

INTELLECTUAL CAPITAL

Keeping ourselves future ready



Our research competency, crucial collaborations with industry bodies and premiere research institutions have helped us expand and improve our business relationships. With the support of our world-class R&D centres with state-of-the-art technologies and our never-ending emphasis to achieve operational excellence in our value chain, we have been able to transform our business into a trustworthy brand synonymous with transforming the Aluminium and Copper business through innovative products.

Contribution to SDGs



Interlinkages with Material Topics and other Capitals

Material Topics	Capitals Connected
Product Stewardship	Financial capital Natural capital Manufactured capital

Alignment with Strategic Priorities
SP-1: Focus on Value-Added Products
SP-2: Strong ESG Commitment

HIGHLIGHTS

₹ 790.15 CRORE

Spent on Research and Development including Novelis operation

259

New patents filed

331

New Patents Granted

32

New products launched

₹ 165 CRORE

Business due to launch of new products



Focus Areas

Future ready products	Explore and adopt cleaner technology	Partnerships and alliances with external institutions
Unique technology development for product and process optimisation	Strengthening the existing R&D infrastructure	Value from waste



At Hindalco, we aim to constantly adapt and grow through our continuous innovation and research capabilities. To future-proof our business, we are focusing on adopting clean technologies, optimising our current processes and strengthening our existing R&D infrastructure.

Our Novelis operations drive innovation with a focus on improving processes and the existing product portfolio. Efforts are channelised to increase recyclability and develop products which could be a superior alternative to steel.

Our strategy of future-proofing is guided by our approach towards product stewardship and technology development. We are contributing towards India's commitment to Net Zero by focusing on developing Aluminium and Copper products

that improve resource optimisation, process efficiency and energy savings. This includes our efforts to achieve higher resource efficiency through beneficiation of low-grade ores, reusability of process water and rainwater harvesting to improve water efficiency and promotion of circular economy through value-added application of wastes.

Adopting digital transformation has helped us identify customer requirements on an ongoing basis. This understanding has led to improvement in the design and execution of projects, leading to the development of new products. Through the introduction of process automation, we have been able to focus on improving product and process optimisation. This philosophy is applicable to the entire process, starting from preparation of project charter,

reviewing the progress at different levels, communicating the results and documentation of the project's outcome.

We endeavour to create value for all our stakeholders. We have moulded our objectives into strategic short, medium and long-term goals in product design and development. The prime focus of our R&D efforts has been to cater to the needs of our customers. To create value for our business, our short-term goal is to provide tailor-made solutions to our customers in a timely manner as per their requirement.

We aim to maximise our business potential as well as add value to our product line up. We have set targets for developing new grades of alumina or hydrates for application in ceramic, refractory, glass, cement, polymer, and others in the next three to five years. We aim to develop various grades of Aluminium and specialty oils and lubricants for sustainable applications of the metal. Our long-term goal is to prepare our business for the future by developing a variety of products and technology aimed at enhancing productivity and profits. We are serving as an organisation that creates a wide variety of intellectual goods and so far, we have filed 259 patents while a few more are in the pipeline. We also aim at more collaborations with national and international organisations that will help us in our aim of future-proofing our business.

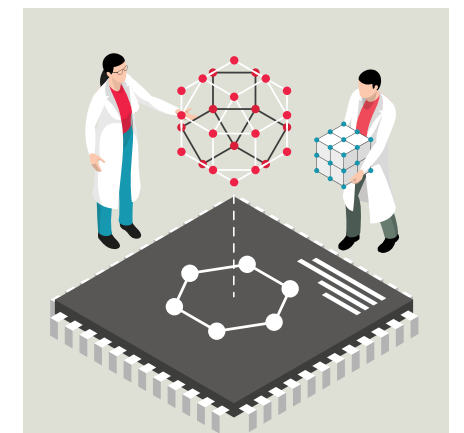


R&D centres for Future-Ready Products and Processes

The backbone of our product development and innovation in process and technology are our three innovation centres at Belagavi, Talaja and Dahej. The three centres specialise in alumina, bauxite, Aluminium, tribology and Copper-related metallurgical services. We are focusing on process ability studies for the efficient use of available raw materials in the Bayer process, improvement of process efficiency, energy savings and development of products and application in specialty alumina and hydrates. In addition to these, all our plants have their own R&D and Technical Cells for quality assurance, compliance with environment standards and the development of new products. Some of the recent areas of developments include high purity and multimodal alumina, reactive alumina, precipitated superfine, nano- and coated hydrates for different polymeric applications. Moving towards innovative solutions in our downstream, we have also

introduced duranium alloy development, UV-C reflector, Aluminium e-rickshaws, and are working towards aluminising commercial vehicles, high-strength plates and sheets for marine and domestic applications.

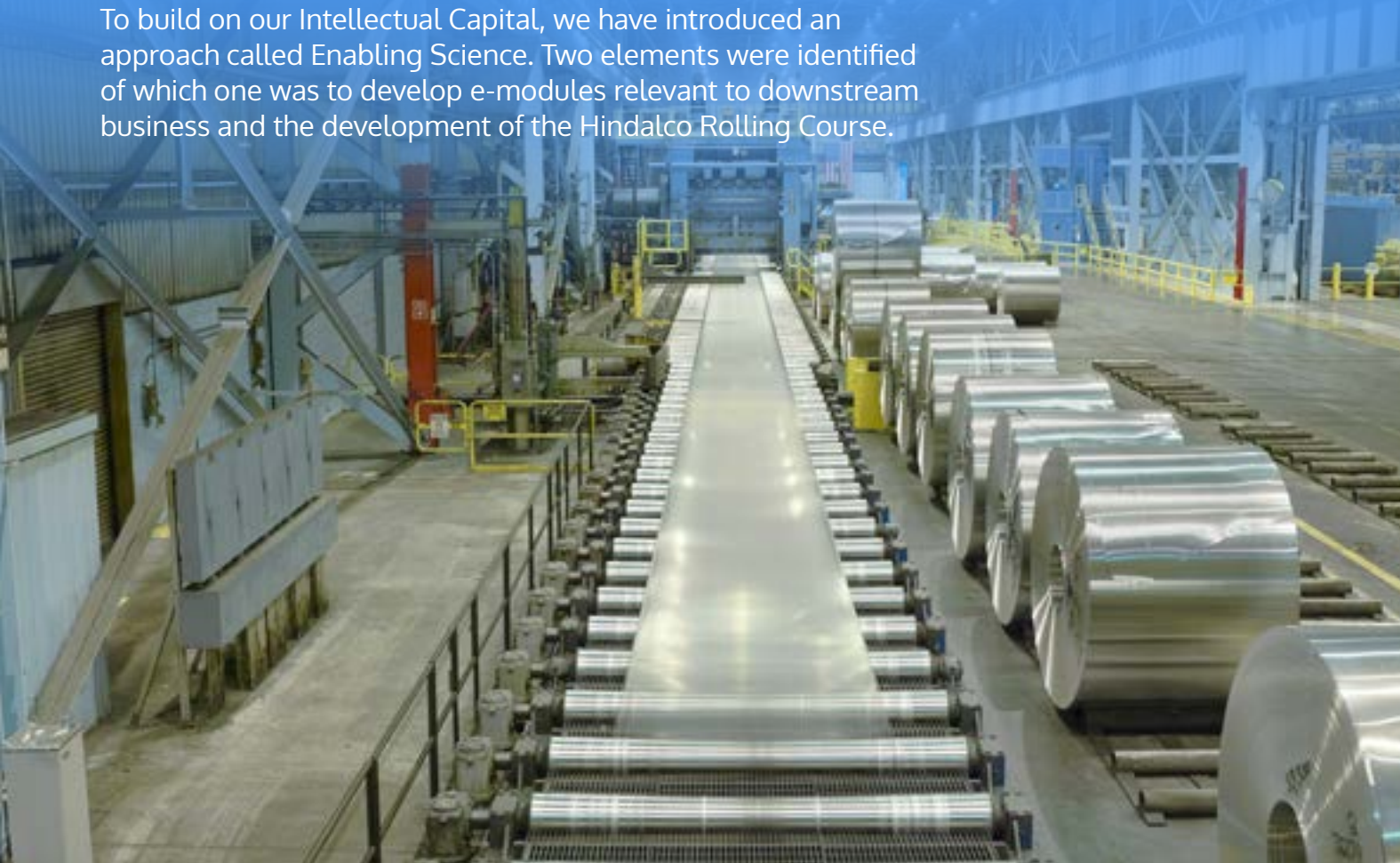
We have a team of more than 200 employees dedicated to R&D and providing world-class solutions to our customers in the short and long term. We have a network of technology centres across the world with equipment and facilities like X-Ray fluorescence (for quantitative analysis), X-Ray diffraction (phase analysis), scanning electron microscope (for micro- structural analysis), inductively coupled plasma (for trace element analysis), total organic carbon analyser, differential scanning calorimeter, different types of furnaces, mechanical and electrical testing, equipment for processability studies, and polymeric application studies for specialty hydrates.



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KEY AREAS OF ADVANCEMENT

To build on our Intellectual Capital, we have introduced an approach called Enabling Science. Two elements were identified of which one was to develop e-modules relevant to downstream business and the development of the Hindalco Rolling Course.



We have collaborated with HTU, downstream teams and SMEs for developing these elements. Further, an internal research knowledge sharing platform, Research Circle, has been created to promote collaboration and learning among technical professionals in the organisation.

Some of the significant products and processes developed by our team:

High purity 3N alumina (99.9%) for Li-ion battery application

This high purity alumina developed by our team is mainly used for Li-ion battery separators having critical properties such as chemical impurity and particle size. We were able to control the purity of alumina

and particle-size through process monitoring during grinding, calcination and milling

Development of Lubricant for Wire Rod Application

Hindalco Innovation Centre (HIC) Tribology Team has developed an in-house lubricant for Wire Rod Application at Mahan Aluminium

Development of In-house Fire-Resistant Hydraulic Fluid (FRHF)

FRHF are specially formulated lubricants that are more difficult to ignite and do not propagate a flame from an ignition source. Our team has developed in-house FRHF for use at our plants

Development of Alloy for Architectural Formwork

The new alloy developed for architectural framework ensures better productivity gains and improvement in the processing speed of between ~40-130%. It has also shown quality gains, lower frequency of pick up and improved surface finish. The alloy has higher extrusion speed and exit temperature that leads to better mechanical properties. Further, the die withdrawal rate significantly reduces leading to productivity enhancement. The patent for this alloy has already been filed

Development of HVAC fin stock

The Aluminium fin stock that is used in domestic and industrial HVAC applications has stringent performance requirement of strength in service and formability at high speeds during production. The market is currently dominated by imported stock. At our Belur plant, the alloy composition was modified and a new process route for the rolling of such thin material using closed gap, speed tension rolling was developed. We have already started our commercial supplies for this product, which is being utilised by the industry

Process Development for Hydrate with Low Iron content

With the increase in demand for high purity alumina for gorilla glass and glass application of smartphones, the major concern remains the impurity of the different substances. With the development of this hydrate with low iron content, we will be able to cater to the market in an improved way

Development of Nano Hydrate

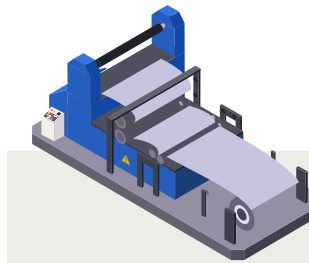
We were able to produce 60 kg spray dried nano-hydrate after a scale up in our pilot plant trial

Development of Green Cold Tamping Paste with Organic Binder

We were able to optimise the specifications and the properties by developing this new product, which was better than the cold tamping paste. The trial is ongoing right now and the patent filing is in process

Our Novelis operations team is working on growing our portfolio by using new technology in other parts of our business, specifically to cater to the aerospace market. We are continuously implementing automation, digital initiatives and advancements in R&D to further capture growth in the market and support initiatives involving sustainability.

One of the key products for Novelis remains beverage packaging, which is picking up growth around the world since customers are opting for a more sustainable solution.



Free Machining Aluminium Alloy

Materials with good machinability can reduce the cost of finished products and Free machine alloys contain constituents which improve machinability. Currently, the global market for free-machining extrusion alloys is 45 kT/annum.

Free machine Aluminium alloys such as AA6262 and AA2011 contain lead as an alloy for improving machinability. However, legislative regulations have been imposed on the usage of lead beyond 0.4% due to its toxicity. With this in mind, we have developed a new lead-free alloy at Aditya Birla Science & Technology Centre (ABSTC).

The new alloy contains addition of tin, which promotes formation of low-melting phases in the alloy and thus improves machinability. The new alloy demonstrates 20% lower surface roughness compared to regular extrusion alloys AA6061, AA6082 and is comparable to lead-based machining alloy AA6262. Cutting forces for the new alloy are also comparable to AA6262 and 20-25% lower than AA6061 and AA6082. The Sn-based alloy also promotes discontinuous and very small chip formation similar to AA6262 alloy.

Aluminium Matrix Composites

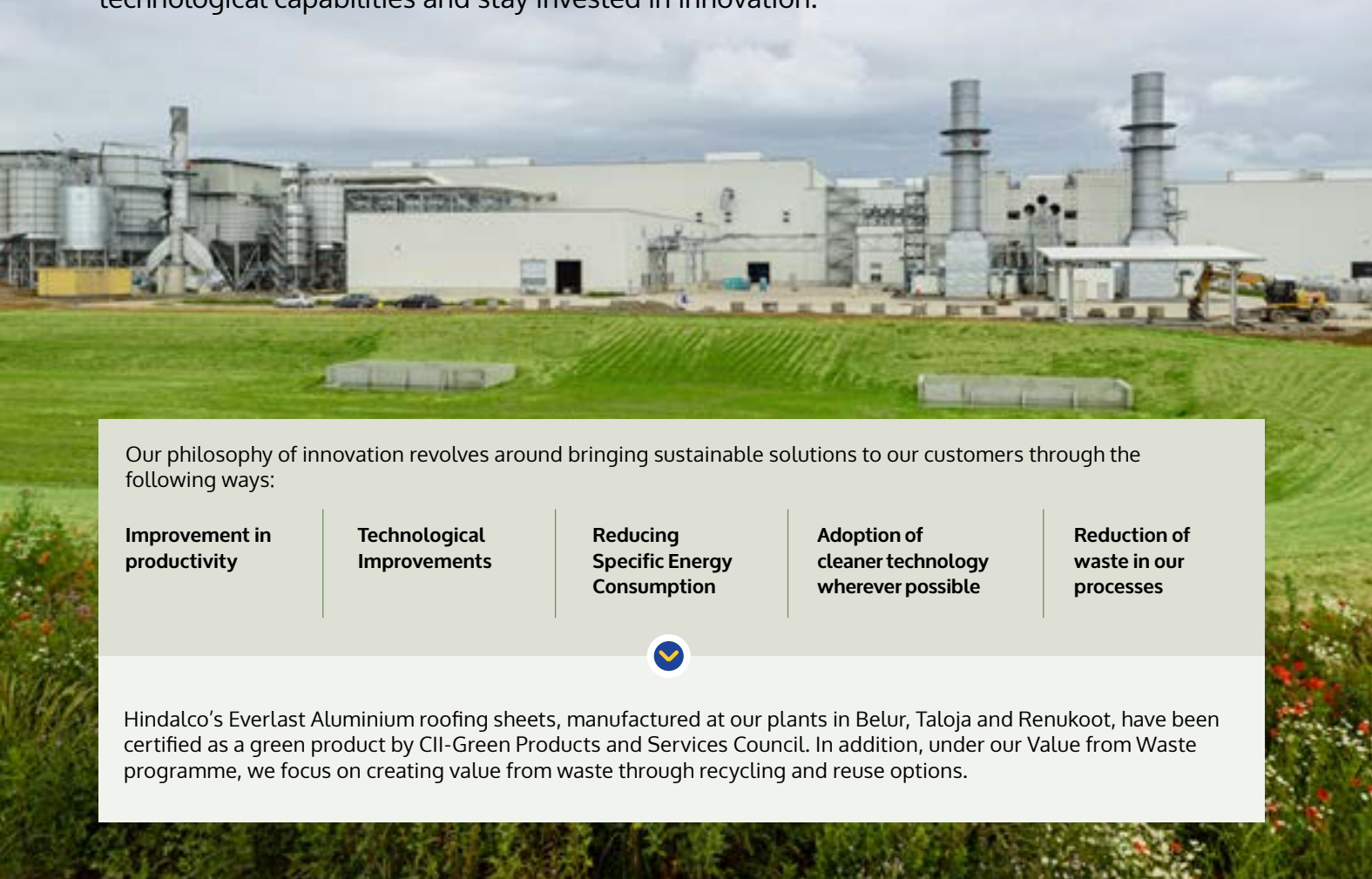
Aluminium and its alloys have various advantages – from being light weight to having high specific strength and others. However, these materials have limitations with respect to combinations of strength, stiffness, and wear resistance. Aluminium matrix composites are gaining importance to meet the ever-increasing engineering demands of modern technology.

ABSTC has developed a new in-situ process for synthesis of Aluminium-titanium carbide composite, using low-cost ingredients and scalable pneumatic powder injection and stirring process.

Due to the in-situ synthesis process, the TiC reinforcement particles have better wettability and thermodynamic stability in the Aluminium matrix compared to ex-situ Aluminium matrix composites. In addition to that, it has 25% higher Young's Modulus and 10-15% higher wear resistance compared to regular Aluminium alloys. Some of the areas of applications are in disc brakes, automotive cylinder liners and grain refiners. These applications offer a combined market potential of about 21 kT/ annum.

EXPLORING LOW CARBON TECHNOLOGY

To produce greener, stronger, smarter products, we continue to strengthen our technological capabilities and stay invested in innovation.



Our philosophy of innovation revolves around bringing sustainable solutions to our customers through the following ways:

- Improvement in productivity
- Technological Improvements
- Reducing Specific Energy Consumption
- Adoption of cleaner technology wherever possible
- Reduction of waste in our processes



Hindalco's Everlast Aluminium roofing sheets, manufactured at our plants in Belur, Taloja and Renukoot, have been certified as a green product by CII-Green Products and Services Council. In addition, under our Value from Waste programme, we focus on creating value from waste through recycling and reuse options.

Aluminium Freight Trailer

We had launched India's first complete Aluminium freight trailer in December 2019. The trailer is a momentous initiative for India's logistics and freight industry. The trailer is 34-foot long, 50% lighter and weighs over 2.5 tons less than an equivalent steel trailer. The high-strength Aluminium alloy ensures that the vehicle is safe, strong, durable, efficient and environment-friendly. Each trailer saves over 15,000 litres of fuel and emits 25 tons less GHGs and helps in achieving BS-VI emission targets. It also has 70% higher scrap value.

Aluminium Bulker

In another project, we have replaced the steel with Aluminium in the manufacturing process, making it lighter by 1,800 kg, thus increasing fuel efficiency and reducing the GHG emissions. A 30 cubic meter bulker is approximately two tons lighter than an MS bulker of the same size. Improved fuel efficiency accounts for a saving of ₹ 50,000 per year along with reduced GHG emission per ton of material transported.

15,000 LITRES

Of fuel saved and 25 tons less GHG emissions by our all-Aluminium Freight Trailer



Aluminium Bus

Our Aluminium bus is also contributing towards reducing energy consumption by saving up to 18,000 litres of fuel and reducing 45 tons GHG emissions.

Electric Vehicle Battery Case by Novelis

Novelis has developed the very first Aluminium sheet battery enclosure, which is 50% lighter than an equivalent steel design and improves the range of single charge by 6-10%, allowing vehicles to run more. It can be customised according to different complex shapes for specific vehicle design requirements while protecting the batteries from road debris and vehicle crashes.

Sustainable Packaging

Sustainable packaging is one of the big steps that we have taken towards making India Single Use Plastic (SUP) free by developing a combination of Aluminium and jute bags. During this year, Taloja, Alupuram and Mouda were certified SUP free under the provisions of the plastic use protocol.

Recycling Products at Novelis

We created the first closed-loop recycling system, which allows us to take back as much of our customers' Aluminium scrap as possible, turning it back into the same product again. Recycling Aluminium produces 95% fewer GHG and requires 95% less energy than primary Aluminium production.

This enables Novelis to achieve lower GHG emissions despite increasing global production capacity. The key results compared to base year of 2007-2009 are:

- **Recycling of Al:** 61% (an increase of 31%)
- **GHG Emission:** 31% (reduction)
- **Energy Intensity:** 25 % (reduction)



End of life can recycling at Novelis

STRATEGIC PARTNERSHIPS AND COLLABORATIONS

To augment our capabilities in R&D we have strengthened our in-house capacity and partnered with different institutions and organisations such as IIT Bombay, ABSTC, IIT Kanpur, National Environmental Engineering R&D, Research Institute, Nagpur, IIT Madras and others.



One of our outcomes from the collaborations with IIT Bombay was in the field of utilisation of red mud in construction applications, which helped immensely in the disposal of wastes from the Bayer plant locations.

These institutions aid our R&D team through research in various fields such as in Copper process improvements, Aluminium smelting process improvement, value from waste in downstream, sustainable bauxite mining, and so on.

HIGHLIGHTS IN COLLABORATION: 2020-21

Reduction of Specific Energy consumption at Aluminium Smelters

In an ongoing comprehensive research programme, ABSTC is working on reducing specific energy consumption at Aluminium smelters. A series of recommendations have already been implemented at Hirakud, Mahan and Aditya smelters. The solutions include:

- Anode rodding plant process optimisation
- Cathode lining
- Innovative Copper collector Bar (CuCB) technology
- Magnetic compensation
- Advance pot control and digital twin

The learnings from implementation at a particular smelter are also being adopted and deployed across other smelters of Hindalco. We have been able to incur savings of around ₹ 40 Crore with this initiative and are expecting to save ₹ 250 Crore more after full implementation.

Improvement of Smelter-1 Throughput at our Copper Plant, Dahej

This is another example of our ongoing collaboration with ABSTC. Waste Heat Boiler (WHB-31) temperature is one of the main bottlenecks to increasing the feed rate from around 68 to 72 Tonnage Per Hour (TPH). To reduce the boiler temperature, a new bottom baffle has been proposed for implementation. Its design and its location inside WHB-31 had been determined through Computational Fluid Dynamics (CFD) simulations. The baffle has been fabricated and already installed in WHB-31, resulting in an increase in throughput by 2.5 TPH.

Copper Slag Application in place of Sand in Concrete-Making

Hindalco's Birla Copper, in collaboration with ABSTC and UltraTech, has established commercial utilisation of Copper slag as replacement for sand in concrete-making. Laboratory studies showed that desirable compressive strength can be achieved by replacing up to 50% of sand with Copper slag. The idea was piloted for an in-house application and subsequently taken up for 200 T demonstration at UltraTech Plant, Makdala. Based on successful demonstration, the slag is now being regularly used by UltraTech at their various locations for concrete application.



Bismuth and Antimony Removal from Copper Refinery Electrolyte:

To improve Copper cathode quality, HIC Copper has identified resin for the removal of both Antimony (Sb) and Bismuth (Bi) in a cost-effective manner. Based on encouraging laboratory results, pilot-scale trials at 500 L/h capacity were undertaken with the Copper refinery electrolyte solution. More than 60% removal of the impurities could be achieved. Regular use of the resin is now being examined.

Our collaboration with IIT Bombay and ABSTC has resulted in the filing of four patents, including two international patents. Researchers from these institutes were invited to share their research findings and future R&D needs with our colleagues in our Research Circle forum.



Copper slag is being used to replace sand in concrete



Hindalco employees are being equipped with knowledge to respond to cyberattacks

Digital Innovation at Hindalco

Digital transformation is the key to stay ahead in today's fast-paced world and we are diligently working towards achieving that. All our plant locations at Hindalco have been certified with ISO 27001 Information Security Management System. We have formulated an IT policy to improve our service delivery and to protect our organisational data. We review and update our policy periodically to strengthen our data security and processes. Our IT and digital functioning is led by our CDO (Chief Digital Officer) followed by the CIO (Chief Information Officer). We have also appointed a virtual CISO (Chief Information Security Officer) who manages various aspects of security and ensures organisation remains protected in this dynamic threat landscape of cyber world.

We are focusing on the consolidation of various applications, integration of systems and digitalising the manual processes. We have adopted a new technology endpoint detection and response (EDR) solution specifically

for malware protection. In addition, we have also adopted Secure Web Gateway proxy solutions to manage our network security with ease. It is important that our employees have the awareness and the knowledge to respond to cyberattacks and threats. Towards that, we carried out learning programmes and simulation exercises on advanced cyberattacks and ways to respond to them.

Under Industry 4.0, and the current trend of automation and data exchange, we undertook two key developments which are cloud adoption and convergence of IT and Operation Technology. We have been able to improve our operations with the adoption of these initiatives. We have also been able to identify the topmost risks related to IT system availability and information security at our Belur plant. The mitigation plans for many identified risks have been implemented whereas work on others is under progress.

We organised our Downstream Digital Conclave in March 2021, as part of our knowledge sharing initiative. At the meet, each unit presented the benefits

and their experience of deploying digital technology and discussed the focus areas for downstream, such as people engagement in digital projects, using digital technology to bridge data gaps, capturing benefits from existing deployments, and going paperless.

One of the biggest challenges we faced during COVID-19 was the security of organisational data while working from home. Since the majority of our workforce was working remotely, it was imperative to strengthen our IT infrastructure. With the adoption of EDR, cloud proxy and Cloud Access Security Broker (CASB), we were able to secure our data as well as network security services.

ISO 27001

Certification for all plants

Our Response to COVID-19

We took these challenging times as an opportunity to improve our services. Efforts such as social distancing, sanitisation, working in shifts, regular health check-ups, and other measures were undertaken to reduce risk of spreading infections at the workplaces as well as during commute. Various collaborative digital platforms were used to hold our virtual meetings amongst team members as well as with our clients and other key stakeholders. Virtual teamwork and simulations were worked upon to ensure ideation and innovation in processes and products while working from our homes during the lockdown.



Mining team at Baphlimali Mines

Aluminium Cot for COVID-19 Isolation



During the COVID-19 pandemic, the need for isolation and quarantine in hospital wards drove the team in Renukoot to design and fabricate ready-to-assemble Aluminium cots to support society.

The team developed an in-house design and prototype Aluminium cot fabricated with available extrusion profiles and sheet material at a cost comparable to those of cots available in the market. Design optimisation helped in reducing weight while maintaining desired strength of the cot. This cot adds value as 90% of the cost can be recovered in the future, and the fabrication cost is also low.

Development of UV-C Reflector Laminate for Sanitiser



During the pandemic, disinfecting and sterilising surfaces became a necessity. To meet the demands of the customers for such reflectors, a new product was developed at Mouda which had high reflectivity.

However, high purity specialised alloy or any specific manufacturing capability was not required. The product development has shown 10% improvement in luminosity and intensity of the sanitiser, and we were able to achieve higher reflectivity in laminate with the use of recycled Aluminium alloys.

Product Innovations

New Extrusion Alloy for Eternia Windows

We developed a new alloy for Eternia Windows which has superior strength and surface properties that differentiates it from the other system window brands. The new alloy has been launched under the name Duranium™ and a patent has been filed. This alloy showed 35% higher yield strength vs minimum requirement and 5-15% higher yield compared to the nearest competitors. It also showed better anodising quality for the extruded profiles.

We were able to optimise the plant process parameters of casting and homogenisation and heat treatment of alloy while developing the new alloy composition with micro-alloying additions. This was done in conformity with the industry standard for architectural doors and windows. Our products Eternia and Erigo (Aluminium windows and doors) meet the requirement of GreenPro Ecolabel and are certified as green products by CII-Green Products and Services Council.



High Temperature Low Sag Conductor Alloy

High Temperature Low Sag (HTLS) conductors can withstand operating temperatures of 210°C without causing sag beyond permissible limit. This allows for more current to safely pass through these conductor wires.

A new Aluminium zirconium alloy has been developed by ABSTC and our team at Mahan for HTLS wire rod for manufacturing power conductors. The composition and casting process were developed and the heat treatment cycle was optimised at ABSTC.

The electrical conductivity and mechanical properties were achieved in the wire rods as per ASTM B 491-10. Customer trials for type testing is still under progress.



3SRC: High Strength Container Stack

Due to the COVID-19 lockdown, there were disruptions in the supply chain of Semi-Rigid Container (SRC). Our team sensed this as an opportunity to introduce a new alloy in the market with superior performance.

The 3SRC alloy was designed to have higher strength percentage formability, lower energy footprint due to reduction in homogenisation and annealing time and high recycle content. For commercialisation of the product, extensive baselining exercise was carried out to understand the requirements of different customers.

Accordingly, at HIC-Semifab, customised products for each customer was developed. Based on this alloy, we have introduced multiple customised products in 2020-21, adding to our story of creating value for our business.

Circles for coated cookware

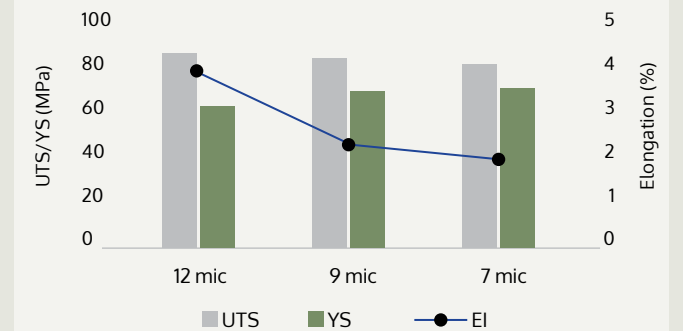


Aluminium alloy circles, a rockstar product for Hindalco, are used in a variety of cookware applications. Amongst several applications, coated cookware is a high growth segment due to lower cost, better surface finish and non-stick coating. One of the issues, however, is occurrence of stretch lines in final product post coating and drawing. To address the issues, detailed analysis of cookware designs, customer operation, and end application was carried out. This project was undertaken to reinvent the product so as to qualify Hindalco circles for roller coated segments.

The manufacturing process route was redesigned to obtain optimal mechanical properties in the finished product. Four different products, requiring different deep drawing ratio were qualified with the material improvement.

High strength foils for export market

Export of light gauge (LG) foils for flexible packaging, insulation, lidding and house foil from Mouda plant started in FY 2017-18. One of the reasons inhibiting the scaling up of the LG export was low ultimate tensile strength (UTS) of LG foils. Customers having high speed rewinding machines and laminators require high UTS material to avoid web breakage during the operation. Softer foils require the customers to run their machines at low speed, thereby lowering their productivity. A revised rolling practice was devised by modifying the thermal treatments and pass schedule for production of LG foils. The results of the trial indicated significant improvement in strength without adverse consequence on surface finish, rollability and recovery. The revised practice led to energy savings compared to current practice. Based on the positive feedback from customers, production was scaled up for both domestic and export customers. Due to the attractiveness of the revised route, the innovation has been implemented for medium gauge blister and pharma products as well.



Product Innovations

LPG cylinder development

Aluminium LPG cylinders are manufactured globally by several manufacturers. Hindalco Renukoot plant is qualified to supply Aluminium alloy circles for this application in the global market. The advantages of Aluminium LPG cylinders, i.e. light-weight, fuel conservation, longevity are well recognised by the stakeholders in domestic LPG industry. Concerns such as compatibility of Aluminium with caustic, ability to handle abuse, quality control in welding and economic viability have impeded its commercialisation in the last decade.

As part of a collaborative project, designs of cylinders were developed to meet the specifications of the international standards. Virtual design verification studies showed that Aluminium cylinders could be designed to meet the yield and burst pressure requirements while volumetric expansion and drop tests need experimental verification.

Two major challenges in fabrication were deep drawing of the circles and obtaining consistently adequate weld quality. Several improvements in terms of welding power source, fixture, practices, consumable and automation led to significant and sustainable improvements in weld quality. The other two work streams focussed on optimisation of the heat treatment and development of in-house test facilities. Testing of cylinders confirmed that the cylinders meet requirements of global standard in terms of yield pressure, burst pressure, volumetric expansion and mechanical properties (tensile, bend) of base metal and weld coupon.

Successful qualification paved the way for drafting of Indian standard for "Gas cylinders — Refillable welded Aluminium alloy cylinders — Design, construction and testing". The draft of the standard has been approved and is ready for publication. Discussions on launching this product are going on with potential customers.



Can Body Stock Development



Aluminum cans are one of the key applications of Aluminium alloys globally and a preferred packaging

option due to key advantages like high barrier properties, excellent recyclability, light weight, thermal properties and aesthetics. The cans are a highly engineered product designed for production at a very high speed. Hindalco's Hirkud plant has worked closely with Novelis and its suppliers on developing this technology for the first time in India. The alloy design and casting process is critical for production on rolling ingots that can be used for CBS.

State of the art tandem hot rolling mill is used to produce the hot band which has special properties to control earing in

the final product. Cold rolling is carried out at very high speeds to ensure very high strengths are achieved in the alloy. Close control of the finishing operations and lubrication ensure that the customers are able to use the material in their lines without any disruptions during the drawing and ironing operations.

These coils have been tested internally and at can pilot lines. The trials are underway with both domestic and global customers to qualify Hindalco as a supplier for world class can body stock.

Copper-insert Collector Bar Technology for Hindalco Smelter

ABSTC (ABG's corporate R&D center) along with plant technical team developed in-house Cu-insert Collector Bar (CuCB) technology for its Hirkud, Aditya and Mahan smelters. CuCB technology was first developed and tested in Hirkud 85kA pot during 2016, subsequently it was further customised to put on trial in Mahan 360 kA pot during 2018.

CuCB technology has helped in saving specific energy consumption of about 250 - 300 kWh/ton of Al along with gain in current efficiency to aid extra metal production. Patents have been filed for the CuCB technology.

Treatment of Phosphogypsum with Lime for Use in the Cement Industry

Lime Mixing with phosphogypsum aids in pH Improvement and P_2O_5 fixation to make it suitable for use in cement industry. Our team conducted several lab and plant trials for controlled dosing of lime and homogenous mixing varying between 0.5-3% concentration of lime, to understand if the resultant can be suitably used in the cement industry.

Based on lab trials, we found that controlled dosing of 1-3% lime to phosphogypsum will improve its pH from ~1.5 to 6 and fix 30-35% free phosphorous pentoxide (P_2O_5) in the form of calcium phosphate. However, total phosphate in phosphogypsum remains unchanged even after addition of lime.

The conversion of free pentoxide to phosphate provides an added advantage by reducing the adverse effect of P_2O_5 , such as impacting the compressive strength of

cement and reaction with cement clinker during the process of cement making. The idea has been commercialised. So far, more than 10 Lakh tons of phosphogypsum has been used by the cement plants.



Development of White Hydrate (ONYX) Grade Muri

We developed onyx alumina hydrate or white transparent hydrates which are deep white, clean, translucent in appearance which can be used for cast polymer application. Showa Denko, Huber and Chalco have been producing this grade and the total market potential is 4,250 T / month as alumina. India's demand is up to ~2.0-2.5 KT as Alumina.

After a successful development of this product, our pilot scale trial was conducted using the Precipitated Superfine Hydrate pilot plant facility at Belagavi. We have also sent hydrate samples to customers, seeking their feedback.

