector. In August and September this year, steel production contracted for two consecutive months (1.5 percent in both), rarely seen before. On the contrary, the index of industrial production (IIP) for basic metals, of which steel is only a part, rose 9.2 percent.

The drop is showing on IISCO's financial performance. In the quarter ended September, it recorded a pre-tax loss of Rs 194.9 crore and in the June quarter Rs 60.5 crore.

IISCO caters mostly to the construction and infrastructure sector which has been adversely affected by the slowdown during the monsoon, a decline in government spending, and liquidity issues.

A small part of the plant's wire rod coils are used by auto component manufacturers and the weak demand in this sector hasn't helped.

Typically, about 60 percent of steel end-use mix is accounted for by construction while 8-10 percent of demand comes from automobile segments.

In a large integrated steel plant, there are very few variables that can be tweaked to cut costs

– except raw material.

"Raw material is the only variable. Even if we can adjust our coke rate by a kilogram, it would translate into savings of crores of rupees," said an official on the shop floor.

IISCO's furnace can produce 7,800 tonnes a day at full capacity. In September, production stood at 6,000 tonnes and in October it stood 6,700 tonnes. In November, however, production to full capacity was restored.

IISCO has 6,700 regular employees and 6,000 on contract." Just because production is throttled doesn't mean we have idle people," said Kamlakar. "There is no impact on manpower."

Around 85 percent of the domestic steel industry's coking coal requirements is met through imports. The average price for the January-October period of 2019 has been $186 per tonne – down 9 percent from $204 per tonne during same period in 2018, said CRISIL Research. The price of the other major input, iron ore, has remained high.

Everyone is resorting to the same measures

With a weak domestic market, IISCO focused on exports. Its story is not an isolated one. Diverting material to the export market to clear inventory, slowing production, and advancing planned shutdowns have been the dominant themes running through small and large, public and private sector steel companies for the past nine months or so.

According to data, finished steel consumption grew only 3.1 percent in the second quarter of the financial year (year-on-year), compared to 10.3 percent in the second quarter of Q2FY19.

ICRA Group Head, Corporate Sector Ratings, Jayanta Roy, pointed out the consequences of weak demand. The slowdown in demand and price levels have led to a significant weakening of financial performance of four large steel players – Tata Steel, JSW, JSPL and SAIL. While the operating profitability declined to around 18 percent from 23 percent in FY19, interest coverage deteriorated to 3x from around 4.3x over the same period. The financial performance of smaller companies has been even weaker," said Roy.

Clearly, the country's economic slowdown is all-pervasive and its ripple effect on people is being felt in different ways. Consider this: the variable pay of executives in a major private sector steel producer is around 25 to 50 percent, Sixty percent of that relates to company- linked parameters, EBIDTA being one.

"The company-linked part of the variable pay is likely to be majorly impacted. We have to factor it in while planning our spend," said a company executive.

The lumpsum payout is mostly used to make big-ticket purchases or pay off home loans – and there lies a potential chink in the India consumption story.

Ancillary units also feel the pinch

The domino effect of the slowdown on the smaller ancillary units linked to the major steel plants can be seen in the figures. Two units of gearbox manufacturers in the industrial belt of Howrah, about 15km from the central business district of Kolkata, shut shop. Companies they supplied to either resorted to cheaper Chinese alternatives or sourced them locally. Lost: 300 jobs.

The gearbox units are just two of the 100 units that have shut in Howrah in the last two to three years, post-demonetisation and post-GST for which the cost of compliance for smaller units has been high. The slowdown in demand was the final nail in the coffin.

"The e-way bill is making it difficult for some people to send material to other states. Hence they are relocating their units to Uttar Pradesh, Punjab, Haryana, or are just incurring losses and going to NCLT," said Santosh Kumar Upadhyay, general secretary, Howrah Chamber of Commerce & Industry. Sanjay Budhia, managing director, Patton, who has a steel tubes and pipes unit, said 70-75 percent of the business which is export-focused is not affected by the slowdown but the remainder has taken a knock because of the slump in the auto sector.

Refractory makers, used mainly in lining for furnaces and kilns, are also suffering volume and pricing pressure. "There has been a clear slowdown in the last 6-9 months. Production of steel plants is at the same level as last year. Some are producing more and some significantly less," said Sameer Nagpal, head, advocacy, Indian

Refractory Makers' Association. A refractory maker supplying to steel plants said: "We are working on wafer-thin margins. Customers are making late payments but there is no relaxation of payment it's a breakdown of structure."

While there are some signs of a price recovery owing to major steel producers increasing prices, the question on everyone's mind is whether this is sustainable. "We need a demand recovery, not price recovery," said the owner of a small ancillary unit.

Source: Business Standard

Domestic steelmakers raise prices for 2 months in a row

In a bid to address margin compression and in anticipation of demand pick-up, domestic primary steel producers have raised product prices by 2.5-3 percent for December. "Since margins have become unsustainable, cost pressures versus the steel product price is not helping producers meet ends. This is the primary reason for the product price hike this month (December)," Jayant Acharya, director (commercial & marketing) at JSW Steel told Business Standard. The December price hike is happening for the second consecutive month. In November, producers raised steel product prices between Rs 500 a tonne and Rs 1,000 a tonne, after a gap of about six months.

BALANCE SHEET In ₹ crore

		Jindal Steel	JSW Steel	SAIL	Tata Steel
Net sales	Sep '18	6,848.8	19,126.0	16,718.0	17,579.8
	Jun '19	7,084.8	17,344.0	14,820.0	15,812.8
	Sep '19	6,572.9	15,218.0	14,127.4	14,486.6
Total expenditure	Sep '18	5,396.7	14,915.0	14,387.2	11,934.1
	Jun '19	5,476.8	13,866.0	13,238.1	12,175.2
	Sep '19	5,317.9	12,724.0	12,967.7	11,395.5
PBIDT	Sep '18	1,707.5	4,990.0	2,445.2	6,743.0
	Jun '19	1,608.0	3,991.0	1,764.8	4,094.0
	Sep '19	1,255.1	2,984.0	1,318.5	3,579.1

Source: Capital Line Compiled by : BS Research

While steel producers expect the market to embrace price hike, industry officials are of the view that the consumer is not ready and continuous hikes of this kind may not be sustainable. "There is absolutely no demand from the infrastructure segment. Also, the auto demand was good only in the festive month of October. Overall, there are no strong demand indicators as of now for steel. Continuous price hikes in such a scenario may be difficult to sustain," a Mumbai-based trader said.

The index of eight core infrastructure industries contracted 5.8 per cent for October 2019, which was its lowest level since the construction of the index with 2011-12 as the base year. Among the eight segments, the steel industry witnessed a 1.6 per cent fall in October, worse than a 1.5 per cent drop in September. In October last year, the steel industry had witnessed 2.4 per cent growth. Meanwhile, steel producers have sealed half-yearly contracts for the auto segment factoring in the recent fall in steel prices. "There is a reduction from H1 (the first half of the year) to H2 (the second half). However, the numbers (quantum) are different from customer to customer, so I wouldn't like to give a single (price reduction) number," said Acharya. While some players had said the price cut was by Rs 6,000 a tonne, others were of the view that the overall domestic steel price drop was sharper, close to Rs 8,000 a tonne, in the last three to four months, and hence contracts could have closed at much lower price levels.

Among top domestic steel producers, Sajjan Jindal-led JSW Steel, Essar Steel, and Tata Steel are into flat products used in the auto sector, while state-owned Steel Authority of India Limited (SAIL) and Jindal Steel & Power cater for the construction and infrastructure segment that uses long steel products. On the inventory front, too, the view of the producers differed from that of industry officials. At one end, Acharya of JSW Steel said: "Inventory-wise, the industry is in a comfortable position as the producers have lowered their production which helped inventory dilution. Even the channel inventories have come down. Exports have also helped bring down inventories."

According to the Joint Plant Committee data, India's steel exports during April-September this year rose 22 per cent year-on-year to al-

most 4 million tonnes. "Steel producers are lowering production by advancing capital repairs but stockists and traders continue to have slightly higher inventory. Even the SME (small-and-medium enterprise) sector, which usually keeps no inventories, is having stockpiles this time," said Sushim Banerjee, director general at Institute for Steel Development & Growth (INSDAG). Capital repair, which is the maintenance of the blast furnace of the steel plant, usually takes place in April. However, companies have advanced this activity to November this financial year citing weak demand scenario, according to industry officials.

Source: Business Standard

SAIL records a growth of 47% in December sales

Steel Authority of India Limited (SAIL), the largest Public Sector steelmaker, welcomed the New Year – 2020 at a function held at the Company's Headquarters at Lodi Road, New Delhi. While addressing the SAIL Collective on this occasion, Shri Anil Kumar Chaudhary, Chairman, SAIL, said "Despite the challenging steel market conditions, SAIL has exhibited resilient performance consistently and will continue to do so in future also. The Company has achieved the highest ever sales in a month during December 2019. With sales of 1.68 Million tonnes in December 2019, the Company clocked a growth of 47% over CPLY". Incidentally, SAIL posted a 36% jump sales during November'19 over CPLY. The Company is consistently maintaining the growth momentum in sales. While making special reference to the supply of rails to the Indian Railways, he mentioned, "During the nine months of FY'20 (April'19 – December'19), SAIL has already supplied 9.25 lakh tonnes of rails to the Indian Railways where the entire supply of rails was 9.85 lakh tonnes during the previous Financial Year 2018-19". To cater to the growing demand of the Indian Railways, SAIL is gearing up to enhance production of rails substantially. Shri Chaudhary applauded the proactive role, supportive policies and continued encouragement of the Government for the development of the steel industry. In the current competitive market, SAIL is making relentless efforts to reduce the cost of production on an ever on-going basis. Its strategic priorities include enhancing volume, improving techno-economic parameters and process efficiency and developing new products.

Source: Business Standard

China's steel mills alter iron ore procurement preferences as market changes focus

Attractive steel margins and a relative lack of pollution controls are having a marked impact on the iron ore procurement preferences of China's steel mills in December ahead of the Lunar New Year holiday that falls early in 2020, on January 25.

Attractive steel margins have shifted the priority for Chinese mills towards efficiency and the utilization of higher quality iron ore fines, widening the discount for low grade and non-mainstream fines against the Platts 62% IODEX in December and weakening demand for low alumina Brazilian fines.

When China's domestic hot rolled coil margins were in the $40-$70/mt range and rebar margins at $70-$90/dry mt in May, premiums for Vale's Brazilian Blend Fines or BRBF over the front month IODEX rose to around $7-$8/dmt while Pilbara Blend fines remained around $2-$3/dmt. Similarly when steel margins were high over August-October 2018, BRBF premiums were notably higher than for PBF.

However, amid the rebound in steel margins since November to above $60/mt for HRC and above $100/dmt for rebar, premiums for both have remained mostly below $2/dmt, reflecting the lack of interest in securing imports of low alumina fines.

Typically, high grade iron ore brands with low alumina from these countries as well as Scandinavia, Canada and the Middle East tend to be utilized more by non-Chinese producers due to proximity and their generally higher demand for high grade iron ore with low impurities.

The increasing preference of Chinese mills for drawn-out restocking from ports rather than a last-minute buying rush for seaborne cargoes before the Lunar New Year holiday was expected to have a longer-term impact on market dynamics. Large-scale procurement activity in a short period is now avoided due to the price surge it prompts, which leaves mills with little negotiating power. In addition, stricter limits on overloading trucks at ports after a bridge collapse in Jiangsu in October have slowed down purchasing for many mills.

The sharp increase in price volatility in 2019 has kept many Chinese mills away from the seaborne market due to the risk of committing to large Capesize volumes. Even on a floating basis, sharper inter-month pricing changes than in 2018 have led to a preference for procuring smaller volumes at ports, even at comparatively higher prices, to reduce pricing risk. Ahead of the Golden Week holiday in October, strong demand emerged from both steel mills and traders for Australian cargoes on expectations of supported levels of steel production.

However, more stringent than expected pollution controls in October, leading to sintering and production cuts, led to a 1.2 million mt fall in steel output from September to 81.52 mt. The spread between the US dollar equivalents of Platts IOPEX -- the 62% index at northern Chinese ports -- against Platts IODEX was $8-$11/dmt in late September as Chinese mills opted for procuring at ports at higher prices due to the flexibility of securing lower volumes.

Current high steel margins are unlikely to continue into winter as construction activity winds down, weakening steel demand. Unlike pollution controls, narrower margins are not expected to impact blast furnace utilization rates, which will only fall if margins turn negative. So, with sintering and blast furnace restrictions currently weak, demand for direct feed raw materials is based almost entirely on attractive steel margins.

Given it is winter, some market sources doubt there will be wider use of high grade-low grade mixtures as a more economical replacement for Australian fines, noting the general preference for fines with low moisture levels to facilitate storage and the relative lack of stability in specifications for certain products, which limits demand to ports where specifications are confirmed before purchase.

If steel margins remain high closer to Lunar New Year, little change is likely to current procurement preferences. Although in theory higher grade low alumina Brazilian fines would enable mills to increase production efficiency, volatility in steel margins presents a hurdle for large mills that are unable to adjust their sinter feed quickly in the event margins narrow.

Mills in northern China that want to increase Brazilian fines usage have the option of port-blended BRBF or the seaborne option from Teluk Rubiah. The tightness in iron ore supply this year from Vale continues to limit end-user interest in a large-scale increase in Brazilian fines usage, especially given the availability of competitively priced low alumina hematite.

Source: Metal Junction

Steel industry commits to Paris targets

The global steel industry has launched a standard for the responsible production of steel. The Responsible Steel Standard, launched on December 2, is an international, multi-stakeholder standard that covers making a processing sites, and was launched in Wollongong, Australia, the home of BlueScope steel operations.

Mark Vassella, CEO of BlueScope, announced at the launch that the Port Kembla Steelworks will be certified to the standard. The Standard aims to reduce greenhouse gas emissions from steel production by committing to achieve the goals of the Paris Agreement, ensure mining practices are sustainable, and ensure employee safety and labour rights. To do so, the Standard sets fundamental elements and levels of implementation that can be characterised as responsible.

The Standard covers 12 principles, Corporate Leadership, Social Environmental and Governance Management Systems, Occupational Health and Safety, Labour Rights, Human Rights, Stakeholder Engagement and Communication, Local Communities,

Climate Change and Greenhouse Gas Emissions, Noise, Emissions, Effluence and Waste, Water Stewardship, Biodiveristy, and Decommissioning and Closure.

The launch of the standard was not only attended by steel producers, but customers such as developer Lendlease. Cate Harris, group head of sustainability and Lendlease Foundation, highlighted why the company was involved. "Membership of Responsible Steel gives us the opportunity to work alongside our supply chain to address pressing global challenges that matter to us, such as climate change and human rights. As a large customer in the steel sector, we see supporting the development of the Responsible Steel Standard as both our responsibility and a powerful way for us to be part of the evolution of the steel industry.

Source: Metal Junction

Coal blocks in India no longer 'captive'; Steel, power firms may bid for mines

Dozens of captive coal mines with abundant reserves of the fuel could be up for grabs soon, without any end-use restrictions, as the Cabinet decided a few days backto promulgate an ordinance amending the relevant Act, with an aim to revive investor interest in the sector.

Essentially, the change will mean that domestic and foreign steel companies and also local power companies will also take part in the auctions to be held to reallocate the captive blocks cancelled by the Supreme Court in 2014. So far, only 89 of the 204 blocks cancelled by the apex court have been reallocated — including 60 assigned to PSUs on a nomination basis and 29 auctioned off — and just 29 of them are operational. While steel and power firms have interest in coal mining as it gels well with their businesses if unhindered open market sales of surplus coal is allowed, they have been largely shying away from the auctions held so far — even 25% open-market sales allowed in February 2019 were not enough to kindle their interest in these coal blocks.

The Cabinet, via an amendment to the Mines and Minerals (Development and Regulation) (MMDR), also extended the policy of composite mining licence, now in force for unexplored blocks of most non-coal minerals, to coal sector as well, adding to certainty of tenure from the prospecting to the production stages. Stating that the policy changes would lead to "democratisation of the (coal mining) sector by opening it for anyone", coal minister Pralhad Joshi said, the decision will result in "promoting foreign direct investment in the sector by removing the restriction and eligibility criteria for participation".

With coal imports surging and becoming another drag on the country's current account on oil imports, the government has taken a series of steps in recent months to populate the sector with more investors and technology players – in February 2018, it allowed auction of coal-bearing areas to private parties for commercial mining, ending the long-held monopoly of public-sector behemoth Coal India and in August 2019, it allowed 100% foreign direct investment (FDI) through the automatic route in commercial coal production.

However, there has been no evidence yet that these steps are bearing fruit, largely because unrestricted commercial coal mining has been out of bounds for steel and power companies. While the idea was to bring global mining giants such as BHP Billiton, Rio Tinto and Glencore into India's coal mining sector, these firms are seemingly withdrawing from the sector in a gradual manner and as a result don't seem to have a keen interest in India's coal sector at this juncture.

After the August 2019 Cabinet decision allowing 100% FDI in coal mining, Rio Tinto told FE that it is "no longer active in any form of coal production." Mining major BHP too had said, "We do not expect to invest in our energy coal businesses for the lack of commercial viability". BHP added that, "We do think this is a business whose demand will be under pressure, partly because of the transition towards cleaner air and to confront the challenge of global warming, but this is a resource that compared to some of our other commodities is in relatively high abundance, so we see squeezed margins in the future."

On the other hand, local steel and power firms have welcomed the recent Cabinet decision. Sajjan Jindal, chairman at JSW Group, said, "Huge reform… This will go a long way in reducing the coal imports which is over $15 billion/year." He added, "This was a long pending reform which will make the Indian steel industry more aggressive and competitive on a global level."

Kameswara Rao, leader, PwC India, said, "The removal of end-use restrictions broadens the energy market, and thus brings price stability". "But the power market itself has to get more competitive by liberalising open access for this benefit to fully transfer to consumers," Rao added. After a long gap of four years and amid rising coal imports, the Centre in December 2019 allocated five captive coal mines to private companies. Since late 2015, the government had cancelled three auctions due to lack of investor interest. In early 2015, as many as 31 blocks were allocated through competitive bidding.

Even though domestic coal production has improved in recent years, the rising demand for the fuel had led to a surge in coal imports · shipments surged from 190 million tonne in FY17 to 235 million tonne in FY19.Captive coal blocks produced only 25.1 million tonne (MT) in FY19, much lower than the peak output of 43.2 MT in FY15 when the Supreme Court had cancelled the licences of 204 such coal mines. However, a senior coal ministry official told FE that captive coal production would surpass the 43 MT mark in the ongoing fiscal.

India is estimated to have coal reserves of up to 300 billion tonne; the country produced 730 million tonne of coal in 2018-19: 607 million tonne by CIL, 64 million tonne by Singareni Collieries and the balance by captive coal producers. The country has set a target to increase coal production to 1,500 million tonne by FY24. Before the August 2019 Cabinet decision, 100% FDI via the automatic route was allowed in coal and lignite mining for captive consumption by power, steel and cement units. Also, 100% FDI was allowed via the automatic route for the setting up of coal washeries, but the FDI firms could sell washed coal only to those units that supply raw coal for processing, and not in the open market.

These restrictions had practically prevented FDI from flowing in. Currently, 100% FDI is allowed in not only mining for sale in the open market, apart form in 'associated infrastructure' like washeries, crushing, coal handling and separation.

Source: Metal Junction

India rethinks its coal future

A common preoccupation of producers of ferrous and non-ferrous metals in India, China and elsewhere is to ensure security of supply of raw materials over a long term. At least in two major minerals, namely iron ore and bauxite required by makers of steel and aluminium, respectively, India being adequately endowed has a distinct advantage over China, which is dependent on import for both. In the case of metallurgical coal, however, this is not the case for India. Its imports are set to rise year-on-year as more and more steel is to be made using the blast furnace and basic oxygen furnace (BF-BOF) route.

The country's growing import dependence is because not only is the domestic supply of coking coal way short of steel mill requirements, the poor quality of local fuel because of a high degree of ash demands its blending with high quality imported stuff to make it BF friendly.

New Delhi by way of the 2017 steel policy has set a task to reduce coking coal import dependence from the present 85 percent to 65 percent by 2030-31. This is sought to be achieved by stepping up production of the fuel and getting it washed to rid it of much of its ash. The steel policy says BF-BOF route will have a 60 to 65 percent share of the 2030-31 steel capacity of 300 million tonnes (mt) and production of 255 mt. On the basis of BF-BOF route's requirement of 700 kg of coking coal for making one tonne of crude steel, the 2030-31 fuel requirements will be 161 mt.

There is nothing wrong with imports if a particular raw material, in India's case it is coking coal, is not available locally in terms of volume and quality. For example, Japan runs its steel industry at the highest levels of efficiency and optimum value addition to primary steel notwithstanding its total dependence on raw

material imports. New Delhi has evolved a three-pronged strategy to progressively cut our coking coal import dependence by overseas asset acquisition, creating a sufficient number of modern washeries and exclusive allocation of indigenous met coal reserves for the steel sector. Coal India is expected to be ready with nine new washeries for metallurgical coal by the end of the next financial year.

While renewed attempts to step up domestic supplies both in terms of volume and quality will be of relief to steelmakers without captive mines, the country is reconciled to doing mostly with coal of foreign origin at all times. The concern is not about unavoidability of imports but, as additional steel secretary Rasika Chaube points out, about India's continuing overdependence on a single source for coking coal. In the past three years, India stepped up imports of such coal from Canada and the US, albeit at a slow pace. As this is happening, the share of Australia in this country's coking coal market fell to 71 percent or 36.91 mt during 2018-19 from around 88 percent three years ago. Irrespective of the rate at which India starts buying coal from countries other than Australia, imports will continue to rise in step with our growing steel production.

What is not to be wished away is the continuing overwhelming dependence on Australia for coal goes against commercial wisdom. First, production in the coal mining region of Australia is periodically disrupted by natural calamities as was witnessed earlier this year when deadly cyclone Trevor followed quickly by Veronica pummelled Queensland, which has as much as half the share of global seaborne supplies. Veronica, a category four storm, whipped up gusts of up to 263 km an hour uprooting rail lines connecting mines to ports in many places. This and earlier natural disasters such as cyclones Debbie and Yasie disupting coal shipments upset production programmes of steelmakers here. The only recourse for our steel producers to avoid production disruption is to maintain coal stocks to last at least a month, says an industry official. But that kind of inventory leads to cost accretion.

Second, the overdependence on a single supplying nation compromises the buyer's capacity to negotiate favourable terms and conditions of purchases. India is finally awakened to that reality. This is leading New Delhi to promote among steelmakers the idea of "risk diversification in metallurgical coal imports" by exploring countries other than Australia wherefrom coal can be procured at competitive costs on a sustainable basis. At a recent brainstorming session with the industry, Steel Minister Dharmendra Pradhan said the time was now "opportune for us to engage with Russia and Mongolia for the import of coking coal… An Indian technological team is to make survey of the quality of metallurgical coal in Russia and logistics supportive of transfer of the mineral to India using road, rail and sea. Then there is Mongolia, very rich in coal resources, where we are to build a railway line that will facilitate movement of the fuel. There is a lot of goodwill for us in Mongolia, which incidentally is the first country to recommend India's permanent membership of the UN Security Council."

To create excitement among Indian steelmakers, Pradhan told them that "almost all of Mongolia's met coal is now exported to China. But that country is keen to reduce its dependence on a single buyer that is China and explore other markets. India figures prominently in that search." Of China's import of 64.2 mt of coking coal in 2018, Mongolia alone had a share of 43 percent. Industry officials here familiar with Mongolian coal say the country will be able to realise better prices in the world market provided it gets its coal washed and blended before selling.

According to Bhaskar Chatterjee, director general of Indian Steel Association, in India's search for long-term suppliers of coking coal in significant quantities, Russia cannot but figure prominently. If leading Russian coking coal producers such as Mechel and Kolmar want a share of the Indian market, some leading steelmakers here are giving indications that once they have satisfied themselves with "coal quality and supply logistics", they will start using fuel from Russia in significant quantities. The point is not be missed that with the market in the West shrinking where more and more steel is made by scrap recycling, Russia sees in India a potential major outlet for its coal.

Source: Business Standard

CONDOLENCES TO STEEL LEGEND

Delhi Chapter of IIM informs with deep regret that Dr S R Jain, former President of IIM, passed away on 31st December 2019. The Chapter deeply mourns his sad demise. During his tenure at IIM, he steered IIM to greater heights of success and achievements in Metallurgical Field.

Dr. Jain's immense contributions in construction, maintenance and operations of steel plants in India will always be remembered. He was also the former Chairman SAIL, HEC and Coal India Ltd. During his tenure in these organisations, his role in bringing about improvements in various areas will always be referred to by posterity.

The Chapter prays to God that the departed soul rests in peace.

India's NMDC to hike Kumaraswamy iron ore output to 10mil mt/year by 2022

India's Ministry of Mines has approved a plan by state-run National Mineral Development Corp. to boost iron production from the Kumaraswamy mines in Karnataka by 42.8% to 10 million mt/year, the state-run miner said late Wednesday, giving a boost to its domestic production.

The expansion is scheduled to occur over 2020-2021 and 2021-2022, boosting Kumaraswamy's current output of 7 million tonnes/year, NMDC said.

The approval comes after the Chhattisgarh state government extended four mining leases held by NMDC until September 2035.The leases for the mines in Bailadila (Numbers 14, 14-NMZ, 10 and 5) were due to expire in March 3, 2020. A fifth mine in the same area was extended in 2017, NMDC said.

The four mines produce about 24 million mt of NMDC's annual production of 33 million mt over April 2018-March 2019, the company said. The extensions come after India's coal ministry awarded the Rohne coking coal mine in Jharkhand to NMDC on December 14."This allocation would ensure the coking coal requirement of NMDC's upcoming steel plant at Nagarnar, Chattisgarh to some extent," the company said."

This is an important step for raw material security for the steel plant and also to some extent reduce the import of coking coal." The Nagarnar plant is expected to have a production capacity of 3 million mt/year and is projected to come online over H1 2020.

Source: Metal Junction

Raw Material Transportation – Pipe Conveyors become the preferred choice

Introduction

Pipe Conveyors have become the environmentally friendly preferred choice for quick and efficient transportation of raw material, be it iron ore, coal, limestone, fly-ash or cement. The inherent properties of a Pipe Conveyors make it ideal. Its acceptance has been on the rise with the commissioning of several long pipe conveyors (a single flight can Stretch up to 10 km). In the past, lack of understanding about Pipe Conveyors led to various installations being inefficient in cost and operation. A few major players in the industry have instilled confidence in pipe conveyors by delivering efficient systems. Macmet Engineering and FLS are established players in this field, having delivered several pipe conveyor systems in India.

JSW – Case History

JSW Steel, the flagship company of the JSW Group, and a leading integrated steel manufacturer, was looking at meeting the iron ore requirement for the proposed expansion of their Plant in Bellary. The JSW Plant located at Vijayanagar, Bellary, Karnataka, had an installed capacity of 12 million tonne. The management aimed to increase its capacity to 18 million tonne post 2020. This increased capacity meant a requirement of nearly 50,000 tonnes of iron ore in a day. JSW weighed various options for transporting the requisite iron ore over a distance of 25 km from mine to plant. The options available to JSW Steel for transporting iron ore to the Plant were Railway Wagons, Road Transfers, Dumpers, Cable belt, Belt and Pipe conveyors.

These options were evaluated, keeping in mind capacity fulfilment, cost, environment, reliability, ease of implementation and operation. We evaluate some of the options available to JSW.

Rail Wagons

One rake can handle 3600 tonnes of iron ore and each cycle time takes 10 hours. This meant that the system could transport 3600 x 2 = 7200 tonnes/day, which would not meet the capacity requirement of 50,000 tonne/ day. Further, the terrain being very hilly, the cost of putting up the infrastructure would be very high.

Dumpers

Dumpers having a 16-tonne capacity, would make 2 trips per day, which means each dumper

could deliver 32 tonnes/ day. Therefore, more than 1500 dumpers a day would be required to meet JSW's requirement. This is, obviously, not a feasible option. Further, the cost of the road infrastructure, spillage and the changes of road accidents make this option unattractive.

Cable Belt

This is the most expensive option. Moreover, it carries material on an open belt, which, because of environmental issues, was not desirable. While the cable belt has advantage in implementation, however, the present-day cost for installation is prohibitive and outweighs the advantages.

Belt Conveyor

A belt conveyor system would be the cheapest solution but it would require substantially more land to accommodate the generous radii of its layout. Acquisition of land / right of way is an arduous task and this was to be kept to a minimum. Moreover, it also poses environmental issues due to carrying of the material on an open belt.

Pipe Conveyor

Pipe conveyors are similar to a conventional belt conveyor at the material receiving area and discharge area. The flat belt is slowly shaped to trough belt through transition and carrying idlers. At the end of the loading zone, the conveyor belt gradually takes on a pipe formation with the help of variable offset rollers, finger rollers and pipe forming idlers.

Fig.1: Pipe Conveyor at JSW, Bellary

The bottom three rollers on the carrying side of a Pipe Conveyor support the belt and material load whereas the top three rollers maintain the belt in its pipe shape. At the horizontal and vertical curved sections, rollers surrounding the belt support the load depending on the direction of the resultant force. The same applies to the bottom or return belt side of the pipe conveyor which may be utilised to transport a second material, thereby reducing capital and operating cost.

A pipe conveyor system provided certain critical advantages. Long single flight conveyors, environmentally friendly, ease of implementation due to tighter radii. Further, the Pipe Conveyor easily met the capacity requirement for the system.

JSW had apprehensions about the reliability of a pipe conveyor owing to its bitter experience with a pipe conveyor at their Goa plant. Macmet explained the utility and reliability of the pipe conveyor systems. One such 7.5 km pipe conveyor system, which was supplied by Macmet, has been running at JPL Tamnar since 2008. JSW finally decided to install a pipe conveyor system in light of the advantages the system provided.

Advantages of Pipe Conveyor System

Pipe conveyors are an environmentally friendly solution for conveying bulk material with zero spillage and the ability to cover difficult terrain which conventional conveyors would find difficult to negotiate. Pipe conveyor systems are being used to carry coal, limestone, sinter, BF dust, iron ore in lengths varying from 48 m to 20,000 m.

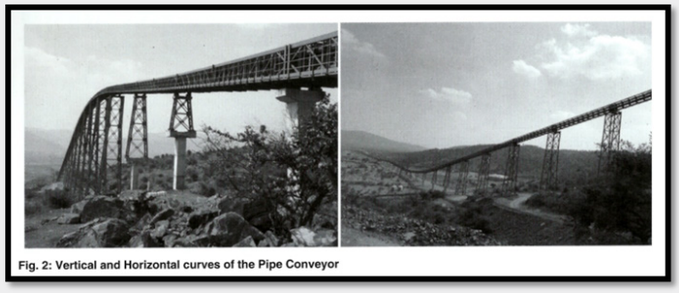

Fig. 2: Vertical and Horizontal curves of the Pipe Conveyor

Development of suitable high resilient flexible belting has been a catalyst for the growth and popularity of pipe conveyor installations.

A Pipe conveyor is a closed conveying system, with no spillage. The material is shielded from the scattering effect of the wind. This makes the system clean and environmentally friendly.

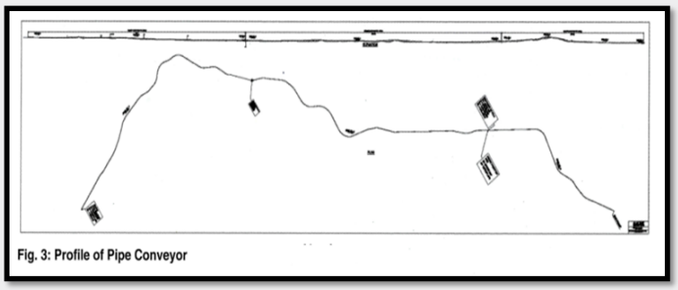
Fig. 3: Profile of Pipe Conveyor

As the material is transported in a closed environment and is not exposed to the atmosphere, the system ensures retention of material properties while conveying.

The pipe conveyor can negotiate both vertical and horizontal curves with much lesser radii compared to a troughed belt conveyor.

The overall savings in space requirement, structural and foundation costs makes investment decisions easier.

Comparative cost advantage (the indicated costs are approximate figures and may vary depending on capacity, length, complexity, etc. however, for any specific capacity the Pipe Conveyor is the most cost-effective system to operate.):

A) Pipe Conveyor: Rs.80/- per tonne

B) Dumper: Rs.300/- per tonne (4 times more expensive)

C) Wagon: Rs.250/- per tonne (3 times more expensive)

Challenges Faced and Overcome during Project Execution

The conveyor system for JSW Steel, Bellari, was designed comprising of three pipe conveyors of 3500/3500/2200tph capacity, travelling at a speed of 5 m/s. The system also included one Sacrificing Conveyors and two Receiving Conveyors. The total length of the conveyor system is approximately 21 km.

There were frequent changes in the conveyor route owing to objections by owners of the lands through which the pipe conveyor would be passing. The system was flexible in accommodating the several changes to the conveyor route with miner cost changes. These pipe conveyors traverse hilly terrain, water bodies, several villages, private lands, roads, railway tracks, graveyards and HT lines. Maintain a safe distance and vertical clearance from these obstacles was challenging.


Fig. 4: Pipe Conveyor Route

The erection of girders on RCC trestles proved to be challenging work as the equipment for lifting could be put in place with a lot of difficulty. Temporary roads had to be built to facilitate the movement of equipment and material. The most difficult task was laying off the belt and pulling it through the modules of girders.

Six maintenance trolleys have also been supplied for repair and maintenance of the three pipe conveyors. The Maintenance Trolleys run along tracks mounted on top of the conveyor structure. It reduces costs (associated with walkways), improves maintenance and reduces accidents. These trolleys are fitted


Fig. 5: Maintenance Trolley

with Driving light and Flood light for dark/night operations. The Trolleys are designed to allow complete access to all parts of the conveyor structure and conveyor components. Each trolley has a terminal station at each end of the conveyor for parking, loading and unloading of personnel & equipment for maintenance. The trolley is controlled by an operator console / dash panel. A diesel generator set is provided on the trolley to meet the requirement for

operation of welding set, grinding wheel, maintenance equipment, for lighting and auxiliary power requirements.

Macmet Engineering, an ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007 certified company based in Kolkata, supplied the 20.9 km pipe conveyor system for conveying iron ore from mines to JSW Steel's plant in Bellary. The conveyor system travels a length of 20.9 km over hills, fields, roads and villages to deliver iron ore to JSW Steel's Plant in Vijayanagar, Bellari. It is one of the longest Pipe Conveyor systems in the world. Macmet successfully commissioned the pipe conveyor system for JSW Steel, Bellari, in May 2019.

Macmet Engineering is India's Premier Supplier of Pipe Conveyors. The Company provides material handling solutions to core sectors like cement, power, steel, mining and ports. Several cement and power, steel, mining and ports. Several cement and power units in India are equipped with Macmet conveyor systems. Some of the most challenging Pipe Conveyor systems in India have been supplied by Macmet for JSW, JPL, Sembcorp, Hindalco, ACC Ltd. etc…

Source: Steel Tech

Niobium Materials Technology in the Renewable Energy Sector

Abstract

During the past several years, niobium (Nb) has made material science technological advancements for both ferrous and non-ferrous renewable energy applications. New product developments within the niobium non-ferrous alternative energy sector are in stage 1 of the product life cycle and in its infancy. Laboratory and prototype trials have revealed promising opportunities for both niobium and its oxides in emerging product applications for lithium-ion batteries (LIBs), solar panels, smart windows and piezoelectricity.

Introduction

In this paper, an overview of the emerging non-ferrous niobium technologies in the renewable energy sector are described – LIBs, solar panels, smart windows, and piezoelectricity. Niobium product applications in this sector are in Stage 1 of the product life cycle. Early results demonstrate several key benefits to using niobium-containing technologies, including achieving substantial efficiency improvements. A cost-effective process technology is evolving. With continuous improvement in the manufacture of these products, consumer prices for renewable energy non-ferrous materials will continue to fall, thus improving the potential of mass market adoption of sustainable, alternative technologies associated with the generation, transportation and consumption of energy.

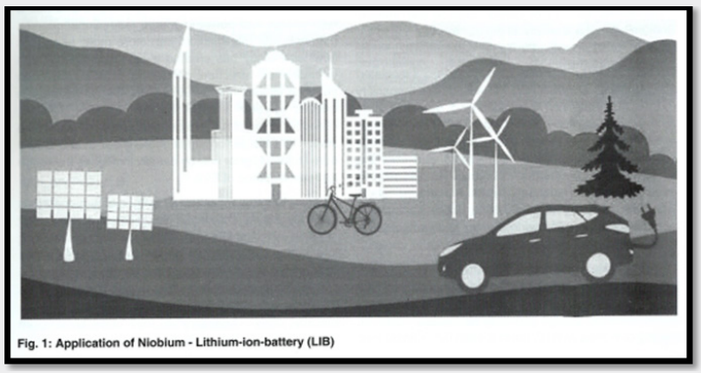

Fig. 1: Application of Niobium - Lithium-ion-battery (LIB)

Lithium-Ion Batteries (LIB)

A step-change breakthrough is needed to facilitate the transition of fossil-fuelled transport vehicles to cleaner forms of mobility, such as electric-powered vehicles (EVs). Technological improvement for LIBs is a high priority within the renewable energy sector. LIBs can convert stored chemical energy into electricity. Niobium application in these LIBs is capable of meeting the increased demand for higher performance, longer life, shorter charging times and safer batteries. Cathode materials typically are cobalt, nickel, manganese, iron, phosphorus and aluminium. Anode materials are graphite and fixed oxides based on lithium and titanium. Transport is the largest source of greenhouse gas emissions in the U.S. as reported by the

Table 1: Niobium Solutions to Overcome Barriers to EV Adoption

Consumer Concerns	Barriers to EV Adoption	Niobium Solutions
Driving range anxiety	Consumers worry about the travel range and performance variation with an EV compared to an internal combustion engine vehicle	Niobium increases the energy density of batteries providing more range, and improves performance at lower temperatures
Charging time	Charging times may take several hours; charging station infrastructure in the development	Niobium materials can increase the rate at which batteries charge and discharge
Performance/ Longevity	Batteries have a relatively short operating life as materials degrade during the charge/ recharge cycle	Niobium increases the stability of the battery so it can withstand more charging cycles
Costs	Even with subsidies, EVs are more expensive than fossil fuel vehicles	Niobium is readily available and determined to be cost-effective compared to other battery materials
Decision-making	There are only a few fully battery operated EVs, and a limited number of hybrid vehicles	With niobium developments, improved efficiencies and effect on carbon footprint, the implementation time is changing rapidly

United States Environmental Protection Agency, exceeding 1,800 million metric tonnes of carbon dioxide per annum. Niobium addresses nearly all the barriers relating to EV adoption as summarised in Table 1.

Scientific material benefits of niobium are associated with electrical conductivity, increased rate capability and ionic conductivity, faster, charging, greater energy density and safety. The consumer expects these product benefits. Electrical conductivity, which controls the speed of transferring electricity to and from the battery, is a major barrier to improving LIBs. Adding small amounts of niobium can make cathodes nearly one billion times (1,000,000,000x) more conductive, thereby improving EV performance and generating a faster delivery of an electric current.

Increased rate capability and ionic conductivity are important for improving charging/ discharging rates. The challenge is that as the rate increases, the amount of stored electrical charge generally decreases. However, coating cathodes with lithium niobate ($LiNbO_3$) increases the rate without reducing capacity, creating a battery that releases more electricity at a faster rate and with higher efficiency. This process also improves battery longevity and safety in the following ways: 1) enables the battery to withstand increased charging cycles, 2) prevents dissolution of the manganese and 3) lowers the charge-transfer resistance.

Greater energy density is of paramount importance to extend battery life and driving range, while reducing the anxiety for the driver of the vehicle. Lithium is used in batteries because it is lightweight and has a high charge and power-to-weight ratio. Consequently, batteries with more lithium can store more energy. A new technology has created a cathode material with a disordered structure containing niobium that can increase lithium ions by 30%-50%. This breakthrough creates greater energy capacity (>250 mAh.g-1 capacity higher than typical capacities). Tests have shown that the performance of this electrolyte is nearly pure lithium. Higher energy density increases the range and performance of EVs.

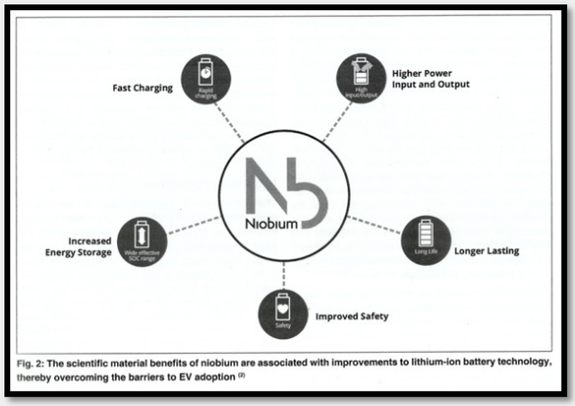

Fig. 2: The scientific material benefits of niobium are associated with improvements to lithium-ion battery technology, thereby overcoming the barriers to EV adoption [2]

Faster charging is achieved with niobium materials currently being developed for battery anodes that improve the mobility of lithium-ions. By creating interatomic spaces in the anode material, lithium-ions can easily move in and out of the anode. This structure creates an extremely high charge/ discharge rate. The materials are used with titanium to create titanium niobium oxides (TNO). This new class of niobium modified anode materials demonstrates nearly three times the amount of energy storage compared to traditional LIBs. The technology is being considered by manufacturers as a pathway to significantly reduce charging times. Safety is a primary concern as EV popularity grows. At LIBs age, there is a risk of short circuits that result in fires. The condition is caused by the formation of lithium metal coming in contact with the cathode, creating excessive heat. As a result, major manufacturers have experienced significant product recalls. Based on materials science engineering research to date, it has been observed that niobium prevents the formation of lithium metal, thereby reducing the danger of short circuits and fires.

Solar Panels

Solar panel costs have decreased dramatically over a two-year period. However, the high cost of solar panel installation for property owners remains a barrier to mass scale adoption. More efficient solar panels lead to a shorter period for recapturing installation costs. Consequently, producing panels that are more efficient in converting sunlight to electricity is a key focus of solar research and development. The silicon-based cells that comprise a solar panel possess a theoretical efficiency limit of 29%. Practical efficiency rates in the low 20% range are considered excellent for commercial solar panels. It is noteworthy that researchers at Kaneka Corporation, a Japanese chemical manufacturer, have built a solar cell with a photo conversion rate of 26.3%, improving the previous record of 25.6%. Although the increased efficiency is just 2.7%, such improvements in commercially viable solar cell technology are increasingly recognised. By comparison, boiler efficiency is in the 30% range.

A special type of transparent conductive oxide glass is used in solar panels to maximise efficiency and durability. Panel manufacturers are constantly attempting to add value to their products. Using niobium oxide to improve the glass is one approach. The application of niobium oxide improves the glass properties, leading to considerable inroads in development. Improving the properties of the glass improves panel efficiency, extends the life span and reduces another barrier to renewable energy technology.

Converting sunlight to electricity is a clean technology due to an abundant, renewable source. The efficiency of conventional solar cells from inorganic material, such as silicon, has reached 24%. However, the process still requires the use of more pure materials that are expensive. New technologies are needed to develop low cost solar devices that can be produced on a commercial scale. A wide variety of methodologies for converting solar energy is currently being developed, including dye sensitised and hybrid all-solid solar cells. A major improvement of such devices has been achieved over the last 10 years. During that period, the efficiency of solar cells has reached 14%. However, a recent discovery revolutionised the field of photovoltaic devices. It has been demonstrated that devices consisting of organ lead trihalide compounds with perovskite structures are able to efficiently convert solar energy to electricity. After discovering the capability of these materials during two years of research, the efficiency of these cells reached 17.9% (certified) with a performance expected to attain up to 20%. Moreover, the system is promising for commercial application due to easy processing and low-cost materials.

Perovskite solar cells have attracted attention due to their high conversion efficiency and low cost. Nb_2O_5 is used as an alternative, compact hole blocking layer in conjunction with mesoporous TiO_2 and CH_3 $NHePb_{13}$ in perovskite solar cells. A study revealed that Nb_2O_5 layer thickness strongly influenced the J-V hysteresis of the cells. Devices constructed with 50 nm Nb_2O_5 have small or undetectable hysteresis, which become detectable and more prevalent with increased Nb_2O_5 layer thickness. For the best device, energy conversion efficiency of up to 12%, short circuit currents of 17mA/ cm2 and fill factors of 74% were identified. These parameters are comparable to the best performance of similar devices in which the compact layer is TiO_2. In addition, the use of Nb_2O_5 improved the stability of solar cells under illumination. These improvements are attributed to a more efficient extraction of photo generated electrons in the perovskite layer.

Smart Windows

Niobium oxide is emerging as a possible additive in smart windows, which independently control the transmission of visible sunlight and solar heat into a building, thereby reducing energy use and improving occupant comfort. The use of smart windows provides separate, dynamic control over the transmission of visible and near infrared (NIR) light. The material properties require high optical contrast, fast switching times, long cycle life and low manufacturing costs. Conventional materials possess significant drawbacks related to cost, durability and functionality. Studies involving niobium glass with nanomaterial show that niobium oxide glass with nanocrystals can produce dynamic switching behaviour, enabling control of solar radiation transmittance. The glass blocks NIR and visible light selectively and independently enhance optical contrast fivefold with 96% of charge capacity retained after 2,000 cycles. Research is underway to improve production processes and extend the application to polymer materials and coatings. Successful development could lead to windows that maintain a cool building in hot weather while allowing light, as well as reducing additional lighting and air conditioning costs.

Piezoelectric Applications

The definition of piezoelectricity is an electric polarization in a substance (especially certain crystals), resulting from the application of mechanical stress. For example, people walking on the floor could generate piezoelectric energy created by the mechanical stress of the activity. Research and development into niobium oxide has shown it can replace lead in these piezoelectric applications, allowing for more widespread use. The manufacture and synthesis of different ceramic oxides have been the main challenge. Relaxor ferroelectric perovskites are highly polarizable and can exhibit giant coupling between elastic strain and an applied electric field.

Summary

There is considerable potential for niobium technology to be used in the renewable energy sector, including LIBs, solar panels,

smart windows, and piezoelectric applications. Improvements to products associated with the generation, transportation and consumption of energy are in various stages of niobium product development and implementation and are demonstrating viable solutions to sustainability.

Source: Steel Tech

CRISIL reduces FY20 growth forecast to 5.1%

The slowdown is deeper than anticipated and will be prolonged, ratings agency CRISIL warned on recently slashing its growth estimate sharply to a low 5.1 percent from 6.3 percent earlier. Meanwhile, according to a report, India's economic growth is expected to remain subdued in near future as the slowdown has deepened and is likely to remain extended for a longer duration than previously anticipated.

Source: Business Standard

Arun Kumar Shukla takes over as CMD, Hindustan Copper Ltd.

Shri Arun Kumar Shukla has taken over as Chairman and Managing Director of Hindustan Copper Limited on 01.01.2020. He had joined the Company as Director (Operations) on 01.01.2018. Shri Arun Kumar Shukla is a Graduate Mining Engineer of 1985 batch from Indian School of Mines, Dhanbad. He has done his M. Tech in Environmental Engineering and also obtained degree of Law (LLB). He possesses First Class Mines Managers' Certificate. Shri Shukla is having a vast experience of Indian Mining Industry. He has started his career from Central Coalfields Ltd. and worked there for more than 21 years, then joined NMDC Ltd. in October, 2006. On deputation from NMDC, he served as Managing Director of Jharkhand State Mineral Development Corporation Ltd. for about 2 years. He was also holding the charge of CEO of joint Venture Companies of NMDC viz. NMDC-CMDC Ltd. and JNMDC Ltd. to start new mines in the state of Chhattisgarh and Jharkhand respectively. Prior to join Hindustan Copper Ltd., Shri Shukla was working as Executive Director in NMDC Ltd. Shri Arun Kumar Shukla was conferred with the prestigious FIMI Golden Jubilee Award for Excellence (2016-2017) and Tata Steel Mining Sustainability Award (2017-2018) for his significant contribution towards sustainable mining.

Source: Business Standard

Request to Members

Delhi Chapter of IIM sends various information of its activities to our members through e-mails ids available in our records. However it appears that all the members do not get the details of Chapter's activities because of change of their ids. On account of this, the details of our activities do not reach all the members. All the members whose e-mail ids have undergone change are requested to let us know their latest / valid e-mail ids, telephone nos., mobile nos., WhatsApp nos. etc. to mail urgently to: **iim.delhi@gmail.com**