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A BRIEF REPORT ON WEBINAR "REQUIREMENT OF STEEL AND OTHER STRATEGIC MATERIALS FOR DEFENCE SECTOR" ON 06.03.2021

A Webinar was organized by IIM Delhi Chapter on "Requirement of Steel and other Strategic Materials for Defence Sector" on 6th March 2021 on the occasion of Platinum Jubilee celebrations of IIM. Shri K K Mehrotra Chairman, IIM DC welcomed Dr. Amol A Gokhale, President, IIM, Dr. R Balamuralikrishnan, Defence Metallurgical Research Lab, Hyderabad and member, National Council, IIM, eminent speakers in the Webinar and participants of the Webinar.

Dr. Gokhale was the Chief Guest of the Webinar. In his address, he stated that the topic of the Webinar is very pertinent in the context of our India's initiatives in the area of Atmanirbhar Bharat.

Dr. Amol A Gohkale
President
The Indian Institute of Metals

In his address, Dr. Gokhale touched upon the definition of strategic materials in the context of production of steel for meeting the defence needs of our country. He stated that the strategic steels should have excellent strength. It should have light weight and should be corrosion resistant. It should be substitute for steel being presently imported by us. The producers of strategic steel should have their own technologies. Many countries are ahead of us in production of strategic steel materials for defence sector.

He emphasised that an all out efforts should be made to be ahead of other countries in production of value added steel. Particular mention was made by him in production of strategic steels by Rourkela Steel Plant of SAIL and ArcelorMittal Nippon Steel India and MIDHANI. They have high level of expertise in production of special steels.

Dr. R. Balamuralikrishnan
DMRL, Hyderabad &
Member, National Council, IIM

Dr. R Balamuralikrishnan, Defence Metallurgical Research Lab, Hyderabad, and Member, National Council of IIM, was the Guest of Honour in the Webinar. In his address, he stated that steel is very important for our economic development. A lot of work has been done by domestic steel producers to increase share of special steel production. The special steels find applications in atomic energy, space, defence and Railways. He also mentioned about the National Steel Policy 2017. The policy envisages steel production capacity of 300 MT by 2030.

Shri N K Kakkar, Hon. Secretary, gave an introductory profile of Shri Alok Sahay, ED (Commercial) SAIL and requested Shri Sahay to share SAIL's perspective on production of special steel to meet Defence Sector requirements.

Shri Alok Sahay, ED (Commercial) SAIL, stated that 50 years back SAIL collaborated with DMRL to set up plate mill at RSP. SAIL is also producing special steel for aircrafts from

Shri Alok Sahay
Executive Director
Steel Authority of India Ltd

2007. He stated that 96% of the steel requirement for Naval workshops is being produced indigenously . SAIL can meet the entire requirement of steel for naval sector. SAIL has got a lot of support from DMRL for production of steel for Defence Sector. SAIL is also supplying steel for INS Vikrant. It takes a long time to develop special types of steel. DM 249 grade of steel was developed by Rourkela Steel Plant in collaboration with DMRL. This marked the end of presentation of Shri Sahay. Thereafter Shri Kakkar gave an introductory profile of Shri Duraiswamy.

Shri M Duraisamy
DGM, IMM (M&R)
Bharat Dynamics Ltd
Kanchanbagh Unit, Hyderabad

Shri M. Duraiswamy, Dy. GM, BDL, talked about missiles being produced by BDL. He informed that a missile is a projectile, guided and controlled from the launch to the terminal stage with or without propulsion and delivers the warhead for inflicting lethal destructed to the designated target.

A missile system consists of

- Launch System
- Target Surveillance and Tracking Radars System
- Command Control Communicative and Intelligence System
- Missile Replenishment System
- Pome Supply System
- Survey Vehicle, Radar Repair & Vehicle Repair Vehicle
- Fuel and Oxidise Carrion
- Missile Automates Health Check System

BDL uses the indigenous & imported technology in production of missiles. The following material is used in missile manufacturing:

- Steel & Its Alloys
- Aluminium & Its Alloys
- Super Alloys
- Molybdenum
- Composites
- Rubber & Plastics
- Explosion Material

The steel used in the manufacturing of missile should have the following characteristics:

- High Strength to Weight Reduction and Corrosion Resistance
- High Fracture Tongue and Fabricability Creep Resistance

- Microstructural Material Missile

Maraging Steel is desirable for Missile Rocket Motor as its micro crack tolerance levels are high due to high fracture toughness, its ageing temperature is approx. 480^{0}C and it has good weldability.

He also spoke about material which is imported and also sourced indigenously for manufacture of different kinds of missiles.

Shri A K Hazra
Jt. GM, Metal & Steel Factory
Ichapore

After conclusion of this presentation Shri N K Kakkar gave an introductory profile of Shri A K Hazra Jt. GM, Metal and Steel Factory, Ichapur and requested him to proceed with his presentation

Shri A K Hazra stated that Ordnance Factor Board (OFB) is having 41 ordnance factories located across India. Each factory is having its own product profile. The profile varies from clothing to armoured vehicle.

As regards steel, some factories of OFB produce plain carbon steel, low alloy steel, special alloy steel to meet hardware requirement of various arms & ammunitions weapons and armoured vehicles etc. The factories also produce grades of cast irons, spheroidal graphite cast iron for hand grenades and number of other products. The Defence Sector is heavily using various type of steel like carbon steel, alloy steel, Aluminium-Alloys, Ti-Alloys, Cu-Alloys and Ni-Alloys etc. Shells are also being produced by OFB factories. Steel is the common material for shells.

This marked are conclusion of presentation of Shri Hazra.

Shri Nitin Amte
GM - R&D
ArcelorMittal
Nippon Steel India Ltd

After this Shri N K Kakkar introduced Shri Nitin Amte, GM, R&D ArcelorMittal Nippon Steel and requested him to present AM/NS India's perspective on "Special Steel for Defence Applications: AM/NS India efforts towards Atmanirbhar Bharat".

In his presentation, Shri Nitin stated that the goal of AM/NS India is to create smarter, more sustainable steels for India and the world: AM/NS India is developing and producing innovative high quality steel products many of which are import substitutes and go a long was in creating a self-reliant India - Atmanirbhar Bharat under the Make-in-India campaign. He touched upon the products profile of flat products being produced by AM/NS India.

He stated that the following steels are being manufactured by AM/NS India for Defence Sector:

- ARMAPRO 500 Bullet proof steel for armouring combat vehicles and civilian vehicles.
- High Strength Ballistic resistance steel plates for artillery guns
- Ultra High Strength special alloy steel
- Weldable Homogenous Armour Steel Plates for ballistics tanks
- High Strength Quenched and Tempered Structural Steel
- High Strength and tough steel for warships hull structures and Quench and Tempered plates
- High Strength steel plates for submarine applications

He mentioned that AM/NS India has the Capability and Capacity to produce high strength quality steel plates required for the land and naval defence applications. He further stated that AM/NS India is fully geared up to actively participate in our Honourable Prime Minister's mission of Atmanirbhar Bharat.

After conclusion of the above four presentations, Dr. Gokhale, President appreciated Delhi Chapter, for organising this Webinar. Dr. Gokhale further stated that Delhi Chapter is one of the active Chapters of IIM organising various technical activities.

Shri K K Mehrotra, Chairman, delivered vote of thanks.

The Webinar was attended by about 40 participants across India.

A BRIEF REPORT ON TECHNICAL TALK DELIVERED BY SHRI C D GOSWAMI, FORMER EXECUTIVE DIRECTOR (TECHNICAL SERVICES), MECON.

Shri C D Goswami
Former Executive Director
(Technical Services)
Mecon Ltd

A Technical talk was organised by Delhi Chapter on 27.3.2021. The caption of the Talk was **"Road Map for Climate Control Technology & Policy Implementation for Indian Steel Plant"**. The Talk was delivered by Shri C D Goswami, former Executive Director (Technical Services), MECON.

At the outset, Shri K K Mehrotra, chairman, IIM Delhi Chapter, welcomed the participants in the Technical Talk.

Shri N K Kakkar, Hon. Secretary, IIM Delhi Chapter gave an introductory profile of Shri Goswami. After this he requested Shri Goswami to proceed with his Talk. Shri Goswami thanked Delhi Chapter to invite him for the Talk.

In his presentation Shri Goswami talked about the importance of Climate Change in terms of Steel Production. It was stated by him that in terms of Paris Climate Summit we are required to reduce CO_2 emission intensity by 33 to 335% by 2030 from 2005 level. He informed that India plans 40% power sourcing from non-fossil sources by 2030. He also talked about the pledges of other companies to reduce CO_2 emission level.

It was informed by him that CO_2 emissions originating from world steel making industry is about 7-9%. The concentration of CO_2 globally increased from 280 PPM to 410 PPM. He also mentioned about the National Steel Policy 2017 which envisage steelmaking capacity of 300 MT by 2030. This will have impact on greenhouse gases emission. Steps needs to be taken to address this problem. He touched upon the paths to reduce carbon footprint in steel industry. He also touched upon the tools for energy efficiency improvements measures to minimize the impact of CO_2 emissions. There are

- Improvement in prevention maintenance
- Increase in hydrogen share
- Improved capacity in the fuel utilization
- Improved use of scrap inputs
- Closing of obsolete equipment

He also shared the CO_2 emissions trends and sources of emission in steel plants. He also talked about the improvement in the techno-economic performance parameters to reduce environmental problems. There is a need to give thrust to usage of renewable energy in the steel sector.

We have to encourage R&D and innovation in steel and deploy break-through technologies. Increased use of scrap will help CO_2 emissions. He also talked about hydrogen based DRI, smelt reduction technologies and integration of low carbon electricity and carbon capture utilization system in the reduction of CO_2 emission levels. He also made a mention of Industry 4.0 measures to control CO_2 emission levels. He also mentioned about Steel Scrap Recycling Policy 2019 which talks about the following 6 Rs:

Reduce
Reuse
Recycle
Recovery
Redesign
Remanufacture

Scrap use in steel production reduces energy consumption by 75% and water consumption by 40%. Worldwide scrap use increased from 367 MT to 589 MT in seven years. Some country-wise figures of major countries for the last two years were also shared by him. A mention was also made by him about scrap recycling through ship- breaking. He also gave

a SWOT (Strength, Weakness, Opportunities & Threats) analysis of hydrogen as fuel for steel making. He also mentioned about Hydrogen Breakthrough Iron Making Technology (HyBRIT) in steel making.

After the conclusion of Shri Goswami's presentation, there was lively question and answer session.

Shri K K Mehrotra, Chairman, Delhi Chapter thanked Shri Goswami in for his informative presentation.

The Talk was held on Google Meet platform and was attended by about 25 persons.

GLOBAL STAINLESS OUTPUT FALLS FOR FIRST TIME IN 5 YEARS

Global crude stainless steel production decreased to approximately 50.7 million tonnes in 2020 – down almost 3 percent, year-on-year. This reduction is lower than initially expected at the onset of the coronavirus pandemic.

However, it is the first decline in world output after four years of consecutive growth. In the main crude stainless steel producing countries, only Chinese and Indonesian output bucked the negative trend. Mill supply in these nations expanded by approximately 2.5 and 15.5 percent, respectively, compared with the figures recorded in 2019.

In China, stainless steel production reached an all-time high of 30.1 million tonnes, last year. This was due to the country's rapid economic recovery from the coronavirus-induced low and the national authorities' ability to contain any increase in Covid-19 infections.

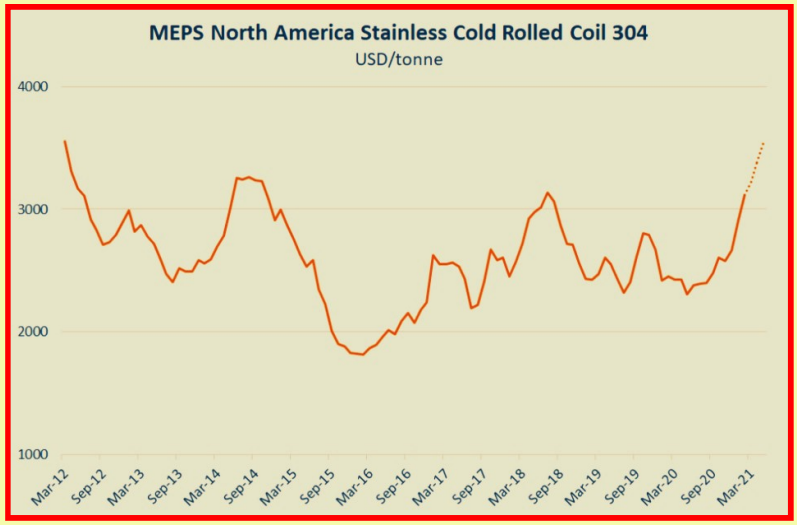
Production in Indonesia was only marginally affected by the pandemic. Output continued to rise, as a result of growing capacity and strengthening demand from export markets.
In many of the established stainless steel producing countries, output is only now approaching its pre-pandemic rate. The uptick in production in the fourth quarter was unable to recover the lost supply caused by the lockdowns.

Production in the United States and Japan recorded reductions of more than 18 percent, last year. Mills in Europe fared slightly better with a 7 percent decrease. The recovery in stainless steelmaking has been gradual in these three areas. However, a surge in demand is creating shortages of material.

Global production is forecast to grow to 54 million tonnes, in 2021. Economic activity is expected to improve, and stainless steelmaking capacity will be gradually ramped up this year. This is particularly the case in Indonesia, where output is forecast to remain above that in many of the more established countries. Nevertheless, market confidence is likely to be boosted by the rollout of vaccinations in developed nations.

US stainless steel prices forecast to reach 9-year high

The past twelve months were a turbulent time for all those involved in the US stainless steel market. In a dramatic turnaround, the unprecedented pandemic-induced slump in steel requirements was superseded by strong demand, stock shortages and soaring prices.



Many industrial sectors witnessed a rise in new orders during the final few months of 2020. Consequently, factories began to boost their output. The IHS Markit US Manufacturing PMI rose to 59.2 in January – its highest level since the indicator began.

The unexpectedly quick recovery in demand resulted in supply chain bottlenecks. Moreover, the rebound in activity is leaving manufacturers, in the automotive, white goods and agricultural segments, short of material and parts to maintain their production schedules.

Shortages start to bite

The surge in demand during the past few months has led to uncharted territory for many US stainless steel market participants. Months of destocking, during the height of the pandemic, followed by such a rapid uptick in demand, quickly depleted distributors' inventories. This was most notable in 300 and 400 series coil products, destined for the automotive and white goods sectors.

Numerous stainless steel buyers report that their inventories are at their lowest for many years. The extraordinarily long delivery lead times offered by the US mills are resulting in delayed customer supplies. Furthermore, local steelmakers are refusing requests for additional material, as they attempt to manage their order books.

The recent adverse weather conditions in parts of the US have caused further disruption to the already struggling supply chain. Companies in the worst affected areas comment that they have lost one week of normal business activity.

High container costs, coupled with the ongoing Section 232 tariffs, continue to deter imports. However, with such tight conditions in the domestic market, US buyers are becoming increasingly interested in procuring material from overseas suppliers, even at a higher cost than local supply.

Prices highest since July 2018

Supply-related bottlenecks are driving up prices throughout the supply chain. Steelmakers are faced with rising input costs, which are demonstrated by ever-increasing alloy surcharges. Daily nickel values continue to strengthen, due to the latest round of electric vehicle hype, and supply concerns.

Global logistical difficulties, especially with shipments from Chile, led to a surge in molybdenum prices, in the past few weeks. Furthermore, recent gains in the spot market value of chromium are likely to result in a significant rise in the second quarter contract figure. Moreover, stainless steel scrap prices are increasing.

In addition to the upturn in alloy surcharges, US stainless steel producers have reduced their price discounts three times during the past six months. Consequently, transaction values for stainless cold rolled coil are now at their highest levels since July 2018.

The shortage of material within the distribution sector is enabling sellers to pass on these increases to end-users. Those companies which have high stocks report that now is the time to make windfall profits.

Further rises on the horizon

Alloy surcharges are likely to increase further in the next few months, driven by rising raw material costs. Moreover, local mills are expected to push for additional reductions in the discount levels applied to basis figures. This is forecast to result in cold rolled coil, grade

304, transaction values climbing to a nine-year high, in the second quarter of 2021.

Shortages are expected to remain a feature of the market, in the near term, particularly for ferritic material. ATI's withdrawal from commodity coil production is to be delayed until the end of this year. However, the company is, reportedly, producing for outstanding contracts only, at present.

Asia produced 1,374.9 Mt of of crude steel in 2020, an increase of 1.5% compared to 2019. China's crude steel production in 2020 reached 1,053.0 Mt, up by 5.2% on 2019. China's share of global crude steel production increased from 53.3% in 2019 to 56.5% in 2020. India's crude steel production for 2020 was 99.6 Mt, down by 10.6% on 2019. Japan produced 83.2 Mt in 2020, down 16.2% on 2019. South Korea produced 67.1 Mt, down 6.0% on 2019.

The EU produced 138.8 Mt of crude steel in 2020, a decrease of 11.8% compared to 2019. Germany produced 35.7 Mt of crude steel in 2020, down 10.0% on 2019.

The Largest Steel Producing Countries (in Mt) Rank 2019-2020

SI	Country	2020	2019	%2020/2019
1	China	1053.0	1001.3	5.2
2	India	99.6	111.4	-10.6
3	Japan	83.2	99.3	-16.2
4	Russia (e)	73.4	71.6	2.6
5	United States	72.7	87.8	-17.2
6	South Korea	67.1	71.4	-6.0
7	Turkey	35.8	33.7	6.0
8	Germany	35.7	39.6	-10.0
9	Brazil	31.0	32.6	-4.9
10	Iran (e)	29.0	25.6	13.4
11	Ukraine	20.6	20.8	-1.1
12	Taiwan, China (e)	20.6	22.0	-6.3
13	Italy (e)	20.2	23.2	-12.9
14	Vietnam (e)	19.5	17.5	11.6
15	Mexico (e)	16.9	18.4	-8.3
16	France	11.6	14.4	-19.8
17	Canada (e)	11.1	12.9	-14.1
18	Spain	10.9	13.6	-19.5
19	Egypt	8.2	7.3	13.4
20	Poland (e)	7.9	9.0	-11.9
21	Saudi Arabia	7.8	8.2	-5.1
22	Indonesia (e)	7.6	7.8	-2.4
23	United Kingdom	7.2	7.2	-0.5
24	Austria (e)	6.7	7.4	-10.2
25	Malaysia (e)	6.5	6.8	-4.7
26	Belgium	6.1	7.8	-21.1
27	Netherlands	6.1	6.7	-9.1
28	Bangladesh (e)	5.5	5.1	7.8
29	Australia	5.5	5.5	0.0
30	Czechia	4.5	4.4	0.6
31	Thailand	4.4	4.2	4.1
32	Sweden	4.4	4.7	-6.6
33	Algeria (e)	4.0	2.4	66.7
34	South Africa (e)	3.9	6.2	-37.0
35	Kazakhstan (e)	3.8	4.1	-7.2
36	Pakistan	3.7	3.3	13.3
37	Argentina	3.7	4.6	-21.4
38	Finland	3.5	3.5	0.8
39	Slovakia (e)	3.2	3.9	-18.3
40	Romania (e)	2.8	3.4	-20.0
41	Others	35.3	39.6	-10.6
42	World	1864.0	1880.1	-0.9 e

Annual figure estimated using partial data or non-worldsteel resource

In the CIS, production was 102.0 Mt in 2020, up by 1.5% on 2019. Russia is estimated to have produced 73.4 Mt in 2020, up 2.6% on 2019. Ukraine produced 20.6 Mt in 2020, down 1.1% on 2019.

Crude steel production in North America was 101.1 Mt in 2020, down 15.5% on 2019. The United States produced 72.7 Mt in 2020, down 17.2% on 2019.

The Middle East produced 45.4 Mt of crude steel in 2020, an increase of 2.5% on 2019. Iran is estimated to have produced 29.0 Mt in 2020, up 13.4% on 2019.

Annual crude steel production for South America was 38.2 Mt in 2020, a decrease of 8.4% on 2019. Brazil produced 31.0 Mt in 2020, down by 4.9% compared to 2019.

Turkey's crude steel production for 2020 was 35.8 Mt, up by 6.0% on 2019.

Africa produced 17.2 Mt of crude steel in 2020, the same as the 2019 production figure.

Top 10 steel-producing countries

Sl	Country	2020 (Mt)	2019 (Mt)	%2020/2019
1	China	1053.0	1001.3	5.22
2	India	99.6	111.4	-10.63
3	Japan	83.2	99.3	-16.24
4	Russia (e)	73.4	71.6	2.65
5	United States	72.7	87.8	-17.26
6	South Korea	67.1	71.4	-6.07
7	Turkey	35.8	33.7	6.08
8	Germany	35.7	39.6	-10.09
9	Brazil	31.0	32.6	-4.910
10	Iran (e)	29.0	25.6	13.4

Oceania produced 6.1 Mt of crude steel in 2020, down 1.4% on 2019.

INDIA'S LEADING STEELMAKERS EXCEEDING PRE-COVID-19 LEVEL PRODUCTION

India's steel industry entered 2021 with output figures indicating healthy growth and production that has exceeded year-ago output. The state-run Steel Authority of India Limited (SAIL) said it achieved the best ever quarterly production of hot metal, crude steel and saleable steel in the quarter ending Dec. 31, 2020, which is the third quarter of its 2021 fiscal year.

> "The domestic steel consumption has a positive outlook as the economy is reviving and all sectors have started to pick-up. We are confident of seizing the unfolding opportunities in the steel market."
>
> Smt. Soma Mondal
> Chairperson, SAIL

SAIL further said it produced 4.37 million metric tonne of crude steel, representing 9 percent growth over the same timeframe in 2019. SAIL's 4.80 million metric tonne of hot metal made in late 2020 was 12 percent more than it made in the comparable quarter in calendar year 2019. "During this financial year, the company has continuously enhanced its production volumes," says Smt. Soma Mondal, Chairman, SAIL. "The first quarter was impacted due to the onset of the pandemic but gradually we have scaled up our performance by enhancing the volumes. It is heartening that pre-COVID levels have already been reached and the production has grown

over [the comparable quarter the previous fiscal year]," she adds.

"The consistent growth reflects that SAIL is poised to grow steadily in future, she continues. "The domestic steel consumption has a positive outlook as the economy is reviving and all sectors have started to pick-up. We are confident of seizing the unfolding opportunities in the steel market." SAIL is one of four leading producers—along with Jindal Steel and Power (JSPL), JSW Steel, SAIL and Tata Steel India — that in combine produced 14.95 million metric nes of steel in the October-December quarter of the current fiscal year, registering a 6 percent year-on-year rise. SAIL exceeded that average with its 9 percent growth, while Mumbai-based Tata Steel India was the single-largest producer in the timeframe, with 4.60 million metric tonne of output in the quarter.

"The consistent growth reflects that SAIL is poised to grow steadily in future, she continues. "The domestic steel consumption has a positive outlook as the economy is reviving and all sectors have started to pick-up. We are confident of seizing the unfolding opportunities in the steel market." SAIL is one of four leading producers—along with Jindal Steel and Power (JSPL), JSW Steel, SAIL and Tata Steel India — that in combine produced 14.95 million metric nes of steel in the October-December quarter of the current fiscal year, registering a 6 percent year-on-year rise. SAIL exceeded that average with its 9 percent growth, while Mumbai-based Tata Steel India was the single-largest producer in the timeframe, with 4.60 million metric tonne of output in the quarter.

Soma Mondal has taken over as first-ever woman head of SAIL. Before taking over as Chairperson of steel CPSU, she was the company's Director (Commercial). "Our immediate focus is to improve the topline and the bottom-line of the company. We are charting out all strategies to improve value for all our stakeholders and make it structurally stronger," she said after assuming charge. Further, she mentioned that SAIL is a colossal organization, with multi-location production units & mines, wide-ranging product basket and diverse workforce. "People are its greatest strength and with synergized efforts of the entire Team SAIL, we will strive to attain the higher summit," she asserted. Mondal was instrumental in introducing new marketing strategies and products at SAIL, enriching its product basket.

Source: MMR

AM/NS INDIA CONFIDENT OF MEETING GROWING STEEL DEMAND AND CONTRIBUTE TO ATMANIRBHAR BHARAT

ArcelorMittal Nippon Steel (AM/NS) India, a joint venture between ArcelorMittal and Nippon Steel – two of the world's leading steel companies – recently celebrated its first anniversary since the acquisition of Essar Steel. Moving forward, AM/NS India's long-term production intention is to expand upstream and downstream capacity in a phased manner, and make a notable contribution to the country's steel needs by providing a spectrum of diversified and superior products. The company recently welcomed Dharmendra Pradhan, Minister for Petroleum & Natural Gas and Steel, at its Hazira manufacturing facility.

In his maiden visit to ArcelorMittal Nippon Steel's plant, Pradhan visited various units of the manufacturing facility. The leadership made a presentation on the company's future plans and its ambitions to significantly enhance contribution to the Atmanirbhar Bharat's vision. Pradhan said, "ArcelorMittal Nippon Steel is an integrated steel manufacturer, creating smarter and sustainable steels for a wide spectrum of steel-consuming industries in India. The company has plans to expand its capacity at Hazira and is actively engaging to come up with a steel plant in Odisha."

"It is encouraging to receive the government's support to deliver on our promise of providing better steel to New India. AM/NS India is confident of sustainably meeting the growing steel demand through various products and significantly contribute to the Prime Minister's vision of an Atmanirbhar Bharat."

Dilip Oommen
CEO, ArcelorMittal Nippon Steel (AM/NS) India

"I am happy that AM/NS India has evinced interest for expanding its investment in Odisha, especially in the areas of value added & special steels. Eastern India, especially Odisha, will play a pivotal role in driving national economic growth making India a $5 trillion economy & achieving the vision of a self-reliant India," added Pradhan.

Dilip Oommen, CEO, AM/NS India, said, "It is encouraging to receive the government's support to deliver on our promise of providing better steel to New India. AM/NS India is confident of sustainably meeting the growing steel demand through various products and significantly contribute to the Prime Minister's vision of an Atmanirbhar Bharat." We have an eye on long products in India," he added. The present facility in Hazira, Gujarat, is one of the biggest standalone units in the world making flat steel. It has an annual capacity to make 10 million tonne of steel. A diversification into long steel is understandable as the 2017 National Steel Policy points out that nearly 60 percent of the metal's consumption will come from construction and infrastructure sectors by 2030, up from 40 percent.

"Apart from the huge volumes that they produce, between the two of them, ArcelorMittal and Nippon Steel also make some of the most high-end steel products in the industry...it's the best thing that could have happened," said Oommen.

Source: MMR

STEEL DEMAND SHOULD GROW AT GDP GROWTH RATE IN FY22

Despite the pandemic and the emergence of a new strain, steel major Tata Steel is confident that there will be a rise in demand for steel in India in 2021.

"We are seeing an inflow of funds from across sectors and an uptick in the overall consumption. The government's efforts of improving infrastructure, coupled with the 'Atmanirbhar Bharat' policy and Production Linked Incentive Scheme (PLI), are expected to further boost this inflow," MD and CEO of Tata Steel, TV Narendran, said. Additionally, the government's focus on rural infrastructure projects will also give an impetus to steel

demand, he added. "We believe that the steel demand in the country should grow at least at the rate of GDP growth or higher in FY22," Narendran said.

> "Overall, the demand-supply situation favours the steel producers with strong international prices. We are certainly back to where we were before the pandemic and we expect the trend to continue through FY22. The pandemic, however, is not behind us yet and we cannot let our guard down."
>
> TV Narendran
> MD and CEO of Tata Steel

Commenting on the outlook on steel prices, he said, globally, steel prices were likely to stay firm as China was not expected to export large volumes owing to a better balance in their domestic market, and there were no other very significant exporters in the world market. "We are optimistic about the overall demand for steel and hence the performance of the steel industry and Tata Steel," he said. On raw material prices, Narendran said it would be a mixed bag. Iron ore has seen a sharp rise in prices primarily because China has recovered quite well. Coal prices have softened because of the geopolitical issues between China and Australia. Consequently, more coal is available from Australia in the world market and India being a big importer of coal is witnessing softening of prices.

He highlighted that currently, capacity utilisation of most of the steel producers in the country has improved and they have healthy order books, while maintaining a cautious stance with regards to the Covid-19 pandemic. "Most steel producers, including us, do prefer to sell more in the domestic market. Overall, the demand-supply situation favours the steel producers with strong international prices. We are certainly back to where we were before the pandemic and we expect the trend to continue through FY22. The pandemic, however, is not behind us yet and we cannot let our guard down," he said.

Meanwhile, Tata Steel Group's climate disclosure has been rated "A-" by the environmental non-profit Climate Disclosure Project (CDP), based on review of potential opportunities, risks and strategies, related to the environmental performance on behalf of investors representing US$106 trillion in assets. Over 9,600 companies, with over 50% of global market capitalisation, disclosed through disclosure programmes managed by CDP at the request of investors and corporate buyers. Climate disclosure was sought from 67 steel companies and only six steel companies are rated in the leadership band. This is Tata Steel's highest rating in last 3 years and this puts the company amongst top six steel companies, globally. The latest rating released by CDP reaffirms the position of the company on climate response.

Source: MMR

HUGE INFRASTRUCTURE PUSH TO DRIVE STEEL DEMAND IN INDIA

After a robust December quarter sales which spilled over to the first few weeks of the calendar year 2021, India's steel demand has again weakened in the last few weeks. Perhaps, its primary demand sector i.e. infrastructure, has slowed pick up at the far end of the financial year to show a healthy balance sheet for the full fiscal 2020-21, which already

showed dwindling figures of top line and bottom line because of four months of nationwide lockdown early last year to prevent spread of Coronavirus (Covid-19). The lockdown hit factory operations and thus, production and transportation of steel and its raw materials. Seasonality factor also played a pivotal role in weak demand trend in the last few weeks as steel consumption picks up normally with the onset of summer season when construction activity accelerates. Since, the government's fund release for infrastructure projects also takes a pause during February - March season to re-start only towards mid-May, mills hope for a recovery in crude steel demand in a month.

Domestic steel demand trend

Financial year	Steel demand	Growth (%)
	(million tonnes)	
2016	82	6
2019	99	9
2020	100	1
2021(P)	90	(9-11)
2022(P)	99	10-12
2025	119	--

Source : JPC, Crisil Research

Background

With 111.2 million tonne of output in 2019, India stood as the second largest producer of crude steel in the world only after China, thanks to abundant availability of raw material i.e. iron ore. Cheap labour also helped India achieve the second rank in global crude steel production. As a consequence, the steel sector proved to be a major contributor to India's factory output and thus, overall manufacturing sector.

While many steel mills across the country have been modernised with adoption of advanced technology and upgradation of next generationl plants and machinery, a number of them are yet to follow suit which drag them behind innovators. Products of such plants and machinery not only lacks competitiveness but also innovation which hinder their growth. Today, the buzz word in the steel industry is energy efficiency. The energy efficient plants are considered to be the benchmark for setting up their product pricing. Either such plants focus on value addition for survival or sacrifice profits to remain competitive in the market.

India's crude steel and finished steel production is projected to report at 108.5 million tonne and 101.03 million tonne in the financial year 2020, respectively. Between April 2020 and November 2020, India's cumulative steel production of crude steel was 62.01 million tonne and finished steel was 55.68 million tonne respectively. Meanwhile, the country' s finished steel consumption grew at a compounded annual growth (CAGR) of 5.2 per cent during FY16 - FY20 to reach 100 million tonne. India's export and import of finished steel are projected to have stood at 8.24 million tonne and 6.69 million tonne, respectively, in the financial year 2020.

Massive investment lined up

Steel and allied industries in India have seen a sharp spurt in investment proposals in the last few years. Data compiled by the Department for Promotion of Industry and Internal Trade (DPIIT) showed that the Indian metallurgical industries attracted foreign direct investments (FDIs) worth $14.24 billion in the period between April 2000 and September 2020. Among domestic players, Steel Authority of India Ltd (SAIL) plans to take its overall capacity to 50 million tonne by 2025 from its existing level of 13 million tonne at a capital expenditure of $24.88 billion. Another steel major JSW Steel has set a plan to add another 5 million tonne to its existing overall capacity of 18 million tonne to take its total at 23 million tonne at a proposed investment of $4.14 billion. Also, Tata Steel has decided to increase the capacity of its Kalingnagar integrated steel plant from 3 million tonne to 5 million tonne at a capital expenditure of $3.64 billion.

Infrastructure push

The capacity expansion in steel production is set to support the government's big infrastructure push construction of national highways, extension in existing roadways waterways and railways, construction of millions of new housing units and modernisation of bridges, ports and airports. For example, the Ministry of Steel prepared a draft framework policy for development of steel clusters in the country. To provide a fillip to the steel sector, the government has proposed major infrastructure push and create job directly and indirectly. The government announced Rs 1.18 lakh crore financial allocation for the highways sector. With this outlay, some of the flagship corridors and other important projects would see considerable activity in 2021-22. More than 13,000 km of roads at a cost of Rs 3.3 lakh crore has already been awarded under the Rs 5.35 lakh crore 'Bharatmala Pariyojana' of which 3800 km of road have been constructed. By March 2022, another 8500 km of road construction and 11,000 crore of national highway corridors are proposed to be awarded.

To further augment road infrastructure, more economic corridors are also being planned of which 3500 km of national highway works in Tamil Nadu at an outlay of Rs 1.03 lakh crore is scheduled. Apart from all these, a number of projects like Delhi-Mumbai corridor is also planned. All these projects are set to boost steel demand in the next few years.

National steel policy sets roadmap

With an aim to create a globally competitive steel industry in India, the Union Cabinet recently approved the National Steel Policy (NSP) 2017 which envisages India's steelmaking capacity to achieve 300 million tonne and per capita consumption of 160 kgs by 2030-31. The current steelmaking capacity in India stands at around 140 million tonne with per capita consumption 74.1 kgs. To accelerate growth, the Ministry of Steel is facilitating setting up of an industry driven Steel Research and Technology Mission of India (SRTMI) in

association with the public and private sector steel companies to spearhead research and development activities in the iron and steel industry at an initial corpus of Rs 200 crore (US$ 30 million).

In the current fiscal, steel demand is expected to contract 9-11 per cent on account of nationwide lockdown through April - May and slower than desirable ramp up in manufacturing activities post the lockdown. While economic activity - and hence steel demand - has picked up from the third quarter, the huge blow suffered in the previous two quarters is likely to weigh on the year.

Conclusion

There is a huge scope for growth in India's steel sector being low per capita consumption and expected rise in it due to increased infrastructure, construction and the thriving automobile and railways sectors. Meanwhile, there is an urgent need to strengthen logistics arrangement for the domestic steel industry as lack of railway rakes and inbound and outbound transport facility affects both production and consumption. If India were to achieve $5 trillion economy (from $2.73 trillion as of now), the comprehensive growth strategy and timely implementation of planned infrastructure projects is needed.

Source: MMR

PROSPECTS AND CURRENT TRENDS OF COPPER SCRAP MARKET & RECYCLING IN INDIA

Implementation of the strict environmental rules, emphasis on the development of zero waste technologies and depletion of metal rich primary ores are the main driving forces that encourages to develop new processes for the reuse/recycle the industrial wastes and by-products to recover metal values and other value added products. Since the cost of Cu production from primary sources is very high due to the involvement of a number of tedious steps, recovery from secondary sources such as various types of solid wastes, scraps and copper electrorefining bleed streams, byproducts from other processes containing appreciable amount of Cu, Ni, Co is gaining importance day by day. Besides the reduced cost of production of copper by secondary processing other advantages are: energy saving, conservation of natural resources and saving the environmental degradation.

The total consumption of refined copper in the country in 2018 was around 6.7 lakh tonne. Electrical/Electronic Industry is by far the largest consumer of copper, where it is used in the form of cables and winding wires. Copper demand in India is expected to grow at 6-7% due to increased thrust of Government of India towards "make in India" and "Smart City" programmes, development of industrial corridors, housing for all Indians by 2022, National Highway development project, Rail project and defense production policy to encourage indigenous manufacture. In addition to this, there is plan for green energy corridor for

transmission of renewable energy.

The market for Electric Vehicles (EV) is also expected to witness growth in coming years. Copper is essential to EV technology and its supporting infrastructure, and the increase in the electric vehicles in the market will have a substantial Impact on copper demand. The projected demand for copper due to electric vehicles is expected to increase by 1.7 million tonnes by 2027.

Copper Scrap Market, price trend

Copper Scrap Market is forecast to reach $72.7 billion by 2025, after growing at a CAGR of 4.1% during 2020-2025. The copper and copper alloy industry's economy depends on any excess materials being commercially recycled. Product waste resulting from production processes is reused and exchanged for recycling to keep the finished product's cost down. Approximately 40% of all production is produced from recycled metal on average.

Copper prices in the global market continue to gain with prices topping $9,000 a tonne for the first time in 10 years recently. It is reported that prices surged on expectations of a pick-up in demand after the Chinese Lunar New Year last month .According to the Trading Economics web site, copper has gained over 20 per cent with the starting of 2021.

Boost from stimulus packages, impact on India

Expectations of stimulus to assist the financial system recuperate from the influence of the Covid-19 pandemic is driving up industrial demand and, in turn, copper. According to Pankaj Kumar, CEO, Sterlite Copper, the world is seeing a powerful restoration because it involves phrases with the pandemic and the graduation of vaccine roll-out. As regards how the copper price spike will influence India, Kumar mentioned India just isn't in the most effective place proper now, when it comes to the copper market.

"As a developing economy, copper is critical to its continued growth. However, with copper prices rising at the levels we are seeing now, there is bound to be an impact on economic activities utilising the metal," he mentioned.

Drop in copper scrap availability

Kumar mentioned prices have gained additionally attributable to a drop in availability of copper scrap attributable to a pause that lasted for months in production. "Comprising 25-30 per cent of the global copper market, this (scrap) paucity is also impacting prices," he said. Supply components have been impacted by the sluggish resumption of copper mining actions, which additionally mirrored the price spike, the Sterlite CEO mentioned. The unrelenting march of copper is especially attributed to the aggressive goal fastened by the

United Kingdom and different EU nations to interchange automobiles operating on fossil fuels with electrical automobiles (EV).

Operating at 50% capability

"Domestic copper industry has been operating at almost half of its capacity since the last two financial years due to closure of Vedanta's four lakh tonnes copper smelter at Thoothukudi," the company mentioned. The home copper business has been working at half the capability of eight lakh tonne every year since May 28, 2018, after the Sterlite Copper plant in Thoothukudi was ordered shuton May 28, 2018, by the Tamil Nadu government.

Cut in import duty on Cu scrap to promote recycling

The Centre said recently that slashing of import duty on copper scrap will promote recycling in the country, as the basic raw materials will now become cheaper. In the Union Budget 2021-22, the government announced reduction of import duty on copper scrap from 5 per cent to 2.5 per cent. "Reduction of import duty on copper scrap... (will) boost recycling of copper in the country," the mines ministry said in a statement. The move will also lead to social, environmental and economic benefits, besides resulting in potential for employment generation, according to the statement. Recycling of metal improves the resource efficiency as there is no loss of property. It is economically viable, energy efficient and environment friendly, it added.

- Metal produced today is scrap for tomorrow and thus again becomes a resource.
- By utilising copper scrap, domestic companies can improve competitiveness and profitability.
- Recycling-based innovations can also give industries an edge in the export market.

New industries can be created in the recycling sector with focus on innovative design and manufacturing from recycled material. Reduced import dependence for critical minerals will help to improve the country's trade balance and promote economic stability, it said. India's mineral rich areas are under dense forests and inhabited by indigenous communities. Extraction of minerals affects local communities. Recycling would put fewer burdens on the need of extraction of minerals, thereby offsetting some of the risks arising out of social conflicts, the statement said.

Extraction activities often result in ecological degradation. Reduced extraction pressures due to adoption of recycling will help in containing ecological degradation and pollution associated with mining. Recycling and adoption of related innovative methods may altogether give rise to the need of setting up of new industries that can contribute significantly to employment generation.

Innovation in recycling process and manufacturing has the potential to create highly skilled jobs, benefitting domestic industries and developing potential for export market. This may further prompt global companies to locate efficient design and/or manufacturing units in India leading to increased skilled/unskilled labour demand, the statement said.

Source: MMR

INCREASINGLY ELECTRIFIED - ELECTRIC MOBILITY IS COMING FASTER THAN MANY EXPECT

According to the German Association of the Automotive Industry (VDA), electric vehicles are suitable for the market. A "young, still small market with high dynamics" has developed around e-cars - even though vehicles with combustion engine technology currently still dominate the global automotive market. Suppliers of the wire and cable industry are already picking up speed and see e-mobility as an opportunity.

"The market potential is enormous," Wafios emphasises. "Accordingly, the forecasts are positive." For this reason, e-mobility became the focus of the company's attention already some years ago. "Technical triggers were enquiries from the automotive sector, both on the OEM side, supplier level and in the equipment sector about three years ago," explains the supplier of machines for bending wire and tubes. E-mobility picked up speed.

However, the industry is still "clear and concentrated on a few market participants", explains Wafios. According to AlixPartners Global Automotive Outlook 2019, the global market share of electric drive units in terms of vehicles sold amounted to 2.7 per cent in 2018. A share that is clearly expandable, which is shown by the growth rate of the e-drive of more than 65 per cent. Thus, according to Outlook 2019, the market is speeding ahead "in the irreversible market run-up".

Faster than expected

According to the VDA, electric mobility is coming faster than many expect. One reason is, for example, the tightening of regulations and the improved incentive systems for electric mobility in order to reduce CO2 emissions. For example, there will be no new registrations for conventional drives in Norway from 2025 - the sale of electric cars will be promoted with massive tax incentives. The Netherlands, Ireland and Israel want to use only emissions-free vehicles from 2030.

A sales ban on combustion engines is planned from 2040 in Great Britain and France. In the USA some states, such as California, plan to permit only emissions-free cars from 2040. In order to get their act together, suppliers have to target these figures. Globally, a drastic increase in hybrids and electric vehicles can be expected between 2020 and 2025. The VDA predicts that "by 2030 a production share of electrified vehicles of 60 per cent or more

worldwide is likely". China will be a pioneer here - every third vehicle could be fully electric by 2030. In Western Europe, the share could rise to 25 per cent due to stricter regulations and driving bans. According to the association, a breakthrough in Africa and South America is not to be expected so soon. For Japan, Korea and North America, a share of hybrid vehicles of around 80 per cent would be conceivable. The car world is electrified – a realistic view.

Huge investments

Car manufacturers and automotive suppliers must, therefore , make massive investments: The AlixPartners Global Automotive Outlook 2010 reports that at least 202 billion euros will have to be spent globally over the next five years to master the technological change to the electric drive and the development, production and marketing of up to 300 planned new e-vehicles. "The level of investment is still out of all proportion to demand," says Dr Elmar Kades, Global Co-Lead Automotive and Managing Director at AlixPartners. At the same time, the current and expected weak sales development for the next few years will increase the short-term pressure on the margins and cash flows of the suppliers, Kades continued. Weak sales and massive investments therefore, coincide. Even though the situation is challenging, the wire and cable industry remains optimistic. "Electrically powered vehicles promise higher sales for our company because more or higher quality cables are needed," explains Leoni. Hybrid vehicles, in particular, which contain both an electric and a combustion engine, require a higher product share from the company.

High-quality cables are required in various areas of the electric car: In the charging cable from the charging station to the vehicle system and from the charging connection to the battery. Lines finally transport the electricity via the inverter to the electric motor. The internal wiring supplies other high-voltage components, such as air-conditioning compressors or electrical heating, with energy. Electrifying outlook...

Battery cabling and connector systems

Leoni is focusing, in particular, on the high-voltage battery as an energy storage device for electric vehicles and plug-in hybrids. The company concentrates primarily on data and power distribution within high-voltage batteries. "We assume that the HV battery in future vehicles will contain parts of the previously exposed high-voltage cable harness due to its large-area arrangement." The aim is to offer customers system solutions for battery cabling from a single source. Together with its partner Diehl, the company is working on offering complete solutions. Already established products of both companies in areas such as cabling, connector systems and cell contacting would be combined to form a complete package. This means that sustainable strategies are needed.

Laser for copper welding Trumpf is also experiencing electric mobility as a growth-promoting

driving force. A central role is played by a new laser, the development of which the laser specialist has accelerated in the course of its e-mobility strategy and which, according to the company, is proving to be very suitable for welding copper. Copper is considered to be the most important material for conducting electricity and an electric car would be inconceivable without it. With the new laser, copper can be efficiently welded, for example, for the high-performance electronics of electric cars. "The shift towards electro-mobility offers great opportunities for German industry," emphasises Christian Schmitz, Managing Director for Laser Technology at Trumpf. The company expects further growth for its own business as a result of the changes in the automotive industry. Compared to the previous year, the company's sales of products and solutions that flow directly into electro-mobility have doubled. "20 per cent of our order intake from the automotive industry now comes from electro-mobility, twice as much as last year," Schmitz continued.

Products and processes are changing

Changing times require flexible suppliers - the right curve position is crucial. You must bear in mind that the exhaust gas and fuel system, the combustion engine and the low-voltage vehicle electrical system are not required for the less complex electric drive. Instead, they must adapt to electric motors, cooling systems for electronics and batteries, chargers, a high-voltage electrical system and a PTC heater -components that sometimes require high-performance wires and cables to prevent vehicles from stuttering. The changes associated with the switch from combustion to electric vehicle technology are, therefore, fundamental and affect products and processes. "Competencies such as blow moulding, pipe extrusion and machining technology are also becoming less important, while processes such as winding processes and forming techniques for parts made of aluminium and magnesium are gaining in importance," explains the VDA. In order to continue on the road to success, the wire and cable industry must, therefore, flexibly steer in the right direction. Then, it will head full speed towards high profits.

Source: MMR

INDIA'S RECOVERY WILL BE LED BY FERROUS & NON-FERROUS METALS, AUTO AND TEXTILES

Moody's Investors Service says that its stable outlook for nonfinancial corporates in India (Baa3 negative) reflects easing pandemic restrictions, government stimulus aimed at boosting consumption and investment, and a benign funding environment. Moody's Indian affiliate, ICRA Limited, meanwhile, has also changed its outlook for some sectors, such as auto and textiles, to stable from negative on expectations of a swift demand recovery.

Moody's: Supportive government measures and funding environment will boost corporate and infrastructure recovery ICRA: Recovery will be led by sectors such as ferrous and

nonferrous metals, auto and textiles, where operating conditions are rapidly improving. Moody's Investors Service says that its stable outlook for nonfinancial corporates in India (Baa3 negative) reflects easing pandemic restrictions, government stimulus aimed at boosting consumption and investment, and a benign funding environment. Moody's Indian affiliate, ICRA Limited, meanwhile, has also changed its outlook for some sectors, such as auto and textiles, to stable from negative on expectations of a swift demand recovery.

"A rising preference for personal mobility vehicles, along with the government's new voluntary vehicle scrappage policy, will support automobile demand. In the housing sector, the shift toward flexible work arrangements combined with tax incentives for affordable homes will propel demand. Increasing activity in the housing and auto sectors along with higher infrastructure spending will in turn drive demand in other key industries such steel, oil and gas and cement," says Vikas Halan, a Moody's Associate Managing Director. Prevailing low interest rates and the government's reforms to boost domestic manufacturing will also support corporates' credit profiles.

According to ICRA, payment moratoriums, additional funding lines and one-time restructuring options have enabled corporates in stressed sectors like textiles, healthcare and auto ancillaries to successfully navigate the challenging environment. "Additionally, we believe that low commodity prices and companies' tight control over their operating and capital expenses have enabled them to conserve cash and maintain good liquidity - although rising commodity prices and the resurgence of Coronavirus cases in some exporting countries remain key risks," says K. Ravichandran, Executive Vice President and Deputy Chief Rating Officer at ICRA Limited.

Despite these improvements, India remains vulnerable to the threat of rising infections and fresh lockdowns, and to the risk of an uneven or underwhelming economic recovery. Consequently, ICRA has maintained a negative outlook on sectors that remain most impacted by the pandemic in the near to medium term, including the aviation, hospitality and retail sectors. Similarly, the outlook for the telecom sector remains negative, reflecting the structural changes it is undergoing. Moody's expects the Indian government will drive infrastructure investment for the next 1-2 years, which will help address infrastructure constraints and support future private investment. Traditional infrastructure segments like power and transportation will likely receive the bulk of investments, as will segments with critical infrastructure gaps, such as healthcare, cold chain, water and sanitation, over the next 6-12 months.

ICRA has maintained a stable outlook for infrastructure related sectors such as roads and ports, noting that growth in toll collections and the steady recovery in cargo growth, along with government measures to improve liquidity for companies in these sectors, will drive profit and revenue growth. As for the power sector, Moody's recently revised its outlook to

stable from negative, given the progressive improvement in electricity demand over last few months and the expected healthy 10.6% recovery in India's real GDP growth next year.

Moody's does not expect the cash conversion cycle for power companies to worsen in fiscal 2022 due to further delays in payments from state owned electricity distribution companies. Moody's believes that India is taking steps to align its power generation mix toward its nationally determined contribution (NDC) commitments under the 2016 Paris Agreement. Renewable energy has had a 69% share in new capacity additions in the last four years, while coal based additions have undergone a sharp slowdown.

"India's focus on greening its energy mix as well as its policy on priority for renewable energy offtake implies strong growth for renewable energy over the next several years, although this is counter- balanced by weak offtaker credit quality and transmission constraints," says Abhishek Tyagi, a Moody's Vice President and Senior Analyst. As for Moody's views on the airport sector, monthly domestic passenger numbers had recovered to above 50% of pre-pandemic levels. However, a full recovery is not expected until around 2023, considering the uncertain timing over the reopening of international borders, potential risks from resurgence in Coronavirus cases or a delay in vaccine rollout. While growing passenger traffic will help boost airport revenue, a recovery in credit metrics will likely take longer for airports with sizable debt-funded capital spending plans.

"A sustained improvement in economic growth will be key to boosting highway and port traffic. Steps taken by policymakers, including large-scale vaccination to contain the pandemic, will be key to the pace of recovery and growth of these infrastructure segments to pre-coronavirus levels," says Tyagi.

Source: MMR

UNTOLD STORY OF A STEELMAN

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1. CHILDHOOD LAYS THE FOUNDATION

Childhood always lays the initial foundation for all of us when, by observation, we try to emulate and pickup family values and ideas from the elders at home. Some of them like an uncle or an aunt even ultimately become the role model from our young days. What I realize now is that I learnt from my parents the art of simple living, respect to others and a strong faith in karma.

Brief Profile of Shri S C Suri

Shri S C Suri graduated with a Bachelor Degree in Science (B.Sc.) in Chemistry Honors with second rank in Delhi University in 1957.

He completed his post graduate studies in Metallurgy from IISc Bangalore in 1959.

He joined SAIL in 1959.

During his various positions in SAIL, he travelled widely on several occasions to Europe, USA, UK and Japan.

Superannuated from SAIL as Executive Director in September 1995.

After his superannuation he worked as Advisor/ Consultant in SAIL, MMTC Centre for Policy Research.

Became a life Member of IIM in 1988, Life Fellow of IIM in 1993 and Honorary Member in 2013.

Bestowed IIM outstanding service Award in 2015.

Was Chairman, IIM Delhi Chapter from 2013-14 to 2014-15.

Closely associated with organizing various International Conferences on Minerals, Metals, Metallurgy and Material (MMMM) at Pragati Maidan, New Delhi from 2010-2018.

Wrote a Book on "Indian Steel Perspectives 2025".

It was pre-independence years, I was born in a traditional Hindu Family at Delhi. My father, a graduate of the vintage era, was an accounts person working in the government. Later he also worked in the President Secretariat when Late Dr. Rajendra Prasad was the President of India; I was too young those days to remember many things. However I do remember that we enjoyed playing in the beautiful garden there. My father used to take all of us to the ceremonial functions in Rashtrapathi Bhawan. My mother was a pious and spiritual lady, looking after the entire family with devotion and sincerity. Single handedly she took good care of the family, consisting of six brothers and two sisters. One can easily guess the usual difficulties in running a big family like ours. As a result of the World War II, the country faced numerous difficulties like cash, rationing of food items etc. We had a very strong bond in the family as well as with all our relatives which continues even today.

I certainly recall with pleasant memories of India securing its hard-won Independence in mid-August 1947. For celebration we were given by the school a packet of sweets, a medal and also a free cinema pass. I also remember the sad days when our Father of the Nation,

Gandhiji was assassinated in the year 1948. Both these incidents have now become very important milestones in India's history.

2. GRAND FATHER & GRAND SON, SAME CLASS?

During the 40s, I studied in a primary school at Delhi which had a kutcha building; the students used to sit on a mat in the floor, with a wooden desk in front of them for writing or reading. We had only one teacher in the school who had a watch and all the other teachers used to ask him frequently for the time. So poor were the people during those difficult years.

In our primary as well as secondary school, our Principal regularly used to give a one hour talk daily on important subjects like Hindu traditions, mythology, culture etc. Our English teacher used to narrate, with physical gestures, one Shakespeare play every Saturday which we all thoroughly enjoyed. The Hindi teacher used to narrate Tulsi Das or Sur Das bhajans in melodious singing tunes. The Principal always carried a cane and he was a very tough person by nature. He mercilessly punished those boys who had not done the homework or performed poorly in the examination. We were so respectful and obedient to our school teachers that we even used to perform their house hold work as and when time permitted.

By nature our teachers were very simple folks and some of them could not afford to have a house of their own; infact some teachers used to stay on roof tops of our class room in a semi permanent house made with wooden structures.

I was actually a student of science stream with biology. My parents wanted me to become a doctor while I was so scared of dissecting a rabbit or a frog, let alone perform operations in hospitals.

On the sports front, our school had a very good popular Kabadi team. There used to be regular kabadi matches in different schools as tournaments. During our games period we used to watch cricket matches in the famous Kotla ground, near Delhi gate where free entry was allowed after the tea interval.

One day, long after our retirement myself and my elder brother wanted to visit our school and also, in a goodwill gesture, pay a courtesy call on the Principal, who was also our Physics teacher. The Principal, so delighted on seeing the "**retired"** old boys with joy and pride, escorted us to all the class rooms to proudly introduce us to the students; he told them how his old students had become successful men in their career in later years. It was an emotional moment for us too.

By the way, we had a teacher whose grandson was also a student in his class. Being a joint family, the teacher, his own son and the grandson lived in the same house. When the academic performance of this grandson was not at all satisfactory, the teacher asked his son to meet him in the class so that the teacher could lodge a complaint about the grandson. When the father came to the class, the teacher rebuked him publically in the school and warned his grandson severely for the future. Indeed a rare incident of that kind, you might wonder! This incident clearly shows how strict were the teachers during those days.

One of our teachers used to live across the Yamuna River. Once the river was flooded because of very heavy rains and his house got washed away. All the students were so happy and thought that this teacher would not come to the class. After the floods receded, the teacher came to the school and promptly asked us about the pending homework. We were shell shocked; honestly none of us had done the homework thinking that he would have forgotten by then. He bluntly told us that he would come to school even by swimming if required to check the homework. The end result was that all of us got severe punishment from that teacher, which we have not forgotten even today.

3. UNEXPECTED SOUTHERN STINT

In the mid-fifties, I joined the Delhi University, studying Physics, Chemistry and Mathematics with Chemistry honours. I did very well and got second rank in the university. The final result was published in the newspaper with names which made me extremely happy. Our monthly fee was a meagre Rs 15/- per month which was reduced to Rs 7.50/- when I joined M.Sc. classes because of my outstanding performance at the undergraduate level. I was very comfortable staying in Delhi and also pursuing M.Sc.

One day I saw an advertisement in a newspaper by the Indian Institute of Science, Bangalore inviting applications for various branches of engineering. I got the application form, filled & sent it to the institute, without the knowledge of my parents. After a month I got a letter from the institute that I have been selected for the post graduate course of Metallurgy department. Since I could not keep this secret any longer, I had no other alternative but to inform my parents with fear and hesitation.

My father had no knowledge about Metallurgy; because of his accounts background. However, he had a friend whose son was studying Electronics & Communication Engg in Bangalore at that time. Therefore my father took me to his friend's house near Bengali market to seek his advice regarding my joining the course at Bangalore. When we went there, fortunately his son was also in the house on a vacation; I indicated my hesitation and asked him whether I should study M.Sc. at Delhi University or join the post graduate course in Metallurgy at IISc Bangalore. He straight away advised me that I should very much go for the Bangalore option because of the reputation of IISc. He also told me that since he was

already studying at Bangalore, he would take good care of me as a local guardian and support me, whenever required. That gave me plenty of courage and strength.

Thereafter I distinctly remember that I travelled alongwith him to Bangalore in the good old Grand Trunk Express; the journey from Delhi to Bangalore took three full days. At the institute there were only 16 students in the Metallurgy deptt and all of them were rank holders from different universities. I ofcourse liked the highly academic atmosphere at IISc.

At Bangalore I missed, in addition to my parents and siblings, “garam garam rotis” and the spicy Punjabi dishes. Soon I felt home sick and missed the Delhi life very much; in order to overcome this feeling, I used to spend most of my time either in the library or in the Metallurgy department.

During my stay at Bangalore the Golden Jubilee of the Institute was also celebrated. For the Golden Jubilee celebrations, the institute had invited the President of India, the Vice-President and the Prime Minister as well as the world famous Nuclear Scientist, Dr. Homi Jehangir Bhaba. The main organizer of the Golden Jubilee celebrations was the well-known Prof. Satish Dhawan, also the Head of the Aeronautics Department at IISc. We were all active student volunteers and had the rare honour and pleasure of looking after so many dignitaries and luminaries.

Many famous scientists, teachers and industry experts - both overseas & India - frequently used to visit the campus. Every Saturday we used to visit a nearby industry or a research laboratory. Once we had the joy of visiting the Raman Research Institute, located across the IISc campus. We were escorted around the Raman Research Institute by none other than the famous noble laurate Sir C.V Raman, whose name triggered admiration and motivation for me.

Once I recall a professor from the US had come to our campus and delivered a talk on semiconductor; Sir C. V. Raman was also sitting in the audience. During the question and answer session, Sir C. V. Raman stated that the speaker had made a certain statement which was not correct scientifically. Hence Sir C. V. Raman delivered a one hour long talk on semiconductor where he also touched upon the Wave Theory and Rectilinear Propagation of Light. The professor from the US was stunned on hearing Sir C.V Raman, short of kneeling, he made very generous remarks & acknowledged Sir C.V Raman’s profound scientific knowledge.

On another occasion, my Professor A. Krishnan was away on tour and one of his lecturers conducted a surprise test. He found out our performance was far below satisfactory. Therefore when the professor returned, he called each one of us to his room and admonished us, saying that we should be ready for such surprise tests any time.

My guru Dr. T. R. Anantharaman, Professor in Physical Metallurgy, used to come to the class room, before all others, in order to draw the phase diagrams in different colours to show the various phases. He explained the various thermodynamic reactions that take place during the different phases transformations in a very simple manner. We could understand Physical Metallurgy so well and his class was always packed with students.

I completed the Metallurgy course from IISc successfully in 1959. Shortly thereafter I was offered a job by a private company through the Head of the Metallurgy Department which I did not accept for obvious reasons, to move and to work in other parts of India.

4. STEEL : MY PASSION

In the sixties, there was an acute shortage of Metallurgists in the country. So, I was straightaway offered a job by the then upcoming Hindustan Steel Ltd (now known as SAIL) and I also got an offer simultaneously from Bhabha Atomic Research Centre at Bombay. Since HSL wanted to send me to UK for training, I accepted the steel assignment very happily.

Initially I spent three months at Tata Iron & Steel Company Ltd (TISCO) at Jamshedpur before I was sent to England for training in UK in 1960. It was a memorable and fruitful stay at Tata Steel. During my training at Tata Steel, I had the opportunity of carrying out the Guarantee Test of Sinter Plant. at Tata Steel. At that time Mr. A. S. Dhanboora was the General Superintendent at Tata Steel.

I fondly recall several interesting incidents at Jamshedpur. At TISCO, now Tata Steel, we were supposed to sign attendance register four times every day. Even if we were late by five minutes, our salary was cut by one eighth i.e. Rs 1/- per day from a monthly salary of Rs 250/-. You can very well guess how rigorous our training at Tata Steel would have been.

At Jamshedpur we were provided lunch at a price of three annas. Water was served in a big metal glass which had a permanent inscription “Stolen from Tata Steel”.

One day I was in the Steel Melting Shop when the General Superintendent called me and enquired as to how the training was going on? He called one of the workers to bring a shovel and wanted me to do the fettling of the Open Hearth Furnace at the door. The dolomite material was lying on the floor. He asked me to build the base at the door of the Open Hearth Furnace. I did not do a good job and he bluntly told me that I needed intensive training.

In the late sixties the then Congress President, Smt.Indira Gandhi - a world leader in her own right - was visiting Tata Steel. I was standing anxiously at the gate to have a glimpse of her. Our Training Supervisor who was passing that way, could spot me at the gate and he

asked me to go to the shop floor immediately and carry on the regular work. So disappointing it was.

Our Training Supervisor at Tata Steel got information from some sources that some boys skip their training and go to Maharashtra Mondal to play cards during training hours. Once he got this information he went to Maharashtra Mondal to spot the trainees. The Training Supervisor pressed the entry bell of Maharashtra Mondal. The trainee who opened the door was suspended immediately from training and the other three trainees covered themselves with bed sheets. The Supervisor asked him about the three persons sleeping in the room. The trainee replied that they were his relatives who were resting after a long tiresome travel. The three trainees fortunately escaped the punishment. We also used to take rest alongwith the workers in different shifts and would be woken-up when the siren went off before the workers went home.

While in England I had the rare opportunity of working in different steel plants there and also had the joy of visiting various cities in that beautiful country. I stayed in England for 18 months before returning to India in the year 1961.

On return, my first posting was at Durgapur Steel Plant where I worked for almost 12 years. I gained first-hand experience of working in different departments of the steel plant. Durgapur Steel Plant also the achieved the rated capacity. At Durgapur I used to interact with all the top steel metallurgists of the country who visited the Steel Plant, now and then, for technical discussions. I also used to liaise with the local Regional Engineering College for various technical activities.

Technical writing has been my flair for a long time; I also read a lot of technical articles especially on steel, metals, metallurgy etc even now. My first boss with whom I worked for several years was Dr. G. P. Chatterjee, a specialist on thermodynamics. He used to give dictation for one hour every day in the morning and I, being his Secretary, used to keep his papers in the file. I was the custodian of two Arc files; unfortunately my boss was hospitalised and also expired. His two Arc files were in my possession and I got in touch with an office staff for printing of these two files. When I gave this material to a reputed publishing house, they suggested that this book needs a lot of revision and editing. I was advised to contact a thermodynamics expert for the revision and editing. This work was finally assigned to a professor at a the Rourkee University (now IIT). He did an excellent job and the book was finally printed in 1990 which was released by the then SAIL Chairman Dr. V. Krishnamurthy.

I also recall that at Durgapur, once a paper titled “Use of hot metal from blast furnace using high ash coke” was being prepared. The paper was a joint paper from my boss Dr. G.P Chatterjee and the then Superintendent of the blast furnace at Durgapur. One author was a practical operator of the blast furnace and the other was purely an academician. It was an

extremely difficult job to match the styles and thoughts of the two authors while preparing such a joint paper; I had to do a lot of balancing!

Dr. G.P Chatterjee, a double doctorate from USA, was very keen to have a Research and Development Centre at Ranchi. He wrote seven letters to the then Chairman repeatedly as to why Ranchi should be selected as the centre for the R&D facility. His efforts finally bore fruit for establishing the SAIL R&D Centre at Ranchi. Hence I moved to Ranchi in 1972 as an Engineer working in this R & D Centre, a job which I fully enjoyed because of my technical aptitude. I was associated with formulation of energy models for Steel Sector based on input-output analysis.

When I moved to Ranchi, one of my bosses wanted me to take over the project responsibility for construction of the R&D complex. I replied that I am not a Civil Engineer and would not be the right person for this job. His curt reply was that he knew my potential very well and that I had no other option but to accept the responsibility. Hence, I was appointed as a Project Engineer for the upcoming laboratory at Ranchi.

As I was given this new project responsibility. I had the freedom to visit various national laboratories for ideas and thoughts such as the Bhabha Atomic Research Centre & Tata Institute of Fundamental Research, both at Mumbai, Defence Metallurgical Research Lab Hyderabad, National Metallurgical Laboratory Jamshedpur, BHEL R&D Centre Hyderabad etc. All these visits gave me a lot of new inputs and directions for the R & D Centre.

5. DAUGHTER INTRODUCING FATHER

I was transferred to SAIL corporate office in 1982, where I had the privilege of working in the Operation Directorate as well as Business Planning; later I was also posted at the Chairman Secretariat. I used to coordinate all the work of the Technical Directorate and also the Special Steel Plants located at various places. These postings gave me a total insight into the functioning and performance of SAIL as a corporate entity and also the challenges in the various steel plants across the country.

My daughter, was staying in the hotel and pursuing a course in Computer Engineering at Ranchi. When the R&D Centre was inaugurated by the then Steel Minister Late Shri K.C Pant in 1983, during the interval of the cultural program, she met and told the Minister that the planning and construction of the R&D centre was done by her father. She also informed the Minister that her father was sitting in the audience. The Steel Minister, so pleased on hearing this news, asked my daughter to go and bring her father. When I met him, the Steel Minister shook my hands and told me that I had a bold and a brilliant daughter.

At the SAIL Corporate Office I had the unique privilege of interacting with several expert

teams that used to visit SAIL HQrs and in the process, I was invariably a member of all the technical discussions. Mention may be made about my responsibilities associated with collaboration with N K K Japan for technological upgradation of SAIL Plant. This collaboration with N K K Japan was for SAIL Plants for a period of five years. Also I had the rare opportunity of visiting steel plants in several overseas countries namely UK, USA, Europe, Japan etc.

I was associated with Annual Performance Plan of different SAIL Units for submission to the department of Steel.

I was the Desk Officer for these special steel plants at Salem, Bhadravati & Alloy Steel Plant, Durgapur.

I also had the honour of interaction with several leading technical and management experts like Dr. V. Krishnamurthy, Shri S. Samarapungavan, Dr. S. R. Jain, Shri S. K. Roy, Dr. S. K. Gupta, Managing Directors and General Superintendents of SAIL Plants. I was associated with Dr. Mohan Reddy a US based Consultant regarding Planning, Marketing & R&D Activities of SAIL Steel Plants for their respective product mix.

Much later, before retirement I was also posted in the R&D and Centre for Engg & Technology (CET) in the Corporate Office in SAIL. I was also associated with CET for AMR Schemes. In this connection was associated for design and development for 600 cubic meter blast furnace at Bhadravati Steel Plant. During this assignment, I should make a special mention of the preparation of a Technology Plan for SAIL plants and also a proposal for Additions, Modifications and Refurbishing (AMR) Scheme in SAIL.

After my retirement I took an assignment in MMTC. In MMTC I was associated with dismantling, transfer and operation of an old Blast Furnace from **Ilva Stock** Italy. Shri Arvind Pande the then Chairman of SAIL provoked and motivated me to write a book on steel. I was at the Centre for Policy Research (CPR), Chanakyapuri for a period of three years. While working at this Centre I could write the book on **"Indian Steel Perspective 2025",** which was widely appreciated and well received too.

I was also associated with another project titled **"India 2025**" which was also a sponsored one. I thoroughly enjoyed writing of the book "India 2025" which also received wide acclaim.

Another project which I undertook at the Institute of Study in Industrial Development was a project on "**Slurry pipeline for transfer of raw materials, gases and water**". The assignment of preparing a report on slurry pipeline was assigned to me in early 2000 by the then SAIL Chairman, Shri V. S. Jain; needless to say I completed this ass assignment with a great sense of satisfaction.

6. ASSOCIATION WITH IIM

My association with IIM has been very long, memorable and excellent. When I joined SAIL at the age of 22 years, I became a Student Member of IIM in 1961.

I have several interesting anecdotes to recall about IIM. In 1964, I was the Secretary of Durgapur Chapter and had the opportunity to organise the Second NMD/ATM at Durgapur in 1964. Looking back, it was a grand function. As I was the NMD-ATM Coordinator, I received some special privileges, to the envy of some, like a vehicle for transport and a security at my residence as I used to travel with the General Manager (a British gentleman) in connection with the various NMD/ATM preparatory arrangements

Dr. Daya Swaroop, Head of Metallurgy Department, BHU, had come to Durgapur to attend NMD-ATM programme in 1964. He presented a paper on "Effect of Basicity on Sinter Strength". I had gone to Durgapur Railway Station to receive him. On my way back from Durgapur Railway Station to Guest House, he saw a sign board on Gemini Circus and asked me to book two tickets of the Circus. He told me to escort him to the Circus. He also wanted to meet all BHU students posted at Durgapur Steel Plant. Both of his requests were acceded to.

At IIM, I interacted with several luminaries like Dr. Dara P. Antia, Dr. P. Rama Rao, Shri V.S Arunachalam, Shri B. Muthuraman, Dr. Baldev Raj, Dr. C. G. K. Nair, Shri R. N. Parbat, Shri A. C. Wadhawan, Shri T. Mukherjee and of course the dynamic and pleasant Secretary General Shri J. C. Marwhah.

After coming to Delhi I was fully engrossed with official responsibilities in SAIL and I was unusually away from IIM. It was Mr Pug (Pugazhenthy is the full name), a Vice Chairman at IIM Delhi Chapter then, who used to call on me repeatedly at SAIL and requested me to join the Delhi Chapter so as to take part in various activities. I had to accept his request (and also because of my affinity for IIM) and became a member of the Executive Committee. Later I became a Chairman of the Delhi chapter during 2013-2015. The chapter made me in charge of the Technical Committee. As a result, I had the opportunity to look after the technical content of the flagship event on 4 Ms (International Conference & Exhibition on Minerals, Metals, Metallurgy & Materials) I was also made in charge of the chapter Newsletter containing technical articles, industry news, statistics etc. The Delhi Chapter Newsletter was regularly sent to IIM HQrs, former Presidents, Council Members, other chapters etc. Many of them appreciated the style and the technical content of the news letter.

I must say that IIM was very kind towards me: making me an Honorary Member in the year 2013 at the NMD at Varanasi and later recognizing me with the Distinguished Contribution

Award in 2017 at the NMD at Goa. On the whole, I must say it was a great opportunity and a very rewarding experience working in the metallurgical industry as well as contributing to IIM.

Let me also take this opportunity to request fellow metallurgists to strive and take Indian metals industry to global standards. After all India had a rich heritage in metals several centuries ago and we have to bring back the lost glory once again.