Annual Issue

METALWORLD

Devoted to Foundry & Non-Ferrous Metals Industry

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D. A. Chandekar
Editor

Dear Readers,

I am very happy to present this annual issue of 'Metalworld'. I hope this makes an interesting reading and also is useful in developing the required insight and the right perspective about the minerals & metals industry.

As we all know, the metals demand lies outside the metals industry and we have to depend on other customer industry sectors such as infra, construction, auto, engineering, consumer durables etc. for the metal consumption. Out of this infrastructure itself consumes more than 70 % of metals in the country and obviously it is the biggest factor influencing metals demand in the country. Thus anything which facilitates and promotes infrastructure activities and projects should be helpful to metals industry as well. To be more specific, mega infra projects floated by the central and the state governments would consume lot of metals and thus need to be pushed hard. This includes roads (including the corridor projects) dams, air and sea ports, rails / metros and other such projects with huge metals consumption potential. One of the major hurdles in these is land acquisition. Unless we have a simple, fair and easy to execute law in place, these infra projects will keep on getting delayed attracting the time and cost escalations. This will naturally lower the metals demand growth rate. If we can overcome this hurdle, it will be a boon to not only metals industry but to the national economy as well.

The metal demand is a function of the overall state of the economy of the country. The last two years were badly affected by the covid pandemic and naturally the economies of most of the regions and the countries suffered a lot. Do we all remember that even before the pandemic erupted Feb 2020, Indian economy was not in the good shape and struggling to maintain a decent growth rate, which was falling by every passing quarter ? In fact, in my opinion, pandemic has given us an opportunity to relook and restructure our economy to some extent. With good growth rate predictions by expert agencies, the world has a better perception of Indian economy, which should result in more FDI in coming years. May be some small changes in export incentives and import duties would be welcome but I must confess that such measures would make a limited impact on the fortune of mineral & metals industry in the country.

2021 was the second consecutive year to be influenced and affected by the covid pandemic. While 2020 was an absolute bad year for the whole world, our country and also for our industry, 2021 was not that bad. Most of the industry verticals including the metals industry recovered during this year. The deepened metals demand curve came up because of the overall recovery of the economy and a strong positive industry sentiment. The year ahead too looks quite bright with most of the expert agencies have predicted a robust growth rate of around 8.5 to 9 % for the Indian economy. This should very well translate into a huge surge in metals demand in coming months. Let us hope all this comes true and 'happy days' are here again !

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Hindalco's continued focus on investments in re-cycling, de-bottle necking and building the downstream asset base

With a focus on transforming our future through integration of people, planet and prosperity, we have grown from India's largest leading non-ferrous metals company to become a global leader in the Aluminium business.

Profile

After taking charge as the CEO of Hindalco's Aluminium Business in August 2013, Satish Pai was the driving force behind three mega green-field projects that established Hindalco as among the biggest producers of primary aluminium in Asia. He is also on the Board of Hindalco subsidiary Novelis – the world's largest aluminium rolling and recycling company.

In February 2014, Satish was appointed as the Deputy Managing Director of the company and was entrusted with Hindalco's copper business. He became the Managing Director of Hindalco (including the Novel is business) in August 2016, where he oversees the Indian metals business and guides Novel is' operations globally.

Prior to joining the Aditya Birla Group, Satish worked with Schlumberger based out of

Paris. Over the course of his 28-year illustrious career with the MNC, he held various important positions and was responsible for Schlumberger operations globally.

Satish holds a patent in directional drilling. He received the Distinguished Alumni

Award by IIT in 2017 and was conferred the Doctor of Letters Honoris Causa (D.Litt) by Ajeenkya DY Patil University in 2020.

Satish Paiserves as Director on the boards of Aditya Birla Management Corporation Pvt. Ltd. and ABB, Zurich.

He is the Vice Chairman of the International Aluminium

Institute, the Vice President and Chairman Non Ferrous, Indian Institute of Metals,

Vice President & Chairman of the Government Affairs Committee of the Aluminium

Association of India and Chairman of FICCI's Non-Ferrous Metals Committee.

A great believer in all-round development and fitness, Satish plays badminton and squash and works out regularly in the gym.

D A Chandekar had an exclusive interview with Satish Pai, MD, Hindalco Industries Ltd. on the occasion of Metalworld Annual issue to under stand Hindalco's strategy for its continuous performance as being the most sustainable company second time in a row by the DJSI.

1. Despite of the pandemic environment, Hindalco managed to outperform in its books of accounts as well as in the stock markets. What were the reasons?

Our record performance is an affirmation of our fully integrated business model, which powers our performance in both upstream and downstream markets. Hindalco's enriched product mix, stability in operations, cost control measures and integration benefits, supported by strong macros, helped the company to deliver its best financial and operational performance.

EBITA touched a record high in India Business as well as on a consolidated basis, including Novelis. We continued to strengthen our Balance Sheet and brought down consolidated Net Debt to EBITDA, to below two times. This standout performance in difficult times owes as much to the resilience and commitment of our employees.

Hindalco's continued focus on stakeholder value enhancement, profitable growth through its investments in re-cycling, de bottle necking, organic expansions in stable and predictable downstream businesses and emphasis on deleveraging, has resulted in overall value unlocking.

2. During this period, Hindalco has acquired few companies (like Aleris Integration, Ryker which was a subsidiary ofPolycab etc.) and consolidated downstream business. What was the strategy governing these actions?

Our long-term strategy is to augment our downstream business, while continuing to push our ESG agenda. Our recent acquisitions are important steps in this direction. The acquisition of Ryker's 225 KT CCR (Continuous Cast Rod) facility, will strengthen Hindalco's copper rod manufacturing capacity by providing a time-to-market advantage, allowing the company to cater to the growing demand from electrical and electronics sectors. The acquisition of Hydro's integrated 15Kt aluminium extrusion facility located in Kuppam, Andhra Pradesh, is a strategic step to expand Hindalco's presence in the upper-end of the value-added market. Over the past year, we had already announced a total capex of Rs.3,730crore towards addition of aluminium downstream capacities at Silvassa and Hirakud.

The acquisition of Aleris by Novelis has provided further product diversification as well as product mix enrichment by adding high-end and high margin segments like the B&C and the Aerospace segments of Aleris.

3. Hindalco was ranked as world's most sustainable aluminium business. How was this possible?

Hindalco was recognised as the most sustainable company second time in a row by the DJSI. The ranking is an affirmation of Hindalco's commitment to operate under a Resilient, Responsible and Reliable business model. Hindalco is at the top of the DJSI Indices, having achieved a score of 73 percentage points against an industry average score of 30. Hindalco is the only aluminium company to enter the exclusive DJSI World Index in 2021 and retains its membership of DJSI Emerging Markets Index.

This continued recognition by DJSI validates Hindalco's pioneering work and consistent efforts to integrate sustainability across the aluminium manufacturing chain – from bauxite mining to end products.

Hindalco has achieved 100th percentile in most aspects of all 3 dimensions - Environment, Social and Governance (ESG) including climate strategy, Environment and Social reporting, Water-related risks, operational eco-efficiency such as waste disposal and resource consumption, cyber security, community engagement and employee development. Hindalco's listing in DJSI is a testament to the effectiveness of our holistic approach and reinforces our commitment to our motto of people, planet and prosperity.

On the environment front, we have worked with reputed organisations like IUCN and IAI on bio diversity and climate change strategies in our plants and mines. We have improved water management, bulk waste management (fly ash and bauxite residue) with our

effective environment improvement strategy. Our contribution towards bauxite residue management is appreciated by global peers in the aluminium industry.

Our governance has improved over the years with transparent dealing with suppliers, customers, transporters, local and national government agencies. Our policies and key performance data are publicly available. We are appreciated for policy executions in the right spirit. We have implemented robust risk management and IT infrastructure management systems.

Our reach to society is beyond the scope of CSR activities. We are actively managing human capital with a focus on safety, health, gender diversity, and training. These interventions deliver business value represented by innovations and optimal use of resources for manufacturing. In some of these parameters, we are the global best. (For example, our metal purity is global best. Our auxiliary power consumption in power plants is best in the country).

4. Could you please tell us about Hindalco's strategy towards new product development?

Sustainability is ingrained in Hindalco's product development agenda. We have innovated a number of lightweight aluminium products that help reduce fossil fuel use and GHG emissions.

Hindalco has engaged closely with ARAI and with Auto OEM majors to promote its newly designed and patented structures for aluminium bus bodies using Hindalco extrusions.

In the commercial vehicles space, Hindalco has developed light weighting application products like Aluminium Bulkers and Trailers and is now working on scaling up the production of these products through creation of an ecosystem to expand its reach, scale, and serviceability.

Hindalco is currently making the country's first all-aluminium wagon rake BOBRNAL for captive coal transportation which is to be launched soon. This will be a big breakthrough in the railway sector.

Hindalco is working extensively with manufacturers in the rapidly evolving Electric Vehicles space. Several new products and solutions are being introduced in the market, like busbars for battery packs of Ola Electric scooters, new aluminium motor casing for two wheelers and handlebars and other components to lightweight electric two wheelers.

5. Of late, Hindalco has increased its female workforce with ladies handling strategically important portfolios. Tell us something about Hindalco's gender equality journey.

At Hindalco, we have been making conscious efforts to create an environment that supports gender parity. We have increased the number of female hires from 17.24% in FY 2019-20 to 20.81% in FY 2020-21 for our India operations.

With 7% women in total workforce today, Hindalco is committed to enhancing our pool of women employees. Share of women employees under various categories is presented in the table below. Further, our target is to increase our female share in all categories by 1% every year.

Diversity Indicator	Percentage at Hindalco	Percentage at Novelis
Share of women in total workforce (as % of total workforce)	7.00	13.50
Share of women in all management positions, including junior, middle and top management (as % of total management positions)	7.27	21.95
Share of women in junior management positions, i.e. first level of management (as % of total junior management positions)	7.41	22.80
Share of women in top management positions, i.e. maximum two levels away from the CEO or comparable positions (as % of total top management positions)	2.4	15.63
Share of women in management positions in revenue-generating functions (e.g. sales) as % of all such managers (i.e. excluding support functions such as HR, IT, Legal, etc.)	4.56	20.63
Share of women in STEM-related positions (as % of total STEM positions)	3.75	16.43

6. Pai, this is your 10th year in Hindalco. While the journey so far must have been quite satisfactory, I am sure you will be having a lot of plans for the future. Where would you like Hindalco to go from here ?

I would like Hindalco to be recognised as the top non-ferrous company in the world. It should be a high-performing company in all aspects - ESG, Financial, People and Technology. We are embarking on the next phase of our growth cycle focussed on downstream value-added products with large capex investments.

We have made a zero net carbon commitment by 2025 and we need to progress towards achieving this by reducing our carbon footprint. We have focussed on talent and diversity and want to be a preferred place to work. We have increased our investment in technology and want to be recognised as a technology leader.

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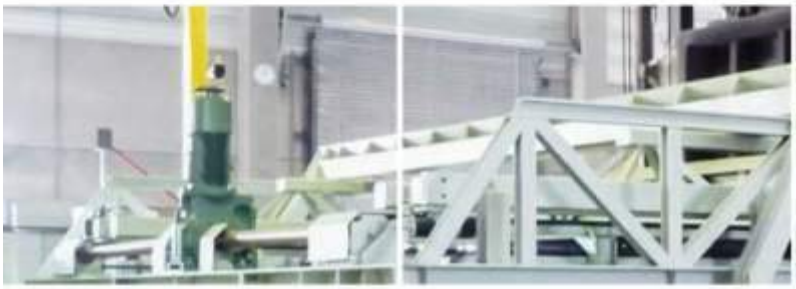


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Make in India to enhance the casting demand by 10 to 15 % in 2022-23

Devendra Jain, President, Institute of Indian Foundrymen and is the Managing Director of Porwal Auto Components Ltd. He has completed Mechanical Enginering from BITS Pilani, BE (Hon's) and MBA – DAVV Indore.

Professional experience, Competence and Accomplishments

- Joined family business M/s Porwal Udyog (India) in 1976.
- Established M/s Triveni Conductors Ltd. Plant at Dewas in the year 1981.
- Established M/s Porwal Diesels Pvt. Ltd. In 1985 as Managing Director.
- Established second unit of M/s Triveni Conductors Ltd. Plant at Pithampur in the year 1991.
- Established M/s Porwal Auto Components ltd. Pithampur in the year 1992 as Managing Director.
- Established M/s D P Aluminium Casting LLC, Rasal Khema, UAE in the year 2008 as Partner.
- Established Solar Plants of Porwal Auto Components Ltd.

01. 1.8 MW Solar Plant in the year 2013.

02. 3.0 MW Solar Plant in the year 2017.

Awards

- Received National award for Entrepreneurship by Govt. of India, Ministry of Small Scale Industries for the year 1999.
- Porwal Auto was awarded for New Product Development by Eicher Motors Ltd in the year 1999.
- Porwal Auto was awarded for Outstanding Contribution to supply chain management by Eicher Motors Ltd. In the year 2006.
- Porwal Auto was awarded for New Product Development by Volvo Eicher Commercial Vehicles Limited in the year 2008.
- Porwal Auto was awarded for National Energy Conservation by Government of India Ministry of Power in the year 2019.

IIF Membership number and years of membership completed

LM/00333/W/IND & 27 Years (Joining 06/10/1993)

CM/02367/W/IND & 12 Years (Joining 04/09/2008)

NC membership From the year 2007 to till date

He was a Past Chairman IIF Indore Chapter from 1997-2000.

Past Chairman IIF Western Region 2007-2008

Council member -IIF National Council since 2007.

Member of Various Committees of IIF.

He is a Director of Pithampur Auto Cluster Ltd. since inception and Vice President & various positions in Pithampur Audyogik Sangathan (Industries Association of Pithampur) since 1987.

In the past, he was a member ACMA – Coordinator of Madhya Pradesh Western Zone. He was a Board Member of Jain International Trade (JITO) Indore Chapter and also held various Positions held in Jain Social Groups.

On the occasion of Metalworld Annual issue, D A Chandekar, Editor & CEO had an exclusive interview with Devendra Jain, President, IIF to understand the present industry scenario, demand perspective and its expectations from the policy makers.

How is the present situation in the Indian foundry sector?

At present the foundry sector is facing a lot of pitfalls. On one hand the input cost is going up with a very unpredictable trend and on the other hand buyers demand is inconsistent and rate revision is on hold or denial mode.

However I feel that this is only a transition phase and Indian foundry is going to become stabilised by April 2022. As on date with all the problems taking place in

China, which used to be by far the largest casting supplier, the buyers are slowly shifting towards India to meet their demand. Even within India with the Government impetus to make in India, demand is definitely going to go up by at least 10 to 15 % in 2022-23.

European countries and the USA are gradually coming out of the economic slowdown, and are looking to out source some of their casting manufacturing requirements. The Government of India is trying to propel economic growth of the country by boosting exports. The new manufacturing policy envisages raising the share of manufacturing in the GDP to 25%. As foundry castings are an integral part of most engineering manufacturing processes, the role of Indian foundries is a very important part of this strategy. While India may be behind China as far as overall castings exports are concerned, it is the second largest producer of castings globally. Understanding the need to be competitive, the government of India is also modifying its policies, so that import of raw material and export of castings is easier. This should boost castings exports from India.

How has fluctuations in raw material prices affected the bottom-line? What is the solution?

Yes definitely. The unpredictable fluctuation in the raw material cost has seriously corroded the bottom line. Generally the OEM's give compensation in price on account of Pig Iron and Scrap. They do not give compensation for Ferro-alloys, Sand Consumable and chemicals, Inoculant, Power and other input materials. The compensation is given on a quarterly basis with a delay of 3 months.

The solution is to make OEM's to give compensation for all the foundry inputs on a monthly basis in a state of quarterly basis effective from pro-rate or maximum delay of one month.

How do you see the short term and the long term prospects for the Indian foundry sector? How can India be the 'Castings Hub' of the world?

Foundries in India need to invest in technology and increase production capacity. Most of the foundry players in India are small or medium, and only a few quality conscious castings manufacturers have taken efforts to invest and upgrade their technological facilities.

China is the most important threat to India as far as castings are concerned, due to technological innovations, which have enabled them to manufacture castings at competitive cost.

Indian foundries should be energy efficient and upgrade their workforce. Of the 5000+ foundries, only one third or even less have International Quality Accreditation and have the expertise that the clients from Germany, UK, France, US and other countries demand.

With an increasing awareness about environmental issues, one major challenge in the foundry industry is stricter laws that prohibit pollution. The tightening of government regulations on the release of waste produced by foundries in the environment is leading to increased investment in waste recycling process and technologies. While this is a welcome step, it increases the overheads on the Indian foundries.

Further, the thrust of manufacturing companies to reduce weight, especially in the automobile sector, presents growth opportunities to those Indian foundries that are progressive and have the expertise to manufacture such specialty alloys castings.

What are the present activities of IIF? What value addition are you proposing during your tenure as the President?

IIF though its policy advocacy committee is working with the Government of India to control the cost of Raw materials by allowing foundry input materials to be imported at nil or lowest possible duty. Imports export duty on iron ore to reduce the cost of Pig Iron and steel in India.

IIF is trying to get technological upgrades front from the Government for Foundries to give subsidy on interest for capital investment loan for upgrading the ecologies and increase the production capacity to increase the export of castings.

IIF has started training programmes and webinars to upgrade the skills of foundry men.

What does the foundry industry expect from the policy makers?

Today Indian foundries are willing to take up the challenge towards production of quality castings. However the technology upgradation and manpower training etc involves massive cost. The Government should come up with a foundry specific policy enabling easy access to finance on affordable terms and conditions, some production linked or export linked incentives. Government should have some controlling mechanism against unjustifiable price hikes of raw material and foundry inputs. ■

BALCO's journey : A story of growth, determination and transformation

Abhijit Pati
CEO & Director-BALCO

Laying the foundation stone

Aluminium is a strategic metal, vital for the growth and progress of any nation. To make the nation self-dependent,Pandit Jawaharlal Nehru, the first Prime Minister of India sowed the seeds of many maiden industries among which Bharat Aluminium Company Limited (BALCO) was one. BALCO was established in 1965 as a Public Sector undertaking in Korba, Chhattisgarh. The company created an aluminium manufacturing complex with a production capacity of 1 lakh tonnes/annum, supported by power generation facility of 270 MW,with the vision of contributing significantly towards development of the country.

The strategic acquisition of BALCO in 2001 by Vedanta, led to the company's turnaround at an unprecedented scale and BALCO became one of India's greatest privatisation success stories. Vedanta Limited is one of the world's leading natural resources conglomerate with operations in India, South Africa, Namibia and Australia. It is a leading producer of Aluminium, Copper, Oil & Gas, Zinc, Lead, Silver, Iron Ore, Steel and Commercial Power. Vedanta contributes 1% towards India's GDP, as per IFC. Currently, Vedanta Limited has a 51% stake in the company, and the Government of India has a 49% stake.

BALCO is part of Vedanta's Aluminium Business, which is India' largest aluminium manufacturer, producing half of India's aluminium (around 1.97 million tonnes in FY21).

Vedanta Aluminium is a leader in value-added aluminium products that find critical applications in core industries, such as aerospace, aviation, automobile & transportation, building & construction, electrification, energy, consumer goods and more. Today, BALCO stands tall as India's iconic producer of a vital raw material for the country – Aluminium.

The story of success

BALCO, the only aluminium company in Chhattisgarh, has contributed significantly towards the development ofthe state and the country throughout its 56 years since its inception. As BALCO grows in strength, it is also capitalizing upon India's demographic dividend to partner in the realization of country's vision of becoming a USD 5 trillion economy.

BALCO's initial capacity was approx. 1lakh tonnes per annum till 2004. Since then, the company has undergone 155% volume expansion to its current capacity of 5.70lakh tonnes per annum, producing aluminium Ingots, Wire Rods, Rolled Products and Primary Foundry Alloy (PFA). The power generation capacity at BALCO has also reached 2010 MW from 270 MW at the time of disinvestment, and the company continues to be a power supplier to the state.

BALCO's turnaround has created a 360-degree multiplier effect for the country. BALCO's stupendous growth story has resulted in the economic progress of Chhattisgarh and the nation at large.It is largely acknowledged that privatisation has the ability to unlock value and realise synergies for businesses in a way that no other means can create. This is proven by many accounts in the past. The magnitude of the turnaround has been such that its impact created ripple effects that went beyond the sphere of business to have an effect on the community. In the last decade alone, BALCO has contributed approx. 10000 crores to the state exchequer and provided employment to 15,000 people directly and indirectly.

Making India self-reliant

BALCO's aluminium production assist the country's tread towards self-reliance.The aluminium sector plays a vital role in nation's economy and is a sector of strategic importance to the country due to its role in energy security, national defence, aerospace, automobile, infrastructure, electricity transmission & distribution, and many other ancillary applications. The metal also has a significant role to play in Union Government's forward looking and visionary schemes of Make in India, Smart Cities, Power for All et al.

Stride towards excellence

BALCO has adopted state-of-the-art technologies to manufacture a wide range of products, establishing itself firmly as a front-runner among the producers of aluminium.

Many firsts as an Organization

- First to produce Alloy Rods for conductors used in power transmission industry
- First to roll material for aerospace applications in the country
- First to produce largest Billet of diameter – 800 mm, length – 6 MT
- First to set up the widest Hot Rolling Mill
- First to set up the widest Hot Rolling Mill in India
- First to roll material for Aerospace in the Country
- BALCO specializes in Hot Rolled Products

- BALCO has one of the oldest mills in the world: Technology from Russia, USA and Italy

BALCO is one of the leading wire rod manufacturers in the world. The mills are fully equipped with in-line degassing and filtration systems to ensure standard metal quality. Apart from producing Alloy Rods, EC Rods and Flip Coils. BALCO produces primary aluminium ingots that are re-melted to produce a variety of end products covering the entire spectrum of aluminium applications using the state of art technology. The company also supplies Primary Foundry Alloys to automobile industry.

BALCO is equipped to support critical and emerging industry sectors like electric vehicles, modern construction, packaging, transmission and other ancillary segments. BALCO continuously strives to adopt advanced and updated technologies and processes to maximise efficiency. On the same lines, several digitalization initiatives have been integrated in operational areas. BALCO has adopted image and video analytics, contextual analytics, situational awareness, safety and security risk analysis that is available in real-time with accuracy.

BALCO is also deploying industry-leading digital technologies, creating super alloys to support the country's emerging applications of aluminium, to make aluminium usage comparable to those of the developed countries in the world. In developed countries, aluminium has over 3,000 applications whereas it is limited to only 300 applications in India. BALCO is dedicated to exploring the enormous scope to enhance the aluminium usage in India, as the country's per capita aluminium consumption is a meagre 2.5 kg against the world average of 11.7 kg.

Towards the betterment of society

The robustness that BALCO's financials achieved under Vedanta, opened up a bunch of opportunities for the community in the vicinity. Vedanta's pursuit of holistic development through the empowerment of its stakeholders triggered an investment of USD 17.63 million in community initiatives alone. It introduced social welfare programs, health facilities and created employment opportunities that reach out to the residents of around 123 villages. The brand has undertaken several development projects under the themes of sustainable livelihood, women empowerment, healthcare, education, afforestation and water conservation benefiting over 1,50,000 people in the region and beyond.

To development tomorrow's workforce, BALCO is operating three centres of Vedanta Skill School in Korba, Mainpat and Kawardha in Chhattisgarh. These are one-of-a-kind institutes that provide technical education to the rural youth to prepare them for a vocation that allows them to become financially self-reliant. Till date, over 9,000 youth have been benefited from the skill schools.

The BALCO Medical Centre, a 170-bedded tertiary care oncology facility, is the flagship initiative of Vedanta Medical Research Foundation (VMRF) that aims to bring ultra-modern, multi-modality

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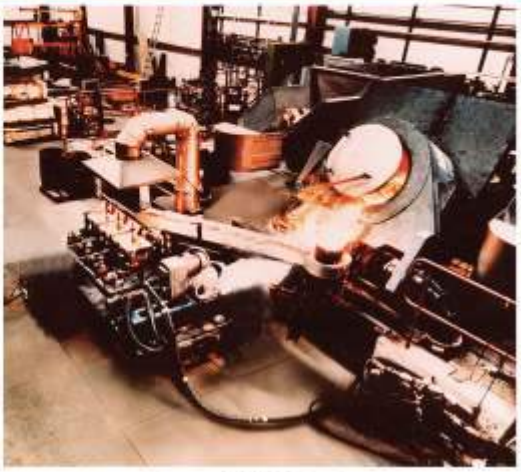
Lift-Swing Furnaces

Channel Furnaces



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diagnostic and therapeutic facilities within easy reach of India's population at a reasonable and affordable cost. The Hospital is based out of Naya Raipur, Chhattisgarh, and has emerged as the most sought-after cancer hospital in central India, visited by patients from all geographies, predominantly from Chhattisgarh, Odisha and Madhya Pradesh.

ESG initiatives

BALCO has planted over 41 lakh trees in the surrounding regions. To create awareness about the importance of water conservation, the company has implemented rainwater harvesting techniques in the plants and in the township, and installed modern equipment to ensure zero effluent discharge. At its spent mines, the company has undertaken biodiversity conservation efforts to promote regional flora and fauna.

BALCO's Power Plants have undertaken various innovative and improvement projects for energy conservation. In the year 2020-21 the specific water consumption of 1200MW and 540MW power plants was 2.1 and 1.95 cubic metre/MWh respectively. A solar plant of 33 KW has been established to promote renewable energy. The plants have also ensured 100% utilization of ETP discharge water and implemented almost 8000Quality Circle and Kaizen projects for operational excellence. In its other energy saving endeavours at all the areas of operations, BALCO has also reduced power consumption in its Potline-1, and become the best potline in India and Gulf countries in achieving energy efficiency, thereby also reducing its carbon footprint.

BALCO has been the

recipient of various awards and accolades for its environmental conservation efforts. BALCO secured the coveted top spot with the highest Energy Saving Certificates, a testimony of its continuous endeavors towards energy conservation for business and environment sustainability. BALCO has also won the Golden Peacock Award for Energy Efficiency –2021', 'CII Energy Efficiency Award', and 'Golden Peacock Sustainability Award'. The company has also bagged 'International Green Apple Award' 'CII Energy Excellence Award', 'Sustainable Business of the year Award', 'National Award for Excellence in Energy Management' and 'Energy & Environment Global Environment Award' in recent years.

CEO Quote:"BALCO is sincerely committed towards the goal of maximizing its efforts in the direction for the betterment of the society and environment. Through our continuous endeavors we aim to achieve the larger goal of creating a sustainable future for the generations to come and contribute to the expeditious development of the nation. BALCO has been an early adopter of smart technologies for heightened operational efficiencies, which further bolsters the culture of energy optimization, safety, and productivity that we have meticulously fostered across the organization. We are dedicatedly driving the Environment, Social and Governance (ESG) dimensions of sustainability for building a greener tomorrow and, therefore, are actively exploring innovations that can help reduce our carbon footprint as

Recycling Sector – Challenges and Opportunities

A panel discussion was held on 16th Dec. 2021 under 10th Asian Metallurgy on the above subject. Following members participated.

1) Mr L. Pugazhenty (ED – ILZDA)

2) Eng Salam SHARIF

3) Mr Vinay Sharma (MRAI – India)

4) Ms Divya (GM-Procurement - RMI)

5) Mr Dyanesh Chandekar (Editor- MetalWorld and SteelWorld)

In the opening remarks Mr Dyanesh Chandekar said that recycling is the way forward. He commented that we should use fewer materials from mother earth. There will be opportunities as well as challenges in the recycling sector.

The views of all the members are presented below –

(A) L. Pugazhenty: In his opening remarks he expected that recycling being a very important issue and priority, it should be discussed first. Green recycling of steel, metal and plastics is important. Industry leaders should do a good job. In India steel scrap is being recycled since the year 1975. Recycling provides good opportunity in India. During the discussion he said that there is a lack of appreciation and co ordination among various government officials. Mines ministry does not have data on production and consumption of metals. Details of primary and secondary metals are also not available with mines ministry. According to different government departments, recycling is a job of ministry of forest and environment.

L. Pugazhenty

State pollution control boards (PCB) do not have good co operation among themselves.

For instant, movement of used lead batteries is not allowed from Tamilnadu state to Karnataka state whereas other states allow the movement.

Massive awakening is required among the government agencies, industries and people.

Government as a whole should have uniform thinking, interpretation and understanding to take the recycling industry forward.

The system should work as a team in a collective manner. Government should make efforts to increase the awareness on recycling with the help of mass media.

Regulatory board should work as facilitator and guide people from recycling industry.

They should help people in getting approvals for handling copper and aluminium scrap.

Clear guidelines should be provided for lead batteries and dry cell batteries.

(B) Eng. Salam SHARIF:

Dhiraj K Chauhan
(Director- METCON)

He offers metallurgical consultancy services in the areas of Heat treatment and quality as well as process controls in cold rolling mills. He is B.Tech (Hons) and M.Tech. in Metallurgical Engg. form IIT Mumbai.

According to him recycling is not a new concept. Almighty created the nature and plants to absorb harmful gases. MFD is absorbed by plants and used as fuel by them. There is massive urbanisation, deforestation, desertification and exploitation of natural resources. Recycling is not a choice but necessity.

Salam SHARIF

In Glasgow climate change conference the world leaders decided to put a stop on decarbonisation.

He echoed the views of Divya madam on recycling issues and problems. Her views are presented below in section (D).

In Middle East young population is 70%. It has highly educated youth and diverse nationality. It has huge oil reserves and the by product is gas.

GCC has investment of over 1.8 billion USD in steel pipeline. In the next 10 years 700 billion Saudi Riyal will be invested in green initiative.

1 MT of steel production generates 1.9 to 2.0 MT of carbon emission. If the same quantity of steel is produced from scrap, only 1/4 to 1/3 of carbon emission will occur. Creating awareness about recycling among various stake holders is on CSR agenda.

In GCC sector waste generation is very high which is a blessing in disguise.

He emphasized that the recycled materials do not lose their characteristics or

properties.

Due to squeeze of supplies, regulations etc the prices of copper and other metals are artificially high. He suggested lobbying and advocating involving all members in the recycling activities.

Trade between India and Middle East is ~110 billion USD. There are 4 million Indians are in UAE. There is a lot of scope for improvement in institutional relations between India and UAE. DMR and MRAI are working closely for improving the relationship. GCC is a backyard for lot of recycled materials which is suitable for Indian industries.

(C) Vinay Sharma: He also agreed with the comments of other participants about recycling business. Earth is suffering in the name of development. Huge waste is generated in the last 40 years as compared to past 4000 years. Recycling is the only solution. Recycling should be put in front seat and not on back seat. Increased in population will need materials from present level of 50 to 130 billion MT like metals, plastics, glass, tyres etc. By the year 2050, four earths will be needed to meet the demands of materials requirements.

Vinay Sharma

Recycling sector employs 1.75 million people and contributes to 2% of GDP. It allows Rs 14 lakh Crore of cost saving and has the potential to create 6 times more jobs.

If steel is produced from scrap instead of iron mineral 74% energy is saved. For use of aluminium scrap 95% energy saving will result, In case of copper scrap 85% saving and for plastic reprocessing 85% energy savings will result.

For 1 mt of steel production from scrap, 642 kwh energy is saved, 1.8 barrels of oil and 2.3 cubic meters of land fill space is saved and reduction in carbon dioxide emission is 58%. 1mt of aluminium production from scrap saves 6 mt of bauxite mineral.

It was suggested that trading of recycled scrap be allowed with minimum regulations.

The recycling industry is getting good support from government of India.

(D) Divya: Vast devastation of Mother Nature has taken place. Material consumption is up 6 times. Resource extraction in India is 1580 mt/acre against world average of 450.

Divya Pandya

Recycling rate in India is 20-25% as against world average of 75%.

Copper scrap is a mine above the earth and more of an urban mine. Recycling is less capital intensive and more environmental friendly.

Domestic scrap business should be given industry status so that it becomes more organised. Recycling of copper scrap will reduce dependence on imports of copper mineral since India has few copper deposits.

BCD on copper scrap is reduced from 5% to 2.5% now.

Copper scrap is non hazardous and covered under Basel convention with a Basel Code B- 1010.

The government has willingness to work and for the recycling industry there is silver lining.

(E) Kegan Vas: Technologies for recycling of lead batteries will have to be implemented. Nearly 5.5 million tons of scrap is imported by Gulf countries. There is a good opportunity between UAE and India for scrap recycling business. Scrap arrives from Europe and it is segregated and shipped to India. There are big recyclers for scrap reprocessing in UAE apart from Europe. The recyclers from UAE are keen to enter India. In fact a recycling facility has been set up in Chennai.

Kegan Vas

Good awareness is required on technological aspects of the recycling industry. For precaution in scrap handling and use of safety gears is a must. Lead metal recovered from batteries must be handled carefully.

Towards the end of discussion Mr Chandekar said that more importance should be given to recycling activities and felt that Government can set up separate department or Ministry.

He thanked all the participating members for the lively and informative discussion and the panel discussion was concluded.

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Incredible Material Resources - The shape of things to come

It is a well-known fact that over the ages, progress of civilization has been described in terms of the primary materials used by humans. When man learnt to make and use tools to make articles out of various materials, that period was named after the respective material.

Earlier, there was a *stone age*, copper *age*, then *bronze age*, then the iron age, then the plastic age, that continues till date. Each age was characterized by capabilities to work on these materials, make tools suitable to shape them, make articles, artifacts, arts, gadgets and things for daily life out of these materials.

We developed ability to shape iron in the form of blocks for construction, sheets for housing walls and roofs, spears & swords to fight, plows to help in agriculture, pots and utensils to cook, and wheels to be used with carts for easier transportation, and all that shaped the civilization of iron age. And the same was true for the earlier ages as well.

As we progress, over the years, discovering new applications, new techniques, new molecules, and new materials, it is observed that each of these takes an increasingly longer period. Thus, a look at patent databases shows that hundreds of new applications get discovered every day; tens of new techniques every day, a handful of new molecules get invented every month; but new materials come once in a decade- or even longer.

Sadguru Kulkarni
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It is therefore imperative that anyone who wants to gaze into the future of mankind, needs to track, guide and even lead the development of new materials. Over the next few monthly issues, Metalworld plans to run a series of articles on what are the major trends we observe in materials today and look for insights into the shape of things to come.

Here are a few examples: Materials for e-transportation, Batteries, Recycle technologies, Nano-technology, material modeling, 3D printing, Biomimicking materials,

Material Genomics and others. We plan to cover a few in this issue.

Materials for e-Transportation: Electric vehicles have become the buzzword today. Battery-operated vehicles are slated to take over all kinds of transportation, whether cars like Elon Musk's Tesla, or e-scooter to be launched by Ola.

While e-vehicles are looked upon as the ultimate solution for minimizing the threat of global warming, they cannot be easily built using the same old materials of construction. Just as the advent in cars by legendary Henry Ford and team, lead to innovations in steel manufacturing, over a century back, making steel plates for car body; new casting technology for engine blocks, rubber technology for tyres which will not wear out fast; the e-transportation industry is demanding material innovations to light-weight the cars without loss of mechanical strength & reliability, alternatives to steel which would help reduce the dead weight of the vehicles, quick couplings which would help eliminate the clumsy power train design, etc.

Transportation has always been making extreme demands from Material Science. Bold steps in making fully reusable vehicles for amature space tourism are now demanding materials of construction which would stand the extreme conditions such as far sub-zero temperatures of outer space, hitherto unseen high temperatures while the space vehicle re-enters the earth's atmosphere, etc. Developments of new materials for aviation and space travel have always been percolating to the transportation industry in a few years, and the materials like special alloys, industrial carbon, composites and novel polymers will land into our daily use over next few years.

Batteries: Remember the days of the good old lead batteries in cars, two wheelers and even the emergency lights and the hassles of checking the acid concentration in the battery compartments? Battery technology has gone through a sea change over the last two decades. Rechargeable, light weight dry batteries has been among the fastest growing industries; and has been a driver for new materials. E-Vehicles have the major issue of high battery dead weight that the vehicle has to carry.

A Tesla model S weighing about 2200 kg carries battery weight that is 20-22% of its own weight! A long charge i-phone is heavy due to the weight of its battery. In addition, there are challenges of supply of the rare & exotic materials/ metals like Lithium which are running into the danger of short supply, coupled with global politics to control their sourcing and supply.

The recent 'lithium coup' in Bolivia- a small south American country is a case that may

repeat for multiple critical metals and materials over the coming years.

Batteries occupy a key position in our daily lives, starting from rechargeable batteries for mobile phones and laptops, hearing aids to Fitbit and Apple or Samsung watches, and cars to the ECG machines. Sizes vary from miniature to half a ton and usage extends from hours to years! The wide impact, spread of applications demands varying range of technologies for batteries. Batteries technology also offers significant opportunities for innovation, such as aluminium-air or zinc air batteries which make use of commodity metals but offer the potential for button cells to car batteries; the sodium metal batteries that Mukesh Ambani's Reliance is slated to be getting into for e-vehicles, the new class of bio-batteries emulating mother Nature, and many others. Such developments are likely to offer challenges and opportunities to basic science, engineering, supply chain, as well as environmental hazards such as disposal and recycling of spent batteries.

Energy: The per capita energy consumption of a country is taken as a key indicator of the level of social development. Expressed in terms of Lit of Oil per day per person, the developed countries like USA consume 25 to 40 L per capita, while China shows 10 and India a mere 1.5! (Ref: https://en.wikipedia.org/wiki/List_of_countries_by_energy_consumption_per_capita). The disparity is being addressed through the use of alternative

energy such as solar/ wind/ etc. These alternatives have provided a significant pull for materials. Solar photovoltaic cells and their extensions require sophisticated high purity silicon, gallium, indium, selenium etc. While these materials are available in trace quantities along with many common minerals, the separation technologies for their recovery raise the cost of production. Solar thermal power option also requires materials which stand extreme operating conditions to get economic power generation. A breakthrough in energy technologies that can offer power generation under milder, safer and cost effective, environmentally protective conditions that ensures on-sight generation with minimal need for power transmission is the need of the day. Early forays in wireless power transmission have been reported last year and offer high potential for such a breakthrough.

Recycle Technology: The discussion on batteries opens the wider subject of recycling. With resources getting more and more scarce, and the waste generation from single use materials causing irreversible environmental damage, recycling is becoming imperative. Whether it is water recycle from large production plants, total water reuse in places like Pretoria in South Africa that has a dire need for water with zero supply, vast amount of waste packaging material that is piling up the dumping yards of cities, the challenges of food waste, all of these indicate a demand for a comprehensive recycling solution. The talk of colonization of the moon and mars has already initiated challenging projects such as generation of oxygen from inorganic resources, water from high titanium soil and rocks, a non-carbon material culture and many hitherto unseen technical challenges. Silicones , with their flexibility of form and function, have already invaded many applications crowded by metals and polymers. We expect tougher, cost effective and comprehensive solutions coming from the silicone world, and a new generation material like silicones developing over the coming decade. Recycling is a technological goldmine that has been mastered by Nature and we have a lot to learn from it.

Metalworld plans to continue this discussion over the next two issues, offering insights into the shape of things to come in the world of materials, covering nanotechnology, biomaterials, material genomics, 3D printing and other rapidly upcoming technologies in Material Science.

To be continued....


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HOW BAUXITE-ALUMINA INDUSTRY CAN GROW?

Despite having large resources of bauxite, some of the alumina plants in India are starving for this basic raw material. With increasing demand of aluminium metal in the country, there are limited opportunities to enhance the output of alumina for sustaining production in smelters and meet the demand. Delay in bauxite auctioning process and limited availability of local laterites and bauxite further affect the smooth functioning of alumina plants in India. For the last 10 years, no large bauxite deposits were auctioned and plants are compelled to import ore from Africa. Unlike the Chinese, unfortunately none of the big aluminium players of India have acquired bauxite deposits in Africa or in other parts of the world and import ore at market prices as and when required. The present high bauxite spot prices and increasing sea freight are making alumina production unviable in refineries based on imported ore.

There are various options available for companies interested in alumina and aluminium production in India and some of them are listed below:

1. Similar to China, India should consider to setup port-based alumina refinery, which can regularly use imported bauxite as well some of the inland ore. In this case a long-term bauxite import strategy can be developed.
2. Countries like Guinea, Sierra Leone, Cameroon, Indonesia, Vietnam and Venezuela have rich bauxite resources and they welcome to set up alumina refineries in their country.

   2.1 Guinea: This country has the largest and best quality bauxite reserves in the world. However, there are practically not rained manpower, other raw materials like caustic soda, energy and infrastructure to set up greenfield alumina refinery. The only plant of this country (Fria refinery

Dr. Ashok Nandi
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A leading bauxite expert with +45 years experience and involved in various bauxite-alumina projects of India, Australia, Guinea, Saudi Arabia, Philippine and Sierra Leone. President of International Bauxite, Alumina and Aluminium Society (IBAAS). JORC competent expert and also ASI Registered Specialist

of RUSAL) is struggling to produce alumina despite having large bauxite resource base due to old plant and obsolete technology. There are some options available in Guinea as

GAC/EGA is holding suitable alumina plant site of BHP-Billiton with dedicated bauxite reserves and infrastructure. This company is not quite keen to set up alumina production facility in this country as they have built refinery in Abu Dhabi (Al Taweelah). However, Alcoa is also holding good plant site near the developed port (Kamsar) of Guinea. In fact, this West African country's risk can be minimised by having2 or more partners to jointly built alumina plant.

2.2 Sierra Leone: The bauxite of this country is characterized by high silica content and it is necessary to wash this ore to produce premium quality ore. Being another underdeveloped west African country, there is high risk in setting up large plant. However, small refinery for special alumina may be viable.

2.3 Cameroon: The large reserve of fairly high-grade bauxite is available in this country; however, the deposit is located about 700 km from port with poor infrastructure. This deposit may be suitable for large pit head alumina refinery.

2.4 Indonesia : There are several large and medium sized bauxite deposits / mines in the country but still lacking in alumina production. Normal bauxite of Indonesia requires beneficiation to bring down the high silica content of raw ore. Chinese have set up one alumina refinery in this country and there is scope to set up 2-3 more plants here.

2.5 Vietnam : There are several large bauxite deposits in this country and some of the mining companies are looking for strategic partners to develop these resources. According to the United States Geological Survey, Vietnam is estimated to hold the world's third-largest bauxite ore reserves, after Guinea and Australia. The majority of Vietnam's reserves are located in the Central Highlands (TâyNguyên) and have only been minimally mined. These bauxites also require washing and after beneficiation high grade ore can be produced here.

2.6 Venezuela: This country is endowed with about 5000 million tonnes of bauxite resources (inventory), however, at present whole aluminium industry of this country has collapsed. Alumina and Aluminium plants have almost shut down their operations under the present socialistic regime. The Los Pijiguaos bauxite deposit, the only working mine, is in the western part of the State of Bolivar in Venezuela, and this mine was supplying ore to Inter alumina refinery of Ciudad Guayana.

3. Australia : Australia, having second largest bauxite deposits in the world, is always eager to supply large quantity of consistent grade ore from their Gove and Weipa bauxite mines. These deposits have vast resources with well-developed infrastructure. As alumina production and manpower are costly in Australia, it is worth processing this bauxite on Indian coastline having port and power facilities like Mudra port of Kachchh. Australian companies can supply consistent grade bauxite, a basic raw material for alumina refinery and there may be opportunity for JV project. Large sizedbauxite vessel with regular supply may significantly cut down the landed cost of ore.

4. An alumina refinery and smelter can be planned in one of the Gulf countries having cheap energy and other raw material resources like caustic soda for alumina production. As these countries are located on coastline and nearer to African bauxite deposits / mines, aluminium industry may be viable in these countries.

With the present shortage of bauxite in the country, it is proposed to adopt following strategies: (Iadopt Natural Cut-off Grade - The bauxite resources in the existing mines and deposits of India can be increased by adopting natural cut-off grade of alumina and silica. As an example, resources and grades are given for one typical bauxite deposit at various cut off here as shown in Table-1.

Table 1: Bauxite thickness, resources and grades at 3 cut off values of alumina & silica

Particulars	Cut-offs Al2O3 ≥35%, SiO2<10%, ≥1m	Cut-offs Al2O3 ≥40%, SiO2<9%, ≥1m	Cut-offs Al2O3 ≥42%, SiO2<6%, ≥1m
No. of Bore Holes	234	234	234
No. of Positive Holes	134	92	56
Av. Bauxite Thickness	5.74m	4.48m	3.63m
Ore Tonnage in MT	9.26	5.43	2.67
Av. % Al2O3	41.2	43.23	44.36
Av % SiO2	6.07	5.47	4.13

Here the natural cut off grade of ore deposit is >35% alumina and <10% silica. As shown in above table, bauxite resources have gone down to less than 1/3rd at higher cut off value of 42% alumina compared to 35% Al_2O_3, however, overall grade significantly improves. In other words, it shows how 65 to 70% low grade precious ore is wasted only to treat high grade ores. Figures 1(a), 1(b) &1(c) provide how these changes in bauxite cut-off influence ore body configuration and continuity of deposit by 3-D geological modelling.

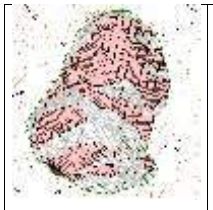

Figure 1(a): Orebody disposition at 35/10 cut off

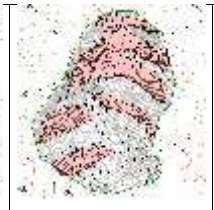

Figure 1(b): Orebody disposition at 40/9 cut off

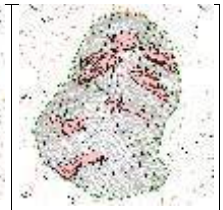

Figure 3(c): Orebody disposition at 42/6 cut off

At natural cut-off grade, not only bauxite resources increase but also it becomes easier to mine thanks to continuity of the ore body.

(Iimprove Ore by Simple Benefciation: Further it is feasible to partly bring down the silica content of lateritic bauxite by simple crushing and screening process andone of the typical examples for the same is given in Table-2.

Table 2: Size and Chemical Assay of Lateritic Bauxite

Size (mm)	Al_2O_3 %	SiO_2 %	R-SiO_2 %	Fe_2O_3 %	TiO_2%	LOI%
+40	45.7	4.76	3.95	20.0	5.24	23.9
-40+30	48.5	2.74	2.49	17.6	5.06	25.8
-30+20	50.1	3.35	2.18	15.9	5.57	25.3
-20+10	46.	4.43	3.72	20.7	3.60	24.7
+10+5.6	45.2	4.73	3.91	21.4	4.12	24.0
-5.6+3.35	43.5	5.69	4.68	23.2	4.26	22.9
-3.35+2	42.8	6.05	4.82	23.9	4.36	22.3
-2+1	43.6	6.86	5.41	24.3	4.54	20.2
-1+0.5	41.9	8.73	6.24	22.3	4.28	22.1
-0.5+0.25	39.5	12.69	8.90	22.2	4.30	20.7
-0.25+0.15	39.5	13.01	9.10	22.0	4.60	20.5
-0.15+0.1	39.4	11.90	7.80	23.4	4.59	20.3
-0.1+0.075	39.7	11.25	7.50	23.5	4.50	20.4
-0.075+0.045	39.4	11.50	7.60	23.7	4.38	20.6
-0.045	35.9	17.65	13.10	20.3	4.29	17.6

In all the existing bauxite mines, particularly in Odisha, except topsoil, all the overburden laterites can be easily beneficiated and used in place of rejecting them. Some of the large bauxite mines, like Panchpatmali in Odisha, have silica rich bauxite and efforts should be made to beneficiate them by dry and / or wet processes to increase the valuable resources.

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Further, the vast resources of aluminous laterites associated with bauxite deposits or standalone deposits can also be made viable for alumina production by simple beneficiation processes.

IBAAS-JNARDDC 2022 International Bauxite, Alumina & Aluminium Society (IBAAS) in association with JNARDDC is organizing Aluminium Conference and Exhibition in Raipur, India during September 14-17, 2022. Raipur, being a hub of Indian aluminium industries, the conference is being organized in this city of central India. In this conference, there will be series of papers on latest developments in the field of bauxite and alumina. Companies like First Bauxite of Guyana, Worley Parson, AKW, SMHL/Vimetco, Utkal Alumina, ABSTCPL, Mecfor Inc. and alumina consultants of Australia and Hungary have confirmed to present papers. Opportunities are also available to exhibit technological developments, new processes and latest equipment for aluminium production. Several International companies like Almatis Alumina, AVEVA, CRU, Fives SAS, GEA, Jingjin, Norsk Hydro, Outotec, Stas Inc, Rain Carbon Inc, REEL Alesa and Tokai COBEX have shown keen interest and confirmed their participation Please visit IBAAS website http://www.ibaas.info/for details.

The light weight composites material could threaten primary metal industry

The Indian composites industry has experienced comparatively healthy growth over the last five years and caters to a wide assortment of raw materials, components, and sectors. The market is driven by growth in mass transportation, electrical and electronics, infrastructure, building, and construction.

Currently, the per capita composites consumption is estimated to have reached 0.35 kg in 2021, a marginal increase from 0.3 kgs in 2018 and 0.25 kgs in 2012. The Indian composites industry has a fragmented structure, consisting of around 3000 stakeholders in the value chain including small, mid-sized, and large players across the country.

The buoyant domestic demand for Composites provides a driving impetus for all stakeholders within the value chain – raw materials suppliers and end component fabricators, thus boosting employment prospects as well. Currently, the Indian composites industry is poised to provide a lucrative opportunity to the International composites community, and the still untapped markets will provide a platform for investments, both foreign and domestic institutional investors.

The composites industry is cyclical in nature, depending on the country's economic growth and business cycles. It is dominated by institutional business, which is correlated with applications, sectors, technology, and the country's overall gross domestic product (GDP) growth as well. The major driver for the Indian composites market growth is the 'Make in India Initiative', the rise in demand for composite components is imminent for renewable energy, oil & gas, mass transportation, electrical and electronics, chemical industry, infrastructure, building, and construction (smart cities development, etc.) and water management.

India's composite output is estimated at 380,000 tonnes in 2019 which was marginally declined in 2020in sync with the falling demand of

Dilip Jha

Dilip Kumar Jha is a veteran journalist with nearly 25 years of experience covering steel and raw materials for the leading domestic and international publications. A graduate in literature, Jha has thousands of articles published in leading business dailies including Business Standard and trade publications viz Steel Times International, London. Jha has received several appreciations and accolades to his credit. A passionate writer Jha led several teams of writers in his capacity as a team leader. Currently, Jha is working as Editor at Polymerupdate

passenger and commercial vehicles on account of coronavirus (Covid)-induced lockdowns and thereby restrictions on the public movement. But in 2021, India's composite output is estimated to have jumped by around 15 percent to 420,000 tonnes.

The automotive industry faces many challenges: improving energy efficiency, reducing vehicle emissions, increasing material systems to meet the needs of the Automotive OEMs and their supply chain, creating solutions for weight and emission reduction, recyclability, and pedestrian protection.

Weight reduction

Composites attain the best attributes of traditional materials by leveraging chemical processes. The simplest composites are formed by combining some form of resin with a corresponding hardener. In combining these products, a chemical reaction occurs then, the final composite hardens and becomes stronger than the materials by themselves.

With this makeup, composites are revolutionizing the design process and end-products across many industries from aerospace to renewable energy. Composites are increasingly replacing metals, offering a competitive price, lighter weight, and design flexibility. There is a strong argument for composite superiority versus metal in a variety of applications.

Advanced materials are essential for boosting the fuel economy of modern automobiles while maintaining safety and performance. Because it takes less energy to accelerate a lighter object than a heavier one, lightweight materials offer great potential for increasing vehicle efficiency. A 10 percent reduction in vehicle weight can result in a 6-8 percent fuel economy improvement. Replacing aluminium and Magnesium alloys with composite materials can directly reduce the weight of a vehicles' body and chassis by up to 50 percent and therefore reduce a vehicle's fuel consumption proportionately. Using lightweight components and high-efficiency engines enabled by advanced materials can save millions of barrels of crude oil use.

By using lightweight structural materials, cars can carry additional advanced emission control systems, safety devices, and integrated electronic systems without increasing the overall weight of the vehicle. While any vehicle can use lightweight materials, they are especially important for hybrid electric, plug-inhybrid electric, and electric vehicles. Using lightweight materials in these vehicles can offset the weight of power systems such as batteries and electric motors, improving the efficiency and increasing their all-electric range.

Alternatively, the use of lightweight materials could result in needing a smaller and lower-cost battery while keeping their all-electric range of plug-in vehicles constant.

Research and development into lightweight materials is essential for lowering their cost, increasing the ability to be recycled, enabling their integration into vehicles, and maximizing their fuel economy benefits. The vehicle technologies can be improved in four ways: increasing understanding of the materials themselves through modeling and computation materials science, improving their properties(such as strength, stiffness, and ductility), improving their manufacturing (material cost, production rate, or yield) and developing alloys of advanced materials. In short, replacing heavy aluminium alloy with composites can decrease component weight by 10-60 percent. Researchers are working on lowering their costs and improving the processes for joining, modeling, and recycling these materials.

Composition

Composites are materials that are made by combining two or more natural or artificial elements (with different physical or chemical properties) that are stronger as a team than an individual player. The components materials don't completely blend or lose their individual identities; they combine and contribute their most useful traits to improve the outcome or final product. Composites are typically designed with a particular use in mind, such as

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added strength, efficiency, or durability.

Also known as fiber-reinforced polymer (FRP) composites, are made from a polymer matrix that is reinforced with an engineered, man-made, or natural fiber (like glass, carbon, or aramid) or other reinforcing material. The matrix produces the fibers from environmental and external damage and transfers the load between the fibers. The fibers, in turn, provide strength and stiffness to reinforce thematrix – and help it resist cracks and fractures. In many of this industry's products, polyester resin is thematrix and glass fiber is the reinforcement. But many combinations of resins and reinforcements are used in composites – and each material contributes to the unique properties of the finished product. Fiber, powerful but brittle, provides strength and stiffness, while more flexible resin provides shape and protects the fiber. FRP composites may also contain fillers, additives, core materials or surface finishes designed to improve the manufacturing process, appearance, and performance of the final product. Composites can be natural or synthetic. Wood, a natural composite, is a combination of cellulose or wood fibers and a substance called lignin.

The fibers give wood its strength, lignin is the matrix or natural glue that binds and stabilizes them. Other composites are synthetic or man-made. Plywood is a man-made composite that combines natural and synthetic materials. Thin layers of wood veneer are bonded together with adhesive to form flat sheets or laminated wood that is stronger than natural wood. Not all plastics are composites. In fact, most plastics– the ones used in toys, water bottles, and other familiar items – are not composites. They're pure plastics. But many types of plastic can be reinforced to make them stronger. The combination of plastic and reinforcement can produce some of the strongest most versatile materials (for their weight) ever developed by technology. Polymer resins (such as polyester, vinyl ester, epoxy or phenolic) are sometimes referred to as plastic. Many terms are used to define FRP composites. Modifiers have been used to identify a specific fiber such as glass fiber reinforced polymer (GFRP), carbon fiber reinforced polymer (CFRP), and aramid fiber-reinforced polymer (AFRP). Another familiar term used in fiber-reinforced plastics. In addition, other acronyms have been developed over the years and their use depended on geographical location or market use. For example, fiber-reinforced composites (FRC), glass-reinforced plastics (GRP), and polymer matrix composites (PMC) can be found in many references. Each of them is a synonym to FRP composites.

Process optimization

This cost of vehicle manufacturing is particularly pertinent when seeking to introduce composites into mass-production vehicles; here cost is of much greater concern than with the few high-performance, low-production volume road vehicles where widespread use of composites has been seen so far. For this reason, many in the industry are of the opinion that starting from a part originally designed to be manufactured from metal and seeking to simply replace the metal with a composite is the wrong way to approach the cost challenge. They suggest that attractive use-cases for composites can instead be found when starting from a blank sheet and designing the part in such a way that it makes the best use of the beneficial properties that composite bring to the table. These include flexibility in design, corrosion resistance, and functional integration, and will facilitate the industry in moving beyond mere light-Weighting of existing parts.

Autonomous and electric vehicles represent an excellent focal point for efforts to develop cost- competitive composite solutions: the number of parts that have fundamentally different design requirements and constraints to their equivalents in internal combustion engine (ICE) vehicles or are completely new, is significant. It is therefore back to the drawing board that engineers will go, free from the inertia and dogmas that exist in designing ICE vehicles.

Some obvious examples spring to mind, including components for battery integration and protection, and changes to drive-train components for use with electric motors. However, more radically, the rise of autonomous vehicles will hopefully also see us move away from the idea of vehicles being metal boxes with rows of forward-facing seats – new uni-body frame shapes will surely arise to take advantage of occupants of the vehicle not needing to face the road or control the vehicle.

It's on this last point that composites have another distinct advantage over metals: the ease of forming structures with shapes far disconnected from the box-like structures of most passenger and commercial vehicles. There are already cases of this proving a significant advantage with EVs.

Several futuristic-solar-powered electric vehicles have a composite monocoque chassis and use a raft of other composite structures in order to provide a vehicle with a highly aerodynamic shape and incredibly low weight. The result is a range of over 1000 miles - around four times that of vehicles with similar-sized battery packs! An elegant solution to consumers' range anxiety courtesy of composites.

Composites are used frequently in motor sports and lower volume, high-end/luxury vehicles, which typically favor continuous carbon fiber materials. Growth in both segments from 2021 into 2022continues. For the more cost-sensitive market of mid- and high-volume production models, composites continue a steady, incremental increase primarily via continuous glass fiber-reinforced polymers(GFRP) in applications such as leaf springs, as well as chopped fiber molding compounds, including sheet molding compound (SMC) body panels and frames, bulk molding compound (BMC) housings and support structures and injection-molded thermoplastics for bumper frames, lift gates and seat structures. The top applications for composites in automotive are, in order of volume, underhood components, exteriors, and interiors. Another growing market is suspension components and drives shafts.

Thus, composites used in the automotive sector offer an immense opportunity for car makers and consumers alike. Apart from fuel efficiency, the high-speed run of these vehicles makes them the preferred choice for riders. But, these features come with numerous challenges. Material cost is a major challenge for composites to clear before their use becomes widespread. Another difficulty is integration into existing supply chains and production lines for vehicles. Even once a use-case for composites has been identify ed, it can be a major challenge for the component to achieve the required speed-to-markettime when it is to be

manufactured from composites. This is in part because composites have lots of options when it comes to fiber selection, resin selection, and how the selected fibers and resin are combined; whereas metals are relatively simple. Whilst automotive manufacturers have years of experience of computationally modeling how metal structures react to real-world forces, their know-howin optimizing composites is comparatively still in its infancy.

Having arrived at an optimized design, manufacture is not straightforward either. Resin transfer molding(RTM), where a dry fiber preform (an assembly of dry fiber layers pre-shaped into the desired form) is positioned in a mould that is subsequently injected with resin, is the technology leading the way for mass-manufacture of composites. This is thanks to the short time the process takes to go from a dry preform to a cured part, the consistency of output, and the absence of an autoclave step (where the composite is raised to high temperatures and pressures). However, the manufacture of the preform, where fabric sheets and filaments are cut and stacked or wound to provide the required shape and fiber orientations before going into the mould, which is a complex process. Fortunately, there has been ongoing development in automation of the traditionally manual processes of preform manufacture using very impressive automated machines for fiber placement and braiding, allowing the preform to be assembled even more accurately and quickly than with expert human hands. Existing solutions currently come with high tooling costs and engineering expertise in using them is not widespread outside the aerospace industry, but both these barriers should diminish as the use of composites in the automotive sector grows.

The composites industry in India is estimated to have reached $2 billion by 2021 and is forecast to have witnessed a compounded annual growth rate (CAGR) of 14 percent between 2016 and 2021. The major driver for market growth is the rise in demand for electrical and electronic, wind energy, and pipe and tank applications due to an increase in the number of government projects like smart cities development, eco-friendly energy generation, freshwater transportation, sewage treatment system, rehabilitation of water and sewage pipelines. Emerging trends, which have a direct impact on the dynamics of the Indian composites market industry, include the emergence of new application areas and capacity expansion / partnership.

RiA Rail Mounted Furnace Tending Vehicles offer the latest safetyand productivity enhancements through Machine Vision

CAST HOUSE ENGINEERING

40RIA Cast House Engineering GmbH was founded in 1997as Rackwitz Industrieanlagen GmbH, by the former Technical Director of an Aluminium plant that today belongs to Norsk Hydro. Experienced in both Cast House and downstream activities, RiA initially engineered and supplied solutions to both areas. In 2018, RiA decided to focus solely on the Cast House and in particular, the key strength of Furnace Charging and Skimming Machines and the company name was re branded to reflect this change. In 2021, RiA signed a worldwide exclusive agreement with Fioscope GmbH allowing RiA to develop Furnace Monitoring applications and offering those solutions in the Aluminium Cast House.

To date, RiA has supplied approximately seventy Furnace Charging and Skimming Machines. All rail-mounted precision machines, capable of charging up to 30 Metric Tonnes in less than 90 seconds or skimming a Furnace faster than a traditional Forklift Truck or wheeled Furnace Tending Vehicle, but with more repeatable results and without damaging the refractory lining. Key customers include Hydro, Constellium, Kaiser, Matalco and others. Many clients have multiple machines in the same Cast House or across multiple sites and territories. One client alone has implemented more than twenty machines from RiA in ten different countries. Customer satisfaction and reliable machines are key to the nature of the repeat business seen over recent years.

RiA integrated Smart Cameras within its machines to enable Autonomous operation. Significant advances

Mark Bumford
Sales Director

Mark, a Mechanical Engineering Graduate, entered the Aluminium Industry back in 1987 with Davy McKee the British Rolling Mill Company and worked in the downstream area of Flat Rolled Products until 2010 when he joined ALTEK and switched focus to the Aluminium Cast House sector, before joining RiA in 2020. Mark is now responsible for Sales Worldwide, outside of the Americas, but most specifically directly responsible for India.

in process control are now possible using air-cooled In-Furnace Cameras. These high-temperature resistant Cameras allow for real time observations of melt progress. They provide a safe and real-time process development benefit that was in the past impossible to even observe let alone monitor, without opening the Furnace door.

The first implementation of Camera technology by RiA was in 2014. RiA was rebuilding a Cast House and the client requested that cameras be installed in their furnace. Following some research, RiA found suitable cameras that had been implemented in glass Furnaces by the German supplier Fioscope. Those same Cameras from that first installation are still in operation today. The images from the Cameras, mounted within the refractory lining of the furnace walls, were relayed to monitors inside a control room, located a safe distance away from the Furnaces. The operators observed the monitors and made decisions about the progress of the cycle.

The project was a great success for both parties. The operators were able to observe the monitors at will, without the need to approach the Furnace and open the door. It was recognized that not only this offered the operators a new level of safety, but it also saved energy and shortened cycles by retaining heat in the furnace. Rather than relying on calculations of melt rates and weights of material in the furnace or monitoring roof temperatures and gas consumption to determine when the melt might be ready for the next step, the operators could simply glance at the video monitor. Even the old method of prediction would have eventually resulted in having to open the door to verify. If they were too early, the door would be closed and the burners fired up to recover the temperature and complete the cycle, with time lost and more gas consumed. If the observation showed the melt was ready, the question remained, how long ago was it ready. Every minute lost in the cycle is lost forever and can never be recovered. If late, there is a potential risk of charging the next load into liquid Aluminium, rather than onto a semi-solid or mushy layer of scrap. With the images on the monitors, the operators were able to make the decisions of when to react, without opening the doors erroneously.

Moving beyond “visual only” to “Image Processing and Machine Vision”, RiA in conjunction with Fioscope began to develop capabilities to enhance RiA Furnace Skimming and Charging Machines. The first capability was to determine that the scrap pile had melted down to a height that would not interfere with the container of the Charging Machine, as it entered the furnace. This enabled requesting the next Charge as soon as possible in

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the cycle and ensure that the next Charge is distributed on a semi-solid layer of scrap from the previous charge, thus ensuring safety, shortening cycle times, and saving energy. The Cameras provide the signal to start the charging cycle and the Charging Machine commences the cycle if the operators have completed the loading of the machine and released or cleared it for use. The machine Autonomously moves in front of the Furnace and when in position, interacts with the Furnace to open the door. Once the door is open, the container extends to around 70 % of the depth of the furnace and a pusher plate starts to push the scrap off the container. Once the pusher plate reaches a pre-set position, it stops and the container is retracted against the stationary plate, until the container is empty. It retracts from the Furnace and closes the door, before returning to the loading position. The charging process takes typically 60 to 90 seconds to evenly distribute up to 30 Metric Tonnes of material across the hearth. This minimizes door opening times, shortens cycles and saves energy and the even distribution of the scrap in the Furnace maximizes melt rates.

Unfortunately, scrap piles melt at uneven rates, due to different size and distribution of scrap in the charge. This is detected by the Cameras and in cases like this, it is beneficial to enter the furnace with a tool such as a skim blade and level the scrap pile, to spread the load and open up the pile, exposing unmelted solids, increasing the surface area and increasing melt rates.

The next step was to add Smart Cameras to RiA Skimming Machines. These machines had been capable of automatic skimming for some years. Through precise position sensing and position control, it is possible to follow a pre-determined skimming pattern, lane-by-lane, to remove the dross from the Furnace, without contacting or damaging the refractory nor the need for an operator to be onboard the machine. However, the machine will skim the entire surface of the bath regardless of the location of the dross, or if the dross moves into an already clean and previously skimmed lane, the machine was effectively blind. The solution was to install Smart Cameras on the Skimming Machine that have a view of the bath surface. The cameras identify the difference between dross and a clean surface, and drive the skim

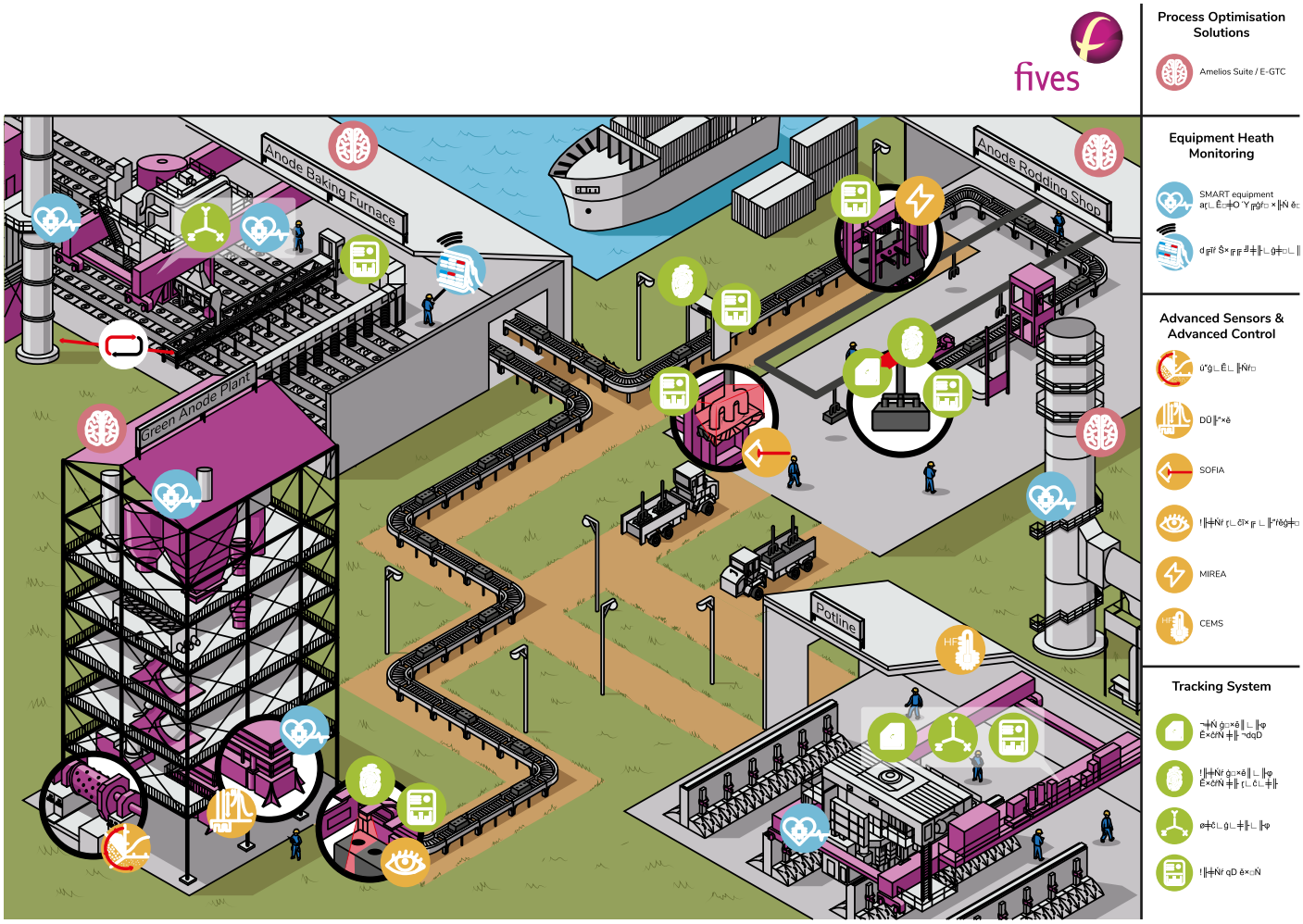
blade to the location of the dross and remove it from the Furnace. Once again all of this is possible, without human interaction, other than to initiate the cycle. Even then, if the Furnace contains RiASmart Cameras, they can determine when flat bath conditions are achieved, ready forskimming. Having established these capabilities, all RiA Charging and Skimming Machines, sold in recent years, were either sold with fully Autonomous capability or were built in such a way that this could easily and modularly be added at a future date.

After introduction, several requests were received for In-Furnace Cameras for applications that were not served by RiA machines. Additionally, new features and capabilities that were unrelated to charging and skimming were arising. The ability to monitor the burner flame, shape, colour, and length, to help with burner tuning or to alert to maintenance issues. Even the ability to monitor refractory damage, propagation of cracks or consistent bright spots, getting brighter or larger. All of these and more are possible by running data through the Fioscope Neural Network that self learns normal conditions and alerts when something is anomalous.

RiA packaged the Furnace Monitoring System into a stand-alone offering, consisting of typically two In-Furnace Cameras and one Cast House Camera mounted externally, with a view of the front of the furnace. A data collection, storage, and display centreis located in a control room. The data collection centre is linked to the furnace controller. As well as storing the time-synchronized video images, it receives and stores data such as roof temperature and gas consumption. Full data video playback is available for a minimum of one hour from all cameras to cover unexpected events; and select frames are stored for time-lapse playback of longer-term trends such as refractory wear and damage.

In conclusion - Smart Cameras can reduce unnecessary door openings, shortening cycles and saving energy. These systems can increase safety and potentially avert accidents. Smart Cameras also allow the melt cycle to be optimised, ensuring charging can take place safely, at the first opportunity. Furnace Monitoring Systems allow playback, trouble shooting and diagnostics.

Fives' digital solutions for equipment monitoring process optimisation and emission control



Fives has been developing pioneering solutions adapted to increasingly stringent environmental standards aimed at reducing emissions, improving performance and lowering operating costs, to meet the growing capacity of smelters equipped with high-amperage pots. To meet these objectives, Fives is offering ground-breaking emissions reduction solutions as well digital and control systems for eco-friendly operations.

Being a worldwide leading solution provider for Green Anode Plant, Anode Baking Furnace equipment, Anode Rodding Shop, Fume & Gas Treatment plant, Potline cranes, Pot equipment and thanks to the combined expertise of Fives Solios and Fives ECL, Fives sets-up a cross-organizational and trans disciplinary team to further develop digital solutions.

Since 2007 and the introduction of Amelios, Fives' Aluminium division has developed a comprehensive range of digital solutions to enhance the productivity of smelters and to achieve greener aluminium production.

As of today, Fives' digital portfolio consist of more than 20 solutions that can be used independently or interconnected to act on Equipment Health Monitoring, Process Optimization and Emission Control.

Equipment Health Monitoring – SMART solutions

Fives' SMART solutions (e.g. SMARTCrane, SMARTFilter, SMARTVibro, …) consist of software solutions plugged in existing equipment for real-time and remote monitoring. The purpose of the SMART solutions is to increase the availability and reliability of the equipment and to maximize the Overall Operations Effectiveness (O.E.E.)

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SMART solutions aim to enhance smelters' operations, maintenance and process by providing a new equipment experience with indicators, dashboards and recommended actions to anticipate fragilities and drifts.

Process Optimization – Amelios Suite

Based on advanced process monitoring & Amelios data analytics software, the Amelios Suite for Green Anode Plant, Anode Baking Furnace and Rodding Shop includes:

- Advanced sensors & Advanced control functions: AVI, MIREA, SOFIA, Dynpac, Optibinder…
- Innovative tracking solutions: ATS, RTS, a trusted database (Anode ID card) along with a first level of Data Analytics …

The purpose of the Amelios Suite is to lower the Net Carbon Consumption (NCC), consequently the CO_2 emissions as well as the consumption of raw material and energy and ultimately to increase the production of aluminium.

Amelios Suite allows to:

- minimise the carbon reject at all stages,
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- maintain key anode parameters,
- guarantee the performance of the reduction process,
- stabilize the production against the raw material variability and ageing of the plant,
- Improve operation teams responsiveness for better anode quality control, and
- reduce the direct CO_2 emission from the pot and anode baking.

Process Optimization – e-GTC

Based on Continuous Emission Monitoring System (CEMS) and advanced process control,the Fives' e-GTC allows for enhancing smelter environmental performance and reducing operating costs through constant monitoring of emissions and equipment.

The above-mentioned solutions have been validated by proof of concept or are already implemented in smelters worldwide with proven track records (e.g. SMARTCrane, Amelios Suite for Green Anode Plant, SOFIA, MIREA…). Additionally, the whole Amelios Suite has been labelled by the SOLAR IMPULSE FOUNDATION in 2021, the Anode Tracking System based on Vision has been awarded by Light Metal Community (TMS) in 2020, and some solutions are patented.

With more than 660 employees worldwide based in multiple locations across the globe, the Aluminium division of Fives has the ability to support smelters on the definition and the implementation of their digital roadmap locally. And finally, with more than 200 people dedicated to services worldwide, located in France, Canada, Middle East, India, South Africa, Australia and Russia, Fives is committed to help its customers to both improve the performance of their equipment and reduce production and maintenance costs.

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IAI marks golden anniversary with a reflection on the past and a drive to shape a better tomorrow

The International Aluminium Institute (IAI) is marking the 50th anniversary of its founding and its role in representing the global primary aluminium industry on a sustainable journey. As part of the celebrations, the IAI will put the spotlight on the industry's people, products and defining moments to share the milestones and challenges of the last 50 years, while looking ahead to the future.

The IAI was established in 1972 to primarily foster industry collaboration with a focus on collecting and publishing statistical data – and this remains one of the IAI's core priorities. During the past 50 years, the IAI has been a leading voice for the aluminium industry, providing solid statistical data, which is widely acknowledged as credible and robust with statistical and analytical expertise, honed over several decades.

Miles Prosser, Secretary General of the IAI said: "celebrating 50 years is a unique opportunity to look back into our past and forward to the future. The evolution of our association reflects that of our industry too. As the world's population continues to grow, one thing is certain that the aluminium industry will continue to have a vital role to play in transport, aviation, packaging, infrastructure, and energy. Aluminium is one of the most used metals in the world and has the potential to stay that way for the next fifty years and more."

Miles Prosser
Secretary General of the IAI

The only body that represents the aluminium industry at the global level. With more than twenty years' experience working on various industrial policy issues, Miles brings in-depth knowledge on resource allocation, sustainability and climate change.

Miles joined the IAI from the Australian Aluminium Council where he served as Executive Director for more than 10 years. He leads the IAI to promote the unique and valuable properties of aluminium in sustainable development. He holds an honours degree from the Australian National University.

As part of the celebrations, the IAI has lined up a series of activities to showcase the growth of the industry and the opportunities that lie ahead.

From January, the Institute will put a spotlight on 50 people who have contributed significantly to the aluminium industry, 50 products that demonstrate the importance and versatility of the metal

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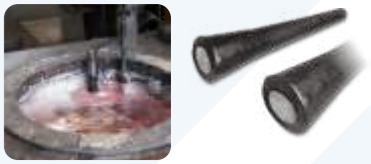

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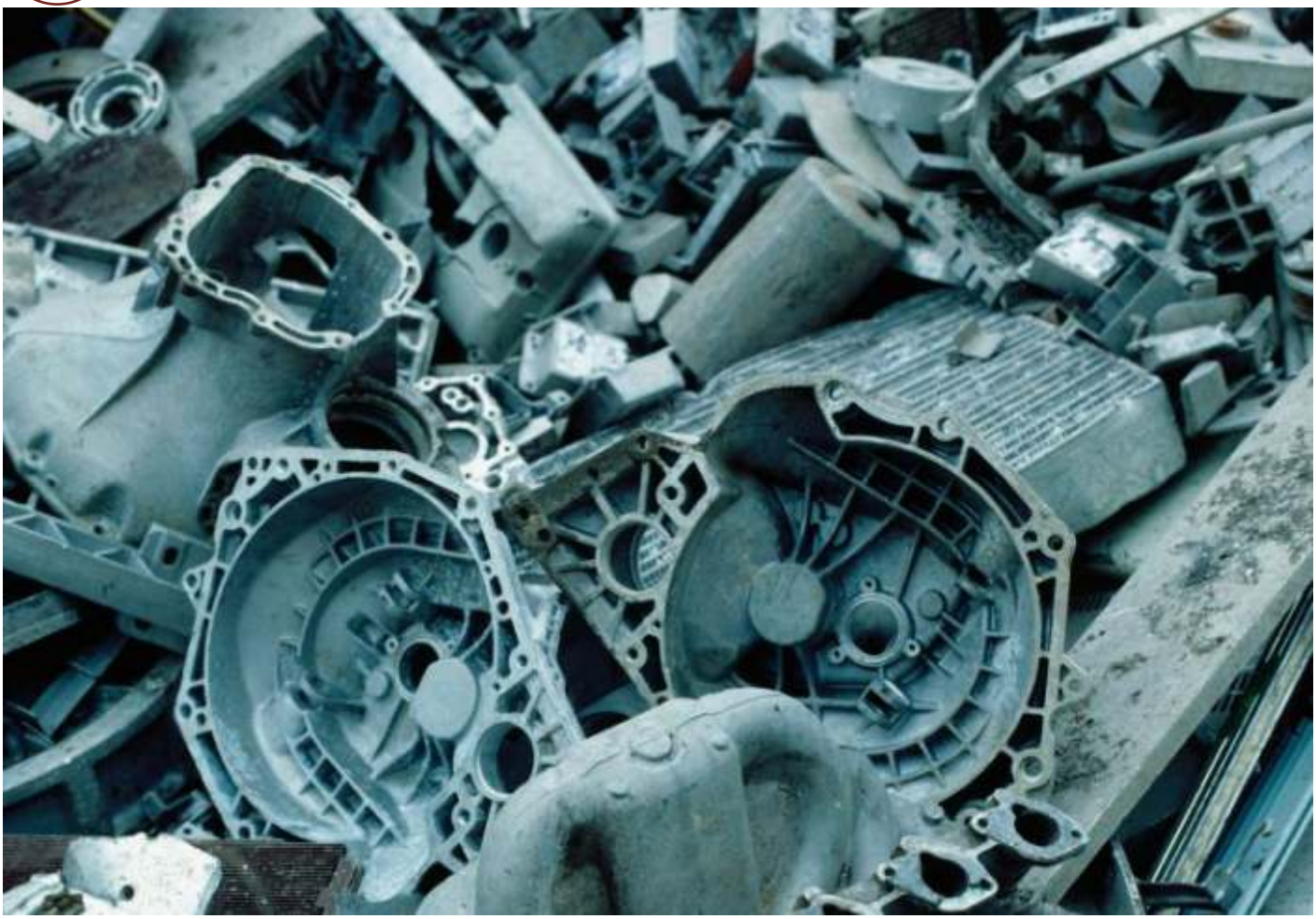

while also showcasing 50 key moments that have shaped the industry and metal.

The 50 People feature will run throughout 2022 and will celebrate the resilience, diversity and ingenuity of individuals (past and present) who have made the aluminium industry what it is today. Individuals can nominate themselves or colleagues via a dedicated page set up by the IAI.

Similarly, the 50 Moments, will focus on key events that have defined the sector. The IAI is seeking suggestions by March 31, 2022. These can be submitted here.

In the last 50 years, aluminium has become a material with almost unlimited uses across various industries including food and drink, construction, transportation, aerospace and domestic goods.

As the institute looks to the future – one that is driven by consumers' growing appetite for environmentally friendly solutions in transport, infrastructure, energy and food security, the IAI understands the challenges ahead.

Aluminium contributes more than 1.1 billion tonnes of CO2 emissions annually, and while the drive to reduce this is a complex challenge, the IAI sees this as an opportunity to drive change and for the sector to lead by example in shaping a better tomorrow.

Mr Prosser added: "Many aluminium producers are already pioneering solutions that reduce their environmental footprint without compromising product quality. Aluminium companies are developing technologies such as inert anode electrolysis; as well as broad-scale investment in technologies around the world.

"At the IAI, we are focused on fostering collaborative partnerships that enable such innovations to be trialled and tested. Part of our role is to raise awareness of these success stories and their positive impact, and to engage with suppliers, customers, governments and other stakeholders so that the adoption of these technologies is as quick and efficient as possible."

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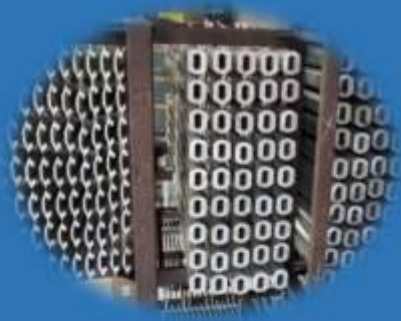

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Non-Ferrous Industry urge zero Import Duty on Scrap for greener India

Material Recycling Association of India congratulates Ms. Nirmala Sitharaman, FM, India for presenting a far-sighted budget that addresses all aspects of the nation's economic activities and its impact on mankind and environment.

From the recycling industry we sincerely applaud your reference to the Circular Economy and the *Panchamrit* proposal of the Hon'ble Prime Minister, Shri Narendra Modi at COP 26. On our part we are committed to provide every support to achieve a One billion MT reduction in carbon emission by 2030.

It is very encouraging that the Government is walking its talk by immediately introducing this key policy intervention to regulate steel prices and reducing energy and GHG emissions by extending Nil duty on Steel Scrap for FY 2022-23. This will naturally build the Indian economy greener, faster and create multiple jobs.

Given a very conservative growth in rise of per capita consumption of Aluminium from 2.5 kg in 2020 to only 8 kg by 2030 (still about only ½ the global average) and the secondary sector share of the total consumption growing from about 30% to 50%, the contribution of the secondary producers to national consumption would be about 5 MMT/per annum. We, and the majority of humanity would like this to be higher to save our planet from dire consequences of pollution, global warming and climate change.

However, to achieve this we need about 5.5 MMT of scrap. As you mentioned in your speech the Government will focus on reverse logistics and other methods to improve scrap collection. But, as is known there is a lag of about 10-12 years before scrap is generated post consumption and requires a highly efficient collection system to retrieve it into the formal economy. Whilst it will be our collective effort to meet the requirement of scrap domestically a sizable shortfall will remain that has to be met from imports for the next few years.

For FY 2022-23, we anticipate total imports of Aluminium scrap would be about 1.5 MMT. The present duty being @2.5% + 10% surcharge, the total revenue generated from imports of 1.5MMT of scrap is only INR 560 crs. But the penalty is much higher on the cost of production resulting in

Sanjay Mehta
President,
Material Recycling Association of India (MRAI) and is a Director of MTC Group, a 44 years old business group with annual turnover exceeding Rs.7000 crores, employing more than 5000 personnel. MTC Group is the largest Ferrous and Non-Ferrous Scrap procurement, processing, recycling & manufacturing company in India.

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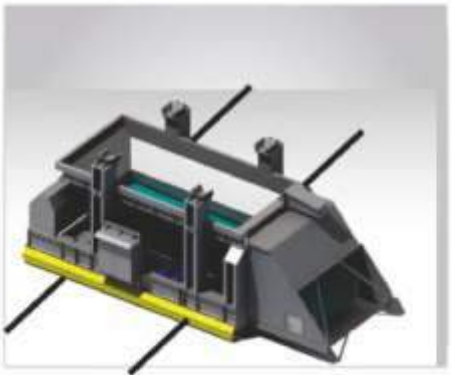

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lesser production. Even if the cost reduction achieved through NIL duties is converted to additional production the additional quantities of secondary aluminium produced would be 37,500 MT. If the entire amount of 37,500 MT[Sb1] is exported as Al alloy ingots, [Sb2] , the export realisation is US $ 117 Million[Sb3] which can go upto US$ 300 million for specified products. If it is sold domestically as high value foils/building materials attracting GST @ 28%, it would generate an additional revenue of INR 336 Crs[1] for the 37,500 MT production, over and above the existing GST collections from this sector. It would also accrue direct tax benefits and a minimum of 1500 additional jobs – mostly women who form the backbone of the sorting process. (pse put a photograph showing women employees sorting scrap here from CMR Plant)

Further, the introduction of 400 Vande Bharat Express trains which is a semi-high speed designed, developed and built by the Integral Coach Factory (ICF) at a frugal outlay of Rs 100 crore.

Not only will it reduce the haulage power requirements due lightweighting, it also improves aesthetics and performance. This will require several thousand tonnes of Aluminium and the recycled Aluminium would best fit these specifications. It would be an emphatic statement if the entire 400 *Vande Bharat* Trains are made from recycled products. This could become the first train in the world made entirely from recycled products. This will demonstrate to the world that India will walk its talk and fulfil every pledge made at the COP 26 in the *amrit kaal*. MRAI would gladly partner to support such an initiative.

We have also done a detailed analysis on GHG emission and other savings. This is placed at Appendix. It can be seen that by 2030 the secondary sector, going by the most conservative scenario, can annually save about 62 MMT of GHG emissions or about 6.2% of the 1 Billion MMT pledged at COP 26, apart from savings of 7,000,000 MKWH of energy, 20 MMT of toxic red mud, 5.6 million cubic meters of landfill generated by primary production method.

In view of the multiple benefits that a NIL duty on Aluminium scrap offers to the nation and to mankind and therefore we are seeking Hon'ble Finance Minister kind consideration to introduce NIL duty on all Non-Ferrous scrap to provide greener products, lower costs, larger employment and lower energy consumption until such time that the domestic scrap generation picks up.

This would not only be a concession to the industry but a service to all mankind.

Appendix : EMISSIONS AND ENERGY SAVINGS

	2020	2030
Per capita Consumption (kg)	2.5	8
Total consumption (MMT)	2.2	10
Primary (%/MMT)	70/1.5	50/5
Secondary	30/0.7	50/5
Scrap Requirement (MMT)	0.8	5.5
GHG emissions (MT)/tonne of Primary production	14.8	13.5*
Total Emissions by Primary route MMT	22.2	65
Secondary Route (emissions only 5%) MMT		3.38
Total Emissions saved (MMT)		62.62
Energy saved @ 1.4 MKWH/Ton		7,000,000 MKWH
Landfill saved @ 7.6m^3/Ton		5,700,000

VACUUM INDUCTION MELTING

Certain alloys containing metals such as chromium, nickel, cobalt, with reactive metal additions etc., have a strong affinity for oxygen. If these alloys are melted in air, the severe oxidation reaction that takes place, seriously impairs the final properties of the cast product due to the volume of oxide particles (inclusions) left in the final casting. This is the main reason why commercial quantities of these high quality alloys are processed in the molten state under vacuum.

-3

A vacuum level in the range of 10 mbar (one millionth of an atmosphere) will ensure that there is minimal oxidation during melting. This vacuum level can be easily achieved in modern vacuum melting equipment.

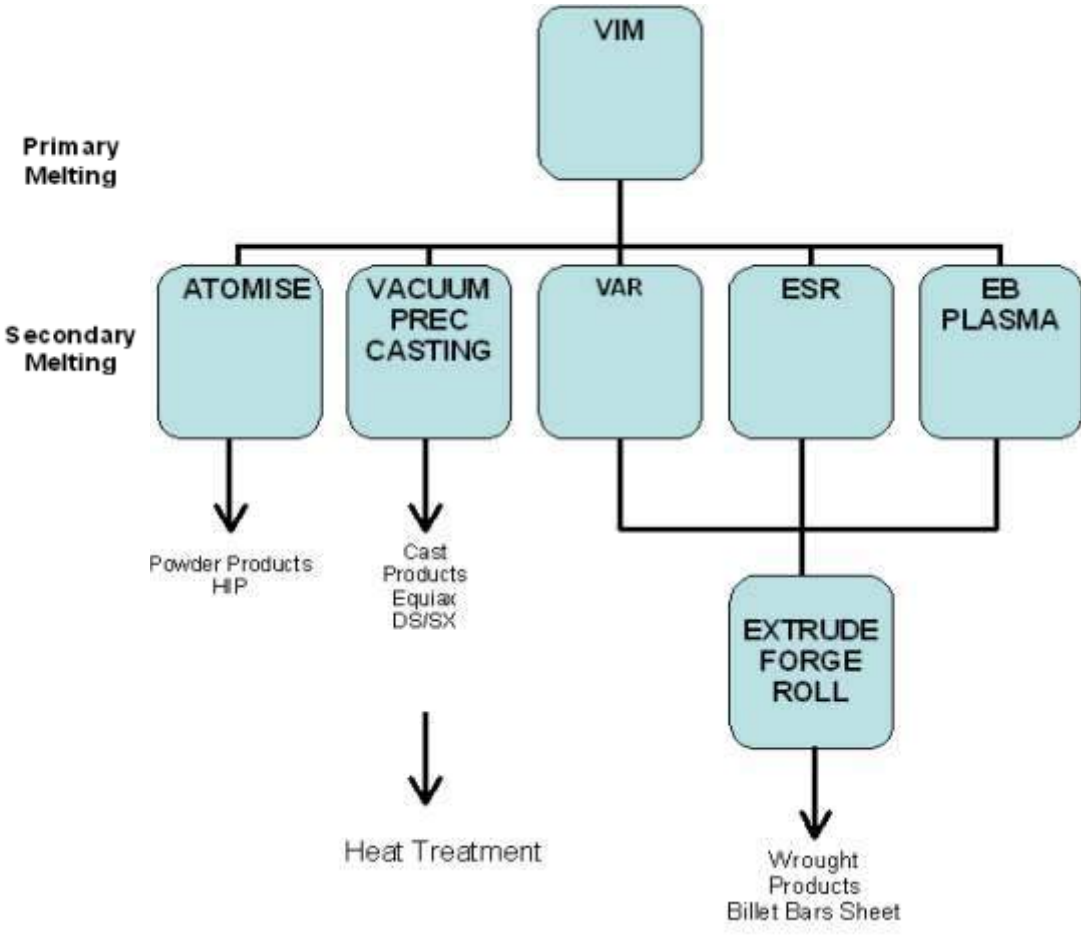
One of the most common uses for such materials is in the production of nickel, iron and cobalt based superalloy components for critical high temperature service applications. The largest market for superalloys is the turbine industry for either aerospace or land based turbine engines. From the primary alloy production through investment casting and to the final heat treatment and brazing into an assembly, all thermal processing is carried out under vacuum (see fig.1)

Turbine industry is not the only market where vacuum melting is employed. Vacuum melting and casting furnaces are very frequently found providing high quality materials for the automotive (such as turbo charger comp), biomedical (medical implant) and chemical industries.

Prakash Chaubal
Sr. Vice President (Business Development), Inductotherm (India) Pvt. Ltd.
Inductotherm Group India

Electronic Graduate from M.S.University Baroda. Have been associated with Inductotherm Group since more than forty years. Initially handled furnace divn at Inductotherm Group India. Handled many special application related to Induction technology.

Since 2015 working mainly for vacuum related products with technology from Consarc UK/USA, an Inductotherm company. Products handled are VIM/ESR/VAR and Vacuum Heat Treatment furnaces.



Different types of Vacuum Induction Melting (VIM) Furnaces

Vacuum Induction Melting process is generally applied in production of complex alloys where gas contents, non-metallic inclusions and level of harmful trace elements have to be reliably reduced to a minimum. The induction melting coil is powered from Induction Power supply with the power and frequency matched for fast melt rates (high productivity) and optimum stirring (metallurgical quality) in the liquid state. The stirring frequency ensures that the alloy is fully homogenized and that fresh liquid metal is cycled to the surface of the bath to aid the degassing procedure.

Vacuum Induction Melting Furnaces for Research and Small Production Units

VIM furnaces in small melt capacity specifically for use in small-scale production or research applications has found good usage in technical and research institutes. The units comprise of water cooled vacuum chambers complete with induction power supply, vacuum pumping system, PLC based controls and a range of optional accessories including:

- Vacuum isolated chamber for charging and fine alloy additions under vacuum
- Optical pyrometer
- Bridge breaker
- Manual or powered tilt pouring
- Mold turntable or trolley
- Immersion thermocouple Once required vacuum is achieved, the charge can then be melted, refined, poured into molds under a vacuum or inert gas environment.

Master alloy VIM Systems - Secondary Metallurgy

Master alloy VIM systems are generally in the range of 1-10 tons and are characterized by their ability to pour many multiples of small diameter ingots configured on a mold car or turntable.

Masteralloy ingots are commonly as small as 73 mm (27/8”) and as large as 254 mm (10”) in diameter and generally about 1.2m (48”) tall.

Vacuum induction melting (VIM) is one of the most commonly used processes in secondary metallurgy applied for refining treatment in the liquid state and adjustment of chemical composition and temperature.

To achieve the increasing quality demands on the resulting material application of vacuum in the induction melting process is a must for many specialized materials. For example, vacuum induction melting is indispensable in the manufacture of special alloys, which must be melted under vacuum or in an inert gas atmosphere because of their reactivity with atmospheric oxygen. The process is suitable for the production of highpurity metals within an oxygen-free atmosphere. This limits the formation of non-metallic oxide inclusions.

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Vacuum Cap (VCAP) furnace

New Vacuum Degassing and Controlled Atmosphere melting technology – Vacuum CAP

The VCAP furnace is designed for Induction Melting a solid charge in an air atmosphere (or vacuum), with final degassing stage under vacuum. The final pouring of the metal is performed in air or under protective atmosphere of inert gas.

The furnace shell is fully sealed for vacuum operation and vacuum lid can be placed on top of the furnace. This lid is connected to a multi stage mechanical vacuum pumping system which can evacuate the atmosphere above the molten bath. The induction melting coil is powered from Power supply with the power and frequency matched for fast melt rates (high productivity) and optimum stirring (metallurgical quality) in the liquid state.

The stirring frequency ensures that the alloy is fully

homogenised and that fresh liquid metal is cycled to the surface of the bath to aid the degassing procedure.

Once the atmosphere is evacuated, the degassing

procedure and intensified CO reaction allows removal of undesirable gases, Hydrogen, Nitrogen and Oxygen to much lower levels than would be possible in air. At the end of the degassing sequence, the vacuum lid can be removed and a protection ring is placed around the sealing flange. The furnace is then ready for tilt pouring into the customers transfer ladle or moulds.

The pouring process is normally carried out in air (option for protective atmosphere)

Applications and Materials

The VCAP furnaces are available to suit a wide variety of melting application in sizes ranging from 80kg – 20Tonnes (other sizes available on request).

Typical applications might include:

- Low and high carbon steels
- Tool and Die Steels
- Stainless Steels
- Nickel based alloys
- Cobalt based alloys
- Non Ferrous alloys

Metallurgical considerations

Some typical processes that can be performed in the VCAP range include

- Air melting from solid charge (Option for vacuum melting)
- Controlled atmosphere melting from solid charge
- Alloy homogenization and chemistry adjustment
- Vacuum degassing (hydrogen and nitrogen removal)
- Reduction of low vapour pressure tramp elements e.g.Pb, Cd, Bi, Zn
- Deoxidation using combination of vacuum and C-O reaction
- Decarburisation - Intensified C-O reaction at low pressure enabling excellent
- decarburization for extra low carbon level

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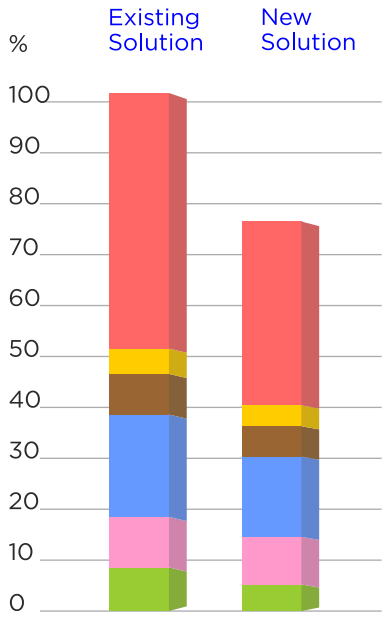

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ICSG predicts copper surplus

As per the International Copper Study Group Statistical Yearbook which was released on 15th December 2021, World copper mine production rose from 16 million metric tonnes (Mt) in 2011 to 20.6 Mt in 2020, with concentrate production rising by around 33% (4.1MT) and solvent extraction-electrowinning (SX-EW) by 16% (0.5 Mt):

The compound annual growth rate (CAGR) for word copper mine production averaged 2.9%/y over the 10-year period. However, average growth in the last three years has been lower at 0.9% due to a series of operational constraints that negatively affected output in 2017 and 2019 and the impact of Covid-19 pandemic and global lockdown in 2020.

There was a small decline in the SX-EW share of total mine production, from 21.7% in 2011 to 19.5% in 2020. SX-EW annual output fell by about 560,000 t in Chile over the 10-year period but increased by around 815,000 t in the D. R. Congo. Notable changes in annual mine production levels over 2011-2020 included increases of 915,000 t Mt in Peru (CAGR 7.2%), 430,000 t in China (CAGR 3.6%), 1 Mt in the D.R. Congo (CAGR 14.7%), and 290,000 t in Mexico (CAGR 6.1%). However, annual production in Chile, by far the world's largest copper mine producer, increased by only 470,000 t (CAGR 1%). Consequently, the country's share of world production declined from 33% to 28% with Peru (the second largest copper mine producer) increasing its share from 7.7% to 10%. The revival of the African copper belt led to an increase in African annual output of around 1.2 Mt.

World refined copper production rose from 19.6 Mt in 2011 to 24.5 Mt in 2020, with a CAGR of 2.5%.

Primary (electrolytic and SX-EW) and secondary (from scrap) refined production increased by 2.8%/y and 1.2%/y, respectively.

The share of secondary production in total refined production remained at around 17% over the 10-year period but with a lower share of 16% during the last two years which were impacted by the Chinese scrap imports ban and the global lockdown.

Over the 10-year period, China's annual refined production more than doubled from 5.2 Mt to 10 Mt (CAGR 7.7%), while production in Chile (the second ranked refined copper producer) declined by 25% from 3.1 Mt to 2.3 Mt (CAGR -3%). However, it should be noted that Chilean electrolytic refined output was constrained in the period 2018-2020 due to temporary smelter shutdowns whilst undergoing upgrades to comply with new environmental regulations.

In the United States, Japan and the EU compound annual growth rates averaged -1%, +2.2% and -0.2%, respectively.

Expansion of electrolytic refinery capacity in Iran, Russia, South Korea and Turkey and electro winning capacity in Mexico,Myanmar and Spain led to increases in annual refined production capacity in these countries.

With the start-up of several SX-EW plants, annual refined production in the D.R. Congo grew from around 360,000 t in 2011 to 1.2 Mt in 2020 (CAGR 15.2%).

World apparent refined usage increased by 28% over the 10-year period, with a CAGR of 2.7%.

Growth was driven by China1 where apparent usage over the 10-year period rose by about 6.5 Mt (CAGR 7%). China's share of world usage increased from 40% in 2010 to over 50% in 2020.

World usage excluding China declined over the 10-year period with a CAGR of -1.2%, including a sharp fall of 9.5% in 2020 due to the pandemic: usage presented a 10-year CAGR of -1.9% in the EU, -1.8% in Japan, and -0.3% in the United States.

With the expansion of semis production capacity, refined copper usage increased significantly in the United Arab Emirates (CAGR 9%) and in Vietnam (CAGR 16%). In contrast, closures of semis plants led to significant declines in usage in Egypt and Australia.

1 ICSG uses an apparent refined usage calculation for China that does not take into account changes in unreported stocks.

ICSG also released it forecast for 2021/2022, which predicts that world copper mine production, adjusted for historical disruption factors, will increase by roughly 3.5 percent this year and by 3.7 percent in 2022 after three years of remaining practically unchanged. As far as refined copper production, the ICSG forecasts that it will rise by roughly 3 percent in 2021 and in 2022. This follows a 1.6 percent increase in 2020.

In 2021-2022, the overall recovery from the pandemic and the continued expansion of capacity in China and the Democratic Republic of Congo will support this growth. While Chinese refined production was reduced by COVID-19 restrictions, tight scrap supply and reduced availability of concentrates early in 2020, growth of about 4 percent is expected for 2021 and 2022, the ICSG says.

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For participation and further details, please contact the IBAAS Office, India

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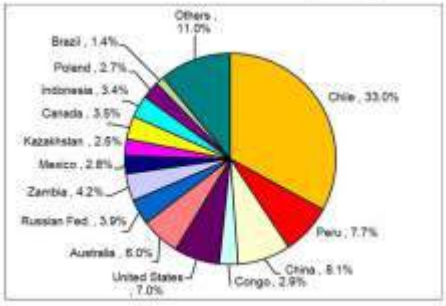
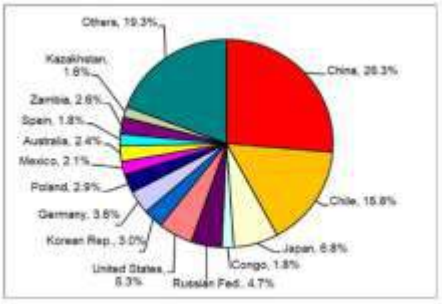
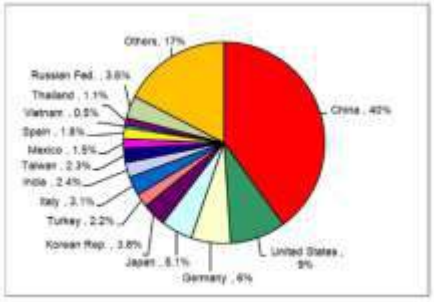


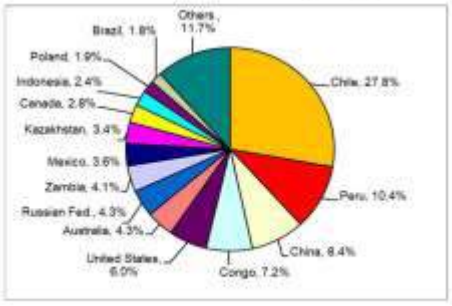
Share in World Mine Production (2020)

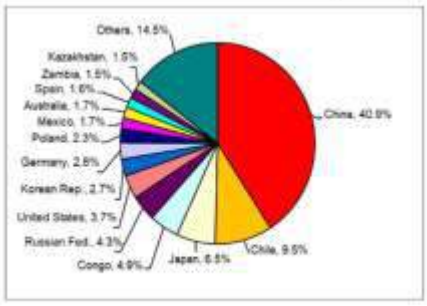


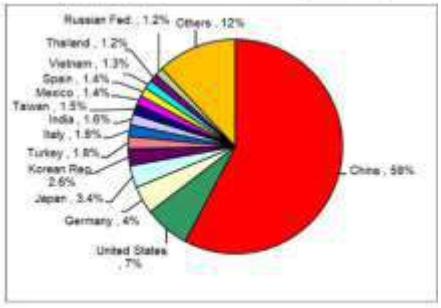
Share in World Refined Production (2020)



Share in World Refined Usage (2020)







(World Refined Copper Usage and supply Trends table on next page)

World Refined Copper Usage and Supply Trends, 2011-2020

Thousand metric tonnes, copper

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
World Mine Production	15,960	16,687	18,185	18,422	19,153	20,395	20,067	20,579	20,571	20,634
World Mine Capacity	19,526	20,061	20,844	21,631	22,411	23,525	24,068	24,108	24,207	24,787
Mine Capacity Utilization (%)	82	83	87	85	85	87	83	85	85	83
Primary Refined Production	16,133	16,598	17,255	18,575	18,892	19,490	19,488	20,028	19,987	20,635
Secondary Refined Production	3,468	3,596	3,803	3,915	3,945	3,866	4,063	4,035	4,028	3,875
World Refined Production (Secondary+Primary)	19,601	20,194	21,058	22,490	22,838	23,356	23,551	24,063	24,016	24,510
World Refinery Capacity	23,533	24,494	25,784	26,660	26,943	27,235	27,770	28,220	29,180	29,882
Refineries Capacity Utilization (%)	83	82	82	84	85	86	85	85	82	82
Secondary Refined as % in Total Refined Prod.	17.7	17.8	18.1	17.4	17.3	16.6	17.3	16.8	16.8	15.8
World Refined Usage 1/	19,709	20,479	21,408	22,906	23,046	23,486	23,693	24,480	24,405	24,989
World Refined Stocks End of Period (4)	1,205	1,376	1,325	1,334	1,505	1,365	1,375	1,227	1,215	1,234
Period Stock Change	7	171	-52	10	171	-140	10	-148	-12	19
Refined Balance 2/	-108	-285	-350	-416	-209	-130	-142	-417	-389	-479
Refined Balance Adjusted for Chinese bonded stock change 3/	-170	283	-597	-439	-312	-118	-139	-477	-567	-369

1/ Based on EU apparent usage and Chinese apparent usage.
2/ Surplus/deficit is calculated using refined production minus refined usage.
3/ In developing its global market balance, ICSG uses an apparent demand calculation for China that does not take into account changes in unreported stocks [State Reserve Bureau (SRB), producer, consumer, bonded]. To facilitate global market analysis, however, an additional line item—Refined World Balance Adjusted for Chinese Bonded Stock Changes—is included in the table that adjusts the world refined copper balance based on an average estimate of changes in bonded inventories provided by three consultants with expertise in China's copper market.
4/ Excludes unreported stocks

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Global zinc market deficit slips to 19,700 T in Nov -ILZSG

The International Lead and Zinc Study Group (ILZSG) released preliminary data report, The global zinc market deficit edged lower to 19,700 tonnes in November from a revised shortfall of 22,100 tonnes a month earlier, data from the International Lead and Zinc Study Group (ILZSG).

Previously, the ILZSG had reported a deficit of 6,100 tonnes in October. During the first 11 months of 2021, ILZSG data showed a deficit of 126,000 tonnes versus a surplus of 479,000 tonnes in the same period of 2020.

As per the ILZZSG report, Supply of lead is forecast to see a surplus of 27,000 tonnes and 24,000 tonnes respectively in 2021 and 2022, while zinc will see a surplus of 217,000 tonnes, and a smaller 44,000 tonnes this year and the next.

The group forecasts global demand for refined zinc to increase by 2.3% to 14.41 million tonnes in 2022, and global zinc mine production by 4.2% to 13.39 million tonnes.

World lead mine production is forecast to increase by 2.8% to 4.81 million tonnes in 2022, while global demand is anticipated to rise by 1.7% to 12.61 million tonnes in 2022, the ILZSG said.

China, the supply of zinc concentrates is anticipated to rise by 2.3% in 2021 and by 0.7% in 2022. Output in the world ex-China is forecast to increase more rapidly, at 5.9% and 5.8% in 2021 and 2022 respectively, it said

Table : World Refined Lead Supply and Usage 2016 - 2021

Provisional data reported to the ILZSG indicate that world refined lead metal supply exceeded demand by 15kt during the first ten months of 2021 with total reported stock levels increasing by 31kt.

Global lead mine production rose by 4.6% over the first ten months of 2021 compared to the same period in 2020. This was mainly due to increases in Bolivia, China, India, Mexico and Peru that more than balanced a significant reduction in Poland.

Rises in a number of countries, most notably Belgium, China, India, Mexico and Poland resulted in an overall increase of refined lead metal production globally of 3.9%. However, output declined in Australia, Kazakhstan and Germany, due to the temporary suspension of activities at Ecobat's Stolberg smelter in mid-July. In the United States production also fell, primarily due to the closure of Clarios' 100 thousand tonne per year secondary lead smelter in March.

Refined global lead metal usage rose by 5.2%, primarily influenced by increases in Europe, Brazil, Japan, the Republic of Korea, Mexico and the United States.

Table World Refined Zinc Supply and Usage 2016 - 2021

According to preliminary data recently compiled by the ILZSG and after taking into account releases totalling 180 thousand tonnes of refined zinc by China's National Food and Strategic Reserves Administration, the global market for refined zinc metal was in surplus by 87kt over the first ten months of 2021 with total reported inventories decreasing by 178kt.

World zinc mine production rose by 6.1% mainly as a result of increases in Bolivia, India, Mexico, Peru, South Africa and Turkey that more than balanced falls in Brazil, Canada, Ireland, Kazakhstan and Poland.

Rises in refined zinc metal production in China, India, Japan, Peru and the United States were partially offset by decreases in Canada and the Republic of Korea, resulting in an overall rise globally of 2.3%.

A 7.6% increase in global usage of refined zinc metal was a consequence of rises in a number of countries and regions, in particular Europe, Brazil, China, India, Japan, Taiwan (China), Thailand, Turkey and the United States.

Chinese imports of zinc contained in zinc concentrates fell by 7.1% to 1449kt.

World Refined Lead Supply and Usage 2016 - 2021

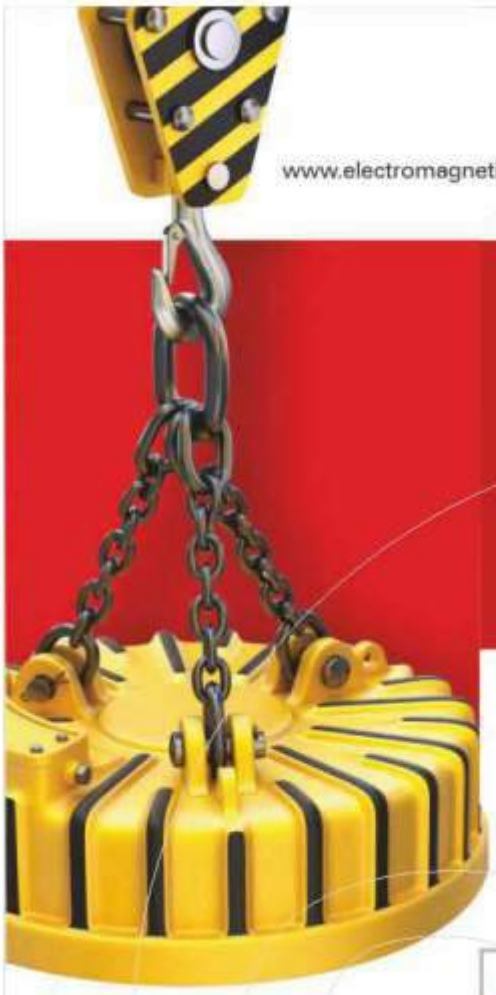
000 tonnes	2016	2017	2018	2019	2020	2020 Jan-Oct	2021 Jan-Oct	2021 Jul	2021 Aug	2021 Sep	2021 Oct
Mine Production	4,704	4,602	4,572	4,684	4,501	3,670	3,838	394.4	414.7	410.8	415.4
Metal Production	11,584	11,961	12,244	12,273	11,894	9,733	10,118	995.8	993.8	985.1	998.4
Metal Usage	11,541	12,104	12,290	12,225	11,754	9,601	10,103	964.2	1,008.0	1,026.6	1,038.6

Source: ILZSG

World Refined Zinc Supply and Usage 2016 - 2021

000 tonnes	2016	2017	2018	2019	2020	2020 Jan-Oct	2021 Jan-Oct	2021 Jul	2021 Aug	2021 Sep	2021 Oct
Mine Production	12,679	12,683	12,744	12,814	12,276	9,999	10,608	1,056.8	1,101.2	1,087.8	1,110.8
Metal Production	13,611	13,534	13,151	13,518	13,774	11,338	11,594	1,170.0	1,157.8	1,156.0	1,151.3
Metal Usage	13,726	13,998	13,718	13,791	13,271	10,862	11,687	1,207.7	1,171.2	1,194.4	1,157.4

Source: ILZSG



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SIAM Statistic

India Passenger Vehicle Sales Dip 13% In December: SIAM

India' s passenger vehicle sales declined 13 per cent to 2,19,421 units in December, auto industry body SIAM said recently in its press release. Passenger vehicle sales in December 2020 stood at 2,52,998 units. Despite a strong demand because the global shortage of semiconductors continued to impact production, even as calendar year sales breached the 3 million mark for only the third time in 2021.

As per the latest data by the Society of Indian Automobile Manufacturers (SIAM), two-wheeler sales also fell 11 per cent to 10,06,062 units, compared to 11,27,917 vehicles in December 2020. In October-December period of this fiscal year, passenger vehicle sales declined 15 per cent to 7,61,124 units from 8,97,908 units in the year-ago period.

Commenting on Q3 sales data, Mr Kenichi Ayukawa, President, SIAM said, "Amidst the rising infection spread, Indian Automobile Industry is taking all necessary precautions in line with the government guidelines. As in the past, Industry continues to stand with the government to support the country wherever possible.

Quarter-3 sales including those of the festive season were not as per expectations. All segments are still behind by many years. Industry is working hard to maximize production and minimize the impact of supply constraints while ensuringsafety of people in the entire value chain.

SIAM is thankful to the Government for rolling out various PLI schemes for the industry includingthat for Auto & Auto Components, Advanced Chemistry Cell and the recently announcedscheme for semi-conductor manufacturing. Industry is looking forward to leverage the benefits of these schemes for increasing localisation and exports."

Commenting on Q3 sales data, Mr Rajesh Menon, Director General, SIAM said, "Demand ofPassenger Vehicle Segment was largely affected due to supply constraints while the Two-Wheeler segment was majorly impacted due to subdued demand. Sales of Passenger Vehiclesin Q3 has been the lowest in 5 years, while for the Two-Wheelers it has been the lowest in 9

years. Only the Heavy Goods segment in Commercial Vehicles have shown positive growthcompared to Q3 of previous two years. Sales of Buses and Three-Wheelers continue to be aconcern. Barring 2020, the Sales of Commercial vehicles in Q3 has been lowest in last 5 yearsand sales of Three-Wheelers, barring 2020, has been the lowest in last 13 years."

SIAM

Segment wise Comparative Production, Domestic Sales & Exports data for the month of December 2021

(Number of Vehicles)

Category	Production		Domestic Sales		Exports	
Segment/Subsegment	December		December		December	
	2020	2021	2020	2021	2020	2021
Passenger Vehicles (PVs)*						
Passenger Cars	185,423	155,055	146,864	112,873	36,154	36,850
Utility Vehicles (UVs)	118,852	109,784	94,787	97,137	20,632	17,770
Vans	11,563	9,388	11,347	9,411	264	226
Total Passenger Vehicles (PVs)	**315,838**	**274,227**	**252,998**	**219,421**	**57,050**	**54,846**
Three Wheelers						
Passenger Carrier	53,027	59,889	13,489	21,205	38,273	41,534
Goods Carrier	9,554	6,811	8,987	6,906	340	1,374
Total Three Wheelers	**62,581**	**66,700**	**22,476**	**28,111**	**38,613**	**42,908**
Two Wheelers						
Scooter/ Scooterettee	334,994	243,284	323,757	246,080	26,767	21,728
Motorcycle/Step-Throughs	1,133,506	1,029,054	744,237	726,587	339,194	342,698
Mopeds	60,742	24,596	59,923	33,395	1,560	744
Total Two Wheelers	**1,529,242**	**1,296,934**	**1,127,917**	**1,006,062**	**367,521**	**365,170**
Quadricycle	579	250	-	10	618	252
Grand Total of All Categories	**1,908,240**	**1,638,111**	**1,403,391**	**1,253,604**	**463,802**	**463,176**

* BMW, Mercedes, Tata Motors and Volvo Auto data is not available

Society of Indian Automobile Manufacturers (14/01/2022)

SIAM						
Summary Report: Cumulative Production, Domestic Sales & Exports data for the period of October - December 2021						
						(Number of Vehicles)
Category	**Production**		**Domestic Sales**		**Exports**	
Segment/Subsegment	**October-December**		**October-December**		**October-December**	
	2020-21	**2021-22**	**2020-21**	**2021-22**	**2020-21**	**2021-22**
Passenger Vehicles (PVs)*						
Passenger Cars	604,753	446,198	521,734	348,635	90,083	93,460
Utility Vehicles (UVs)	378,081	418,588	339,276	382,315	45,308	45,167
Vans	37,099	30,419	36,898	30,174	625	736
Total Passenger Vehicles (PVs)	**1,019,933**	**895,205**	**897,908**	**761,124**	**136,016**	**139,363**
Commercial Vehicles (CVs)**						
M&HCVs						
Passenger Carrier	3,052	4,992	1,719	3,615	1,651	1,645
Goods Carrier	55,157	69,563	49,473	60,349	3,960	7,094
Total M&HCVs	**58,209**	**74,555**	**51,192**	**63,964**	**5,611**	**8,739**
LCVs						
Passenger Carrier	3,807	4,421	2,801	3,535	369	441
Goods Carrier	151,232	132,420	139,041	127,213	10,776	16,886
Total LCVs	**155,039**	**136,841**	**141,842**	**130,748**	**11,145**	**17,327**
Total Commercial Vehicles (CVs)	**213,248**	**211,396**	**193,034**	**194,712**	**16,756**	**26,066**
Three Wheelers						
Passenger Carrier	167,760	177,779	44,270	60,056	117,075	125,230
Goods Carrier	31,495	23,273	28,961	22,300	1,487	2,805
Total Three Wheelers	**199,255**	**201,052**	**73,231**	**82,356**	**118,562**	**128,035**
Two Wheelers						
Scooter/ Scooterettee	1,480,588	1,040,621	1,417,478	1,022,580	83,235	84,828
Motorcycle/Step-Throughs	4,188,561	3,390,098	3,153,691	2,444,410	976,981	1,009,471
Mopeds	214,914	118,312	210,941	131,309	4,054	1,602
Total Two Wheelers	**5,884,063**	**4,549,031**	**4,782,110**	**3,598,299**	**1,064,270**	**1,095,901**
Quadricycle	1,395	827	-	58	1,272	810
Grand Total of All Categories	**7,317,894**	**5,857,511**	**5,946,283**	**4,636,549**	**1,336,876**	**1,390,175**
* BMW, Mercedes and Volvo Auto data is not available						
** Daimler & Scania data is not available						
Society of Indian Automobile Manufacturers (14/01/2022)						

SIAM						
Summary Report: Cumulative Production, Domestic Sales & Exports data for the period of January - December 2021						
						(Number of Vehicles)
Category	**Production**		**Domestic Sales**		**Exports**	
Segment/Subsegment	**January -December**		**January -December**		**January -December**	
	2020	**2021**	**2020**	**2021**	**2020**	**2021**
Passenger Vehicles (PVs)*						
Passenger Cars	1,692,071	1,902,075	1,432,303	1,543,530	261,718	350,043
Utility Vehicles (UVs)	1,040,417	1,607,532	897,416	1,419,649	149,847	184,829
Vans	104,046	121,488	103,754	119,242	1,452	2,392
Total Passenger Vehicles (PVs)	**2,836,534**	**3,631,095**	**2,433,473**	**3,082,421**	**413,017**	**537,264**
Commercial Vehicles (CVs)**						
M&HCVs						
Passenger Carrier	15,802	14,591	13,388	11,184	4,803	5,015
Goods Carrier	122,576	246,407	115,306	215,951	10,261	25,149
Total M&HCVs	**138,378**	**260,998**	**128,694**	**227,135**	**15,064**	**30,164**
LCVs						
Passenger Carrier	21,216	20,108	17,596	17,682	2,076	1,981
Goods Carrier	385,691	486,911	358,812	432,302	27,156	52,834
Total LCVs	**406,907**	**507,019**	**376,408**	**449,984**	**29,232**	**54,815**
Total Commercial Vehicles (CVs)	**545,285**	**768,017**	**505,102**	**677,119**	**44,296**	**84,979**
Three Wheelers						
Passenger Carrier	568,899	668,102	182,997	180,531	378,498	497,860
Goods Carrier	84,373	92,737	79,500	82,842	4,318	9,794
Total Three Wheelers	**653,272**	**760,839**	**262,497**	**263,373**	**382,816**	**507,654**
Two Wheelers						
Scooter/ Scooterettee	4,318,363	4,708,726	4,206,609	4,333,928	233,375	352,654
Motorcycle/Step-Throughs	12,150,074	13,659,525	9,459,970	9,616,578	2,769,347	4,083,939
Mopeds	611,718	534,205	603,242	519,008	8,961	10,238
Total Two Wheelers	**17,080,155**	**18,902,456**	**14,269,821**	**14,469,514**	**3,011,683**	**4,446,831**
Quadricycle	3,399	5,380	-39	79	3,008	5,411
Grand Total of All Categories	**21,118,645**	**24,067,787**	**17,470,854**	**18,492,506**	**3,854,820**	**5,582,139**
* BMW, Mercedes and Volvo Auto data is not available						
** Daimler & Scania data is not available						
Society of Indian Automobile Manufacturers (14/01/2022)						

Global steel output grows 3.7% in 2021 despite Chinese weakness

Global crude steel production gained 3.7% last year to 1.95 billion tonnes, World Steel Association data showed on Tuesday, despite weaker output in top producer China as an energy crunch curtailed operations.

Chinese steel production dropped 3% in 2021, while second-ranked India saw output surge by 17.8% and third-place Japan jumped 15.8% as economies recovered from the COVID-19 pandemic.

As per the World crude steel production for the 64 countries reporting to the World Steel Association (worldsteel) was 158.7 million tonnes (Mt) in December 2021, a 3.0% decrease compared to December 2020.

Crude steel production by region

Africa produced 1.2 Mt in December 2021, down 9.6% on December 2020. Asia and Oceania produced 116.1 Mt, down 4.4%. The CIS produced 8.9 Mt, down 3.0%. The EU (27) produced 11.1 Mt, down 1.4%. Europe, Other produced 4.3 Mt, down 0.8%. The Middle East produced 3.9 Mt, up 22.1%. North America produced 9.7 Mt, up 7.5%. South America produced 3.5 Mt, down 8.7%.

Table 1. Crude steel production by region

	Dec 2021 (Mt)	% change Dec 21/20	Jan-Dec 2021 (Mt)	% change Jan-Dec 21/20
Africa	1.2	-9.6	16.0	26.7
Asia and Oceania	116.1	-4.4	1,382.0	0.6
CIS	8.9	-3.0	105.6	5.6
EU (27)	11.1	-1.4	152.5	15.4
Europe, Other	4.3	-0.8	51.21	1.6
Middle East	3.92	2.1	41.2	1.2
North America	9.7	7.5	117.8	16.6
South America	3.5	-8.7	45.6	17.8
Total 64 countries	**158.7**	**-3.0**	**1,911.9**	**3.6**

The 64 countries included in this table accounted for approximately 98% of total world crude steel production in 2020. Regions and countries covered by the table:

- Africa: Egypt, Libya, South Africa
- Asia and Oceania: Australia, China, India, Japan, New Zealand, Pakistan, South Korea, Taiwan (China), Vietnam
- CIS: Belarus, Kazakhstan, Moldova, Russia, Ukraine, Uzbekistan
- European Union (27)
- Europe, Other: Bosnia-Herzegovina, Macedonia, Norway, Serbia, Turkey, United Kingdom
- Middle East: Iran, Qatar, Saudi Arabia, United Arab Emirates
- North America: Canada, Cuba, El Salvador, Guatemala, Mexico, United States
- South America: Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela

Table 2. Top 10 steel-producing countries

	Dec 2021 (Mt)	% change Dec 21/20	Jan-Dec 2021 (Mt)	% change Jan-Dec 21/20
China	86.2	-6.8	1,032.8	-3.0
India	10.4	0.9	118.1	17.8
Japan	7.9	5.4	96.3	14.9
United States	7.2	11.9	86.0	18.3
Russia	6.6e	0.0	76.0	6.1
South Korea	6.0	1.1	70.6	5.2
Turkey	3.3	-2.3	40.4	12.7
Germany	3.1	0.1	40.1	12.3
Brazil	2.6	-11.4	36.0	14.7
Iran	2.8e	15.1	28.5	-1.8

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