13th International Bauxite, Alumina & Aluminium Conference & Exhibition

A GREEN AND SMART ALUMINIUM INDUSTRY FOR TOMORROW

IBAAS-IMMT-IIM 2025

SOUVENIR

CSIR-INSTITUTE OF MINERALS AND MATERIALS TECHNOLOGY (CSIR-IMMT)
BHUBANESHWAR
INDIA

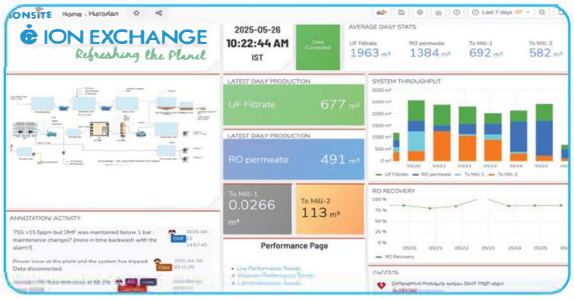
OCTOBER 8-10
2025

60 Years of Trust

ION EXCHANGE
Refreshing the Planet

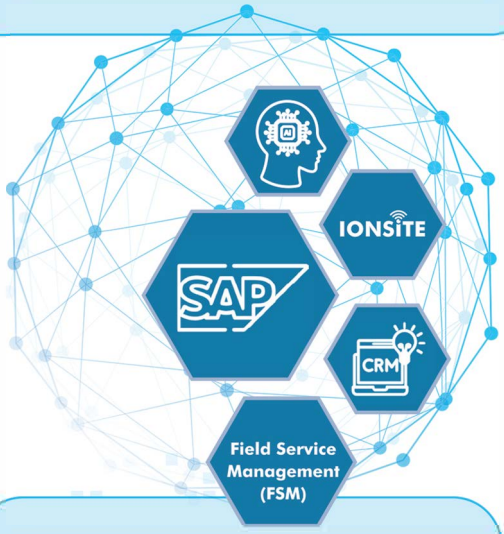
Powering Growth and Delivering Customer Value with IONSiTE Digital Solutions

Remote Monitoring I Digital Twins I Cloud I Hybrid I Edge Control



Real-time insights from digital twins, powered by Predictive AI, enhance asset performance, optimize plant operations and save costs for customers

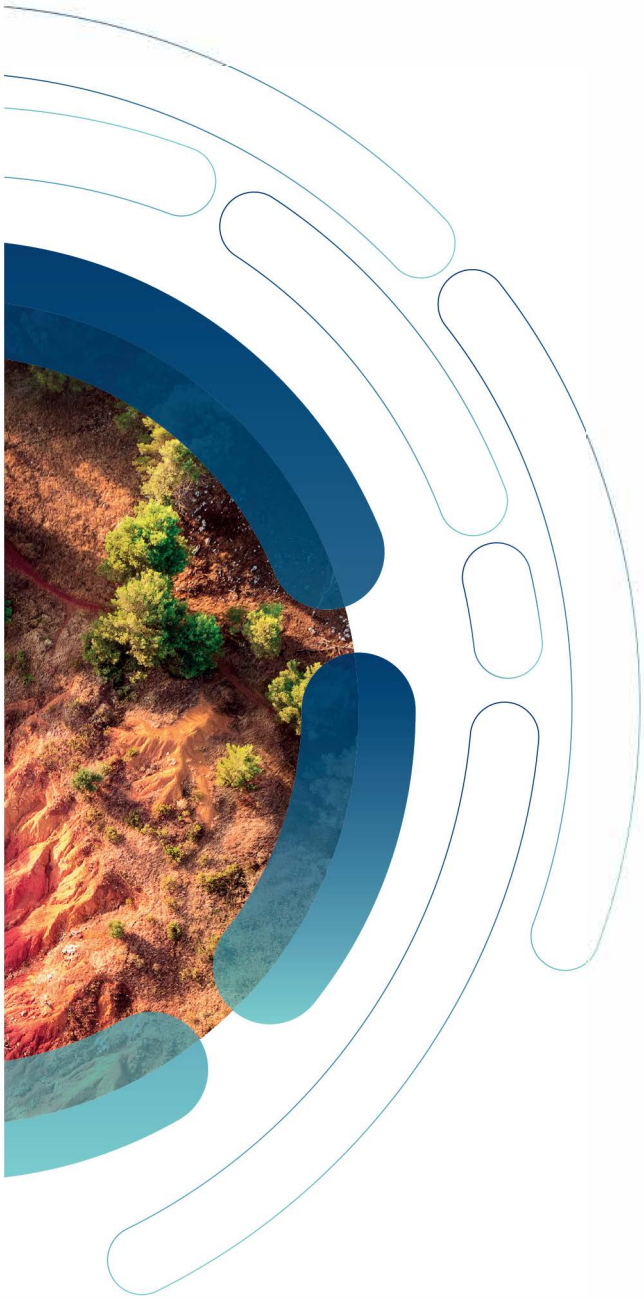
INDION® Autochem for Remote Monitoring, Analysis and Control of Utility Water Management



Our IONSiTE Digital Twin Centre for Real-Time Monitoring, Analysis and Predictive Control of Plant Operations

ieil@ionexchange.co.in +91 22 6231 2000 www.ionexchangeglobal.com

SNF
WATER SCIENCE



YOUR SUSTAINABLE PARTNER

Alumina Specialty Chemicals

Global Leader
in Water-Soluble
Polymer Manufacturing

Complete Range of Solutions
for the Bayer Process

Fully integrated Company
Chemicals, Engineering,
and Services

SNF

Contact Us

SNF (India) PVT. LTD
Plot no.19, Jawaharlal Henru Pharma
City, Parawada, Visakhapatnam
531019, Andhra Pradesh, India
T: +91 891 6198888
info.vizag@snf.com

TOKAI COBEX

UNLEASH YOUR POTENTIAL WITH EVERY BLOCK

Elevate your aluminum production with RuC® Cathodes from experts in the carbon industry.
Choose from our comprehensive range — amorphous, graphitic, and graphitized — supported by expert technical assistance.
For innovative Solutions and sustainable Excellence.

Empowering the future of mining

FLS

Smarter calcination. Lower costs. Greater uptime.

Maximise productivity while keeping costs under control with our Gas Suspension Calciners (GSCs). Designed for the thermal treatment of fine minerals, our GSCs offer superior process control, excellent fuel efficiency, and minimal maintenance requirements. With decades of experience and continuous innovation, we deliver a calcination solution that's built for performance and sustainability – now and into the future.

Key benefits:

- Easy optimisation and automation
- Reduced maintenance downtime
- High thermal efficiency
- Flexible fuel options

Read the full performance study **Gas suspension calciner**

India's First Ever Online Mineral Market Place
Made in India for Global Minerals Trade

www.101minerals.com

The Mineral Market Place revolutionizes the way minerals are Traded by providing 360-degree services for industrial mining including.

1. Marketplace Listings
2. Trade Facilitation
3. Price Discovery
4. Quality Assurance
5. Processing Options
6. Warehousing

Want to know more? Get in touch with us now.

MAG-AL ELECTROMINERALS PVT LTD

email : info@101minerals.com | phone no : +91-7698777708 | www.101minerals.com

Innovative solutions from Nalco Water help to:

- Increase productivity
- Minimize loss
- Improve product quality
- Optimize water use
- Enhance operational efficiency

Backed by more than 50 years of experience and a global network of Alumina & Aluminium industry experts, Nalco Water can tailor a program that fits the complex needs of your operation.

TOGETHER, WE ARE LEADING THE ALUMINA & ALUMINIUM INDUSTRY FORWARD.

Total Water Management

Alumna Processing Aids

Bauxite Handling Aids

Tailings Management

To learn more about how Nalco Water takes on the toughest mining and mineral processing challenges, visit Ecolab.com/Mining


Leading industrial solutions for a safer, smarter, and more efficient Aluminium industry.
Together we are
EPIQ
AD BROCHOT MECFOR EPIQ DTA FAFECO
ADF ENGINEERING EPIQ DIGITAL EPIQ STYMER NOVIMEQ AUTOMATION
Scan to contact our team of experts
www.epiqmachinery.com

Table of Contents

Abstracts 2025

WELCOME NOTE

The Organizing Committee is delighted to extend a warm welcome to all the delegates, speakers, sponsors, and exhibitors to the **13th IBAAS International Conference & Exhibition (IBAAS-IMMT-IIM 2025)** on the theme:

"A Green and Smart Aluminium Industry for Tomorrow"

This prestigious event is being held in **Bhubaneswar, India during October 8–10, 2025, in association with the Institute of Minerals and Materials Technology (CSIR-IMMT) and the Indian Institute of Metals (IIM), Bhubaneswar Chapter.**

We are proud to announce that about 80 abstracts of technical papers have been selected for the presentation, reflecting the strong international interest in this mega aluminium event. The present souvenir compiles all the abstracts under the following categories:

1. Bauxite–Alumina
2. Aluminium Smelting
3. Aluminium Downstream
4. Sustainability, Decarbonization & Aluminium Industry 4.0

In addition to these sessions, **a special session by the Aluminium Stewardship Initiative (ASI)** will highlight responsible sourcing, certification, and sustainability standards for the aluminium value chain. Another key highlight will be the **IBAAS-CETIZION Verifica ESG Awards 2025**, which will recognize and celebrate companies making outstanding contributions in the fields of Environment, Social, and Governance (ESG) practices within the aluminium industry.

This event promises **stimulating technical discussions** and provides a unique platform for **networking and collaboration** with global leaders, experts, and professionals from the bauxite, alumina, and aluminium sectors.

A **special emphasis** this year is placed on **decarbonization efforts and innovative technologies** being developed and implemented to shape a sustainable future for the aluminium industry.

We welcome you to join us in Bhubaneswar for this landmark international event and are confident that your participation will be enriching, insightful, and rewarding.

Best Regards,

ORGANIZING COMMITTEE

IBAAS-IMMT-IIM 2025

Patrons

- MR. SATISH PAI, MANAGING DIRECTOR OF HINDALCO INDUSTRIES LTD, INDIA
- MR. BRIJENDRA PRATAP SINGH, CMD OF NALCO, INDIA
- MR. RAJIV KUMAR, CEO OF VEDANTA ALUMINIUM, INDIA
- DR. RAMANUJ NARAYAN, DIRECTOR OF CSIR-IMMT, INDIA
- MR. BIBHU MISHRA, ADVISOR OF HINDALCO, INDIA
- MR. MARK ANNANDALE, ASI'S DIRECTOR OF RESEARCH AND IPAF, AUSTRALIA
- DR. VILAS TATHAVADKAR, CHIEF TECHNOLOGY OFFICER (ALUMINIUM UPSTREAM AND COPPER) OF HINDALCO INDUSTRIES LTD, INDIA

Advisory Committee

- DR. AMIT CHATTERJEE
- DR. AMIT GUPTA
- MR. GYORGY BANVOLGYI
- MR. SANKAR SANKARANARAYANAN
- DR. KALI SANJAY
- DR. PRABHAS CHANDRA BEURIA
- MR. KAUSIKISARAN MISRA
- MR. SATYANARAYAN DAS
- MR. PRADIP CHOUDHURY
- MR. SENTHIL NATH
- MR. N.N. ROY
- DR. SARADA PRASAD DAS
- DR. BANKIM CHANDRA TRIPATHY
- MR. KIRAN DESHPANDE
- MR. PHILLIP CAMPBELL
- DR. I.N. BHATTACHARYA
- DR. B.P. SINGH
- DR. R. SAKTIVEL
- DR. ANIL CHAUBEY

Organizing Committee

- DR. ARUN NANDI
- DR. M.K. ROY
- MS. PRIYANKA JADHAV
- MR. CHUDCHANDRA SHENDE
- MS. PIYAL SEN GUPTA
- MS. KABITA NANDI

Convener

- DR. ASHOK NANDI

Co-Conveners

- DR. C.K. SARANGI
- DR. ALOK TRIPATHY

IBAAS Profile

International Bauxite, Alumina & Aluminium Society (IBAAS)

The International Bauxite, Alumina & Aluminium Society (IBAAS) is an organization created by industry professionals from India and Asia, dedicated to advancing the global development of the bauxite, alumina, and aluminium sectors. Established in 2012, IBAAS has organized twelve prominent international events, bringing together industry leaders, companies, engineers, and entrepreneurs from India and around the world.

IBAAS International Events

- **IBAAS-2012**: The inaugural symposium, titled "Bauxite, Alumina and Aluminium Industry of Asia – Vision 2020," was held in Nagpur, India, in collaboration with JNARDDC, focusing on non-metallurgical bauxites and alumina products.
- **IBAAS-2013**: The second symposium in Nanning, China, centered on the global status and prospects of the bauxite, alumina, and aluminium industries, with special reference to China, and was organized with CHALIECO and ANTAIKE.
- **IBAAS-2014**: The third symposium in Visakhapatnam, India, examined technological advancements and market developments, particularly for value-added products.
- **IBAAS-2015**: The fourth symposium, hosted in Suzhou, China, was themed "The Development and Future of Aluminium Industry in China - Reality and Dream," organized with CHALIECO and SINR.
- **IBAAS-2016**: The fifth symposium, "Aluminium Industry – The Evolving Asia-Pacific Story," took place in Goa, India, attracting over 200 delegates and was co-organized with The Indian Institute of Metals and key Indian aluminium producers.
- **IBAAS-2017**: The sixth symposium, "Sustainable Development of Bauxite & Alumina Industry in Guinea," was the first such event in Guinea and was praised by participants and the government alike.
- **IBAAS-2018**: The seventh symposium in Mumbai, India, focused on the Indian aluminium industry's strategies and future growth, organized alongside several major industry associations.
- **IBAAS-2019**: The eighth conference in Guiyang, China, explored advances in alumina, aluminium smelting, downstream fabrication, energy conservation, environmental protection, and smart manufacturing, with GAMI's cooperation.
-

- **IBAAS-2020**: The ninth conference was hosted online with JNARDDC, drawing participation from over 400 global aluminium professionals.
- **IBAAS-2022**: The tenth conference in Raipur, India, addressed "Sustainability Challenges of Bauxite, Alumina & Aluminium Industry," in partnership with JNARDDC.
- **IBAAS-2023**: The eleventh conference in Nagpur, India, focused on "Latest Technological Developments in Alumina and Aluminium Production," organized with JNARDDC.
- **IBAAS-2024**: The twelfth conference in Goa, India, entitled "Aluminium Industry Vision 2030," was held in association with IIM and was a resounding success.

Ongoing Activities

IBAAS has consistently generated interest throughout the industry by creating platforms for collaboration and knowledge exchange. In addition to conferences and exhibitions, IBAAS conducts monthly online technical sessions and supports ongoing research and development within the bauxite, alumina, and aluminium industries.

For more information, please visit the IBAAS website http://www.ibaas.info/

Associated Organizations

About IMMT

CSIR-Institute of Minerals and Materials Technology (IMMT), Bhubaneswar, established in 1964 and renamed in 2007, is a premier research institute under CSIR, New Delhi. It focuses on R&D in mineral and material resource engineering, supporting mining, mineral, and metal industries. IMMT empowers Indian industries through advanced, zero-waste technologies and PPP-based consultancy. It is a key partner for mineral-based industries and is advancing in value-added material processing and critical raw material efficiency.

About IMM

The Indian Institute of Metals was formed in 1945 to provide a professional body for metallurgists in India. The Institute has since grown to over 10,000 members. It is recognized as one of the premier metallurgical organizations in the world, with activities including organizing conferences, conducting research, and publishing materials related to metallurgy and allied technologies. The organization was established to undertake key activities in the space of metallurgy in India.

Organizer

Associated Organizations

Gold Sponsors

Silver Sponsors

Supporters

Lunch Sponsor

Lunch Co-Sponsor

Dinner Sponsors

ASHAPURA Group of Industries

SYENSQO ADVANCING HUMANITY

Exhibitors

SNF WATER SCIENCE

WESTECH SWIRE WATER

RIEDHAMMER CARBON BAKING TECHNOLOGY

ALTEK AN ENVIRI COMPANY

ABHITECH

Heraeus Electro-Nite

INDFAB PROJECTS

U3S ENGITECH PRIVATE LIMITED The power of 3

Parker DISTRIBUTOR HYDRAULIC TECHNOLOGY CENTER

ROMCO ALUMINATES PVT. LTD.

ELMECH BBI

Drache

PRECIMETER Molten metal level control

TOMORROW TECHNOLOGY

BRUNO PRESEZZI

skamol

Media Partners

Participating Companies & Organizations

IBAAS-IMMT-IIM 2025

Participating Companies & Organizations

- AKW Apparate + Verfahren GmbH, Germany
- Aluminium Stewardship Initiative (ASI), Australia
- AlCircle, India
- Aluminium International Today (AIT), UK
- ALTEK Europe Ltd, UK
- Abhitech Energycon Limited, India
- ALEMAI – Aluminium Extrusion Manufacturers Association of India
- AlTech Consultant, Tokyo, Japan
- Aditya Birla Science & Technology Company Pvt. Ltd. Taloja, India
- Aditya Aluminium Ltd (A unit of Hindalco Industries Ltd)
- Aditya Aluminium, Lapanga
- ATS Resources S.A.R.L, Guinea
- Allcargo Logistics Ltd, India
- Alumina Chemicals and Castables, India
- Anand Mining Corporation, India
- Ashapura, India
- BALCO, India
- Balpande Industries Private Limited, India
- Bhoruka Extrusions Pvt. Ltd., India
- Bhoruka Fabcons Pvt Ltd., India
- Becquer Energy, India
- Bruno Presezzi, Italy
- CETIZION Verifica Private Limited, India
- CSIR-IMMT, India
- Dharti Industry Pvt. Ltd., India
- Drache, Germany
- Ducon Infratechnologies Ltd.
- Elixir Metals, India
- Epsilon Carbon, India
- Elmech BBI, India
- EPIQ Machinery, Canada
- FIVES Aluminium, France
- FLSmidth Private Limited, India
- Falcon Consultancy Services for Carbon Anode Plants LLP, India
- GEA Group, France
- GEA Process Engineering India Pvt Ltd., India
- Gimpex Pvt Ltd, India
- Gharda Scientific Research and Foundation, India
- Gouda Refractories, Netherlands
- GKC Projects Limited, India
- Haver & Boecker India Pvt. Limited, India
- Heraeus Technologies India Pvt Ltd, India
- Hindalco Industries Ltd., India
- Haver & Boecker India Pvt. Limited, India
- Indian Institute of Metals (IIM), India
- Ion Exchange (India) Ltd.
- Infinit, India
- ISR Infomedia Pvt. Ltd. (Metal Asia)
- IB2, France
- Indian Institute of Technology, Bombay
- Indfab Projects Private Limited, India
- Mendeleev university of Chemical Technology, Russia
- K. G. Services, India
- Lila Global Ltd, UAE
- Mag-Al Electrominerals Pvt Ltd., India
- Mahakoshal Refractories Pvt. Ltd., India
- Minex Metallurgical Co Ltd, India
- Murugappa Group, India
- MCX India
- Metaenterprices Ltd, UK
- Maharashtra Carbon Pvt. Ltd., India
- Malvern Panalytical, a division Spectris Technologies Pvt Ltd, India
- NALCO, India
- Nalco Water India Pvt. Ltd, India
- Naitik Industries, India
- NITK Surathkal, India
- Nirzar Enterprises, India
- Parth Agroworld, India
- Pt Solugen Inovatif Abadi, Singapore
- Proadcat India Limited, India
- Pitamber Impex, India
- PKM Minerals and Resources
- Precimeter Control AB, Sweden
- Panizzolo S.r.l, Italy
- Pioneer Furnaces Pvt. Ltd., India
- q-Maxim LLP, India
- Regen Materials Pvt Ltd, India
- Riedhammer GmbH, Germany
- Refcast Corporation, India
- Romco Aluminate Pvt Ltd, India
- SNF (India) Private Limited
- Shandong Luyun New Materials Co., Ltd., China
- SpectraFlow Analytics AG, Switzerland
- Sahl Regen, Dakar, Senegal
- SEP Salt & Evaporation Plants Ltd.
- SR Steels, India
- Saint Gobain, India
- Simonsen a/s, India
- STAS, US
- Skamol, Denmark
- Shinagawa Refractories India Pvt. Ltd, India
- Syensqo, India
- Tallinn University of Technology, Tallinn, Estonia
- Tokai COBEX GmbH, Germany
- Techmo Car and SPA, Italy
- Tridiagonal.AI Pvt Ltd, India
- Tomorrow Technology S.p.A. – Italy
- Turbovent Industries Pvt Ltd, India
- Transtec Marketing and Consultancy Pvt. Ltd., India
- Utkal Alumina International Ltd., Utkal, India
- Uniseven Engineering & Infrastructure Pvt. Ltd., India
- U3S Engitech Pvt. Ltd., India
- Vedanta Aluminium Ltd., India
- V S A Infra Projects Private Limited, India
- Westech Process Equipment India P. Ltd, India
- Worley, Australia
- Wood Mackenzie, India

Company Profiles

Sponsors

Gold Sponsors

SNF

SNF India Prive Limited, Visakhapatnam is SNF Group company.
Our strategy is to be the leader in developing a complete range of products for the Bayer process.

- We have 35 years of manufacturing experience in India driven by
  - Large, diverse and growing markets
  - Cost effective manufacturing hubs
  - Short delivery time and multiple sourcing for BCP purpose
  - Access to critical Raw Materials
  - Good suppliers base for local Equipment sourcing and plant construction
- 2 complementary plants conveniently located either side of the country
  - Vizag: liquid polymers, capacity 177 KT
  - Gandhidham: dry polymers, capacity 60 KT
  - Head Count: 450

Please visit website www.snf.com for further information.

Romco Aluminate Pvt Ltd

We manufacture high-purity, synthetic White Fused Alumina using premium calcined alumina as feedstock, fused in electric arc furnaces at over 2000°C. The result is a hard, chemically stable, and thermally resistant material ideal for high intensity refractory applications. Our product line spans a wide range of custom crushed sizes, ensuring flexibility for various industrial applications.
At Romco, our business is centered around one core mission: to deliver world-class White Fused Alumina (WFA) solutions under the brand name RomAlux, tailored for applications where performance is non-negotiable. As a proud Indian manufacturer, we bring together global quality standards, cutting-edge

technology, and customer-centric values to serve a diverse spectrum of refractory applications.

Please visit website www.sarvesh.com for more details.

Silver Sponsors

Tokai COBEX – a company of Tokai Carbon Group

We operate worldwide in the development, manufacture and distribution of premium carbon and graphite products providing innovative solutions to our customers. A highly skilled team with years of experience in product development and application assists our customers with their technical knowledge and expertise. Our core competencies include wide-ranging expertise in raw materials, application know-how, and excellent understanding of manufacturing processes in our customers' industries (including primary aluminum, pig iron, silicon metal, and ferro-alloys). Our global service network enables us to respond flexibly to both regional and industry-specific requirements of our customers.

Please visit website https://tokaicobex.com/ for more information.

FLSmidth- FLS

FLS is a leading, full flowsheet minerals processing supplier to the global mining industry. We deliver proven technologies and services across the lifecycle of operations and have set targets of providing solutions for zero-emissions mining by 2030 with our Mission Zero programme.

MissionZero is our sustainability ambition towards zero emissions in mining by 2030. We deliver innovative solutions accelerating our customers towards more sustainable operations – reducing greenhouse gas emissions and energy and water consumption. FLS works with fully validated Science-Based Targets, our commitment to keep global warming below 1.5°C and to becoming carbon neutral in our own operations by 2030.

Please visit website www.fls.com for further details.

Dinner Sponsors

Ashapura

With a legacy of more than 60 years, Ashapura is a leading multi-mineral solutions provider with a global footprint, having a wide network of operations in several states within India and in 7 other countries.

Our captive mineral resources, state-of-the-art manufacturing base, cutting edge research capabilities, logistical prowess and 2,800 dynamic, progressive, result oriented employees accord us global leadership in several segments. Our consistent quality and our ability to customise mineral solutions make us a preferred supplier to multinationals in more than 70 countries across the continents.

Ashapura means “Fulfilling Aspirations”; we believe that sustainable growth occurs only when we fulfill aspirations of all our stakeholders such as customers, employees, shareholders, the environment and the society as a whole.

Please visit website https://www.ashapura.com/ for more details.

Syensqo

As a spinoff from the former Solvay group, Syensqo is a “science-based” company and one of the leading global pure play specialty chemical companies. We are explorers who partner to create breakthroughs that advance humanity. Syensqo Mining Solutions leverage more than 100 years of experience in mining chemistry, global supply chain and teams of professionals to develop unique reagent-based solutions that enable customers to increase productivity, reduce costs and improve sustainability. The business serves a diverse range of global mining markets, including alumina, copper, phosphates and more.

Please visit website https://www.syensqo.com/en/ for more details.

Lunch Sponsor

FIVES

Under its legacy names, ECL and Solios, Fives specializes in the design and supply of key process equipment and the management of complete installations for the primary aluminium industry.

Fives has been developing Industry 4.0 solutions for the metal industry for more than a decade and is today able to offer a wide range of digital tools such as: Amelios Suite - the Carbon Digital Chain, Smart GTC and SMART Crane, to help aluminium producers to improve the performance of their existing facilities.

Thanks to its local service subsidiaries worldwide, Fives is committed to accompany its customers during the lifetime of their installations.

Please visit website www.fivesgroup.com for more information.

Supporters

Nalco Water

Nalco water, an Ecolab company, is a global leader for industrial water & process management.

With a presence at more than 100,000 customer sites in more than 40 different type of industries across the globe, we leverage connected chemistry, digital innovation and expertise to address industrial water treatment & complex process problems. Our experts work with customers worldwide to help and meet their sustainability and business goals such as ensuring operational efficiency, safety, product quality etc. We partner with customers to make world cleaner, safer & healthier while protecting people and resources vital to life.

Please visit website https://en-in.ecolab.com/nalco-water for more details.

EPIQ Machinery

EPIQ Machinery transforms heavy industrial material handling with intelligent, end-to-end Industry 4.0 solutions—seamlessly integrating automation, robotics, and digitalization. Merging the strengths of a technology innovator and a heavy

machinery manufacturer, we deliver tailored, scalable systems. Our client-centric approach ensures customized solutions backed by strong aftermarket support for lasting performance. EPIQ's expertise spans mobile and fixed equipment, AGVs/AMRs, process systems, and smart automation. We also offer strategic analysis and recommendations for equipment upgrades, retrofits, and

technology integration—empowering complex industrial operations to achieve greater efficiency, reliability, and innovation.
Please visit website https://epiqmachinery.com/ for details.

Exhibitors

WesTech

WesTech Process Equipment India Pvt. Ltd. (WPEIPL), established in 2010, is a leading provider of process solutions with expertise in liquid-solid separation (LSS) for mineral beneficiation, alumina red mud CCD washing circuits, thickened tailings disposal, pulp production, water & wastewater treatment and many other applications. In collaboration with WesTech Engineering (USA) and Gaudfrin (France), WPEIPL offers world-class technologies including Settler/Washers (DeepBed™ Paste Thickeners), HiDensity™ Thickeners, Disc Filters, Pan Filters, Diastar Filters and Lime Slaking plants for the Alumina Refineries. With a proven track record across smelter-grade and specialty alumina markets, WPEIPL has delivered projects for Gujarat Credo Alumina Chemicals, NALCO, Pioneer Aluminium, Vedanta, Hindalco, Utkal Alumina, and Maa Kudargarhi Minerals, driving sustainable, efficient, and innovative industrial solutions globally. Since 2024, WPEIPL has been appointed as Authorised Distributors for PLA *SmartDivers*™ by Precision Light and Air Pty. Ltd. Australia. The PLA *SmartDivers*™ is an essential instrument for the proper operation of Settlers/Washers.

Please visit website https://www.westechwater.com/ for details.

ALTEK Europe Ltd

ALTEK is a technology-based company with specialist expertise in the design, manufacture and installation of aluminium dross and scrap processing systems. We pride ourselves on supplying market-leading equipment to maximise aluminium recoveries and optimise cast houses through our Electromagnetic Stirrer (EMS), Dross Press and Tilt Rotary Furnace (TRF) technologies. We are the only partner than can provide zero waste, 'End-to-End Dross Management', utilising our AluSalt™ salt slag recycling system to recover aluminium, salts and conversion of NMP into high value-added products, and RAME™, a new and novel high aluminium recovery, zero-waste primary smelter dross recycling technology and process.

Please visit website https://www.altek-al.com/ for details.

Heraeus Technologies India Pvt Ltd

Heraeus Electro-Nite has led the market in molten metal measurement tech since the 1950s. We supply integrated systems to steel, iron, aluminum, and copper producers, including sensors, instruments, and associated hardware. including those for temperature, oxygen, hydrogen, and carbon. Continuous temperature measurement systems for Ferrous and Non- Ferrous melts.

Heraeus Electro-Nite also provides wide range of measurements for Aluminum melt also like Bath Temperature, Superheat, XsALf3 and pot Chemistry within seconds at the Shop floor itself. Customers trust our top-notch products and services. Our continuous research and development keep us ahead in measurement technology, helping customers achieve peak quality and efficiency.

Please visit website https://www.heraeus-group.com/en/ for more information.

Riedhammer GmbH

RIEDHAMMER GmbH (RH) is the leading technology supplier of industrial kilns and delivers innovative technologies for various industries. For the Carbon Industry, RH only offers complete solutions and its proven furnace technologies for baking anodes, cathodes, electrodes, and special carbon products. Today, Riedhammer gives you the perfect answer for rebuilding and modernization demands, up to turn-key plants based on the most advanced technology. We combine as best your needs with our 100 years of experience, innovative technology and know-how.

Please visit website https://www.riedhammer.de/ for details.

Abhitech Energycon Limited

Abhitech Energycon Limited is a prominent manufacturer specializing in conservation of both solid and liquid fuels. Established in 1997, Abhitech is providing innovative technologies that focus on reducing operational costs, promoting energy conservation and facilitating pollution control. All our products are based on the technology developed in collaboration with the prestigious Indian Institute of Technology (IIT - Bombay).

Our company holds the ISO 9001:2015 certification, ensuring that our operations meet internationally recognized standards.

Abhitech leverages its existing knowledge of solid and fuel additives, alongwith continuous new product development supported by an in-house laboratory to emerge as a market leader in performance improvement additives.

Please visit website https://www.abhitechenergycon.com/ for details.

Indfab Projects Private Limited

We are a leading organization for Project & Maintenance specialising in Aluminium Smelters both in the Greenfield as well as Brownfield. Our expertise spans across fabrication/ erection/commissioning of Potline equipment's like Pot Shell/Pot Super Structure/Aluminium Busbars and Pot Tending Machine, Carbon plant equipment's like Rodding Shop, Anode Handling System, Furnace Tending Assembly; Cast House equipment's like complete Casting Line, Melting Furnace and Holding Furnace and Plant Utilities like complete Compressor House and Pipeline system, Aluminium Foil Rolling Plant equipment's Like Utility cranes, piping, BOP Equipment's, ASRS, Rolling Ingot Casting Machine, Pusher & Soaking pit furnaces

Please visit website https://www.indfab.in/ for details.

U3S Engitech Private Limited

Tagline: Comprehensive Solutions in Motion Control Technologies combining Hydraulics, Pneumatics & Electromechanical Systems.

Please visit website https://www.u3sengitech.com/ for details.

Elmech BBI, India

Elmech represents overseas companies in India from all over the globe, who supply their technology & services, machineries & equipment, spares &

consumables to primary & secondary aluminium plants that include Smelters, Secondary remelt plants, Flat rolled products plant and Extrusion plants.

Please visit website https://elmechindia.net/ for more information.

Drache, Germany

Drache Umwelttechnik GmbH is supplying innovative and sustainable products and equipment in cast house technology - like filter boxes, launder segments, ceramic foam filters, boron nitride, precast ceramic shapes, casting spouts and stoppers, thimbles and T-plates etc.

Please visit website https://www.drache-gmbh.de/en/ for details.

T. T. Tomorrow Technology, Italy

T.T.Tomorrow Technology S.p.A. designs and manufactures special vehicles and automatic equipment for Primary and Secondary Aluminium Industry like multifunctional tending vehicles, metal tapping and transfer vehicles, coil transport vehicles, rail mounted charging vehicles. TT Tomorrow Technology is the leading solution provider & Manufacturer of anodes slot cutting machine.

Please visit website https://tomorrowtechnology.com/ for more information.

Precimeter, Sweden

Precimeter is a premium supplier of molten metal control sensors. It specializes in solutions for molten metal level, transfer and flow control & Providing solutions for all metals and alloys. Their major products are metal level sensors, Flow control by actuator system & Control systems. Precimeter is a leading solution provider in Handsfree casting solutions.

Please visit website https://www.precimeter.com/ for details.

Bruno Presezzi, Italy

Bruno Presezzi S.p.A is a leader in design and construction of complete continuous casting lines to produce aluminium strip and moreover to the cores and shells used in the specific field. They also provide graphite-based parting solutions and coating also.

Please visit website https://brunopresezzi.com/en/ for details.

Skamol, Denmark

SKAMOL is a global supplier of insulation system approved by all leading smelting Technology like GAMI, RTA, DX, HYDRO etc. They supply Moler & diatomaceous earth bricks, calcium silicate boards, vermiculate boards etc.

Please visit website https://www.skamol.com/ for more information.

Gouda Refractories, Netherlands

Gouda Refractories provides technical support and solutions, and their bricks are used in anode baking furnaces, transfer ladles, melting and holding furnaces etc. Other products supplied by them are precast shapes and castable.

Please visit website https://goudarefractories.com/ for details.

Ducon Infratechnologies Ltd.

Ducon Technologies Inc. is a leading technology company engaged in the engineering, supply, and erection of turn-key projects in the environmental control, emission monitoring, decarbonization, Green Hydrogen, material handling like alumina handling, pneumatic conveying, ash handing systems, infrastructure and plant maintenance. Ducon provides services to clients globally in a wide variety of industries, such as chemical, refineries, cement, power, steel, mining and infrastructure.

Please visit website https://duconinfra.co.in/ for details.

STAS, Canada

STAS Inc. is involved in process equipment for the global aluminium industry for 35 years. Various equipment being manufactured by STAS are covering various areas and functions of aluminium industry like cast house applications,

metal treatment processes, molten metal handling technologies, aluminium solidification, smelter technology, etc.

Please visit website https://www.stas.com/ for more information.

Panizzolo, Italy

Panizzolo recycling provides competitive cutting-edge metal waste recovery and processing solutions designed to maximize the return on customer's investment. Panizzolo provides turnkey recycling solutions for various materials like copper, fluff, cables, inerts, aluminium caps, other mixed wastes and ferrous as well as non-ferrous scraps.

Please visit website https://www.panizzolo.com/en/ for more information.

IBAAS-IMMT-IIM 2025

BAUXITE-ALUMINA

Application of NIR Mineral Phase Analysis in Bauxite Ore in the Example of Chalco

P. Mühlen
CEO, SpectraFlow Analytics AG, Switzerland
Author Email: petra.muehlen@spectraflow-analytics.com

ABSTRACT

This technical paper examines the theory behind near infra-red (NIR) real time analysis for use in the minerals industry and the practical application of an online chemical analyzer for bauxite and coal analysis in the aluminium industry, focusing on improving process control in digestion and optimizing alumina recovery.

Traditional lab-based analysis methods are often not correctly representing the chemistry of the bulk material fed to the process as sampling techniques cannot keep up with the mass of material. Further, the time delay till the samples is analyzed prevents a proactive process control. Hence, a real time analysis, which scans the entire bulk of bauxite or coal going to the process will allow for real time process control, especially as NIR technology will measure mineral phase composition as well as organics and moisture contents.

As part of the paper, our installations Chalco are showcased, and online analysis is compared with the lab results. In addition, an outlook to the process control is given.

Keywords: Near Infra-Red (NIR) Analysis, Real-Time Mineral Analysis, Alumina Recovery.

Enhancing Wet Bauxite Handling Without Compromising the Bayer Process

Aurélien Bonneau[1]*, M.V. Jagannath[2], Manish Kumar Mishra[3], Oguzhan Yildrim[4], and Andre Azevedo[5]
[1]Mining R&D Manager, SNF SA, Andrézieux-Bouthéon, France
[2]Alumina Sales Director, SNF India Pvt. Ltd, Visakhapatnam, India
[3]Technical Alumina Manager, SNF India Pvt. Ltd, Visakhapatnam, India
[4]Dry Processing Application Specialist, SNF SA, Andrézieux-Bouthéon, France
[5]Global Technical Alumina Director, SNF Holding Company, Riceboro, USA
**Corresponding Author Email: abonneau@snf.com*

ABSTRACT

The handling of wet bauxite presents significant operational challenges, including material adhesion, flow difficulties, and equipment clogging. These issues can lead to increased maintenance costs, reduced processing efficiency, and unplanned downtime, negatively impacting overall plant performance. To address these challenges, the use of a handling aid agent can enhance material flow, minimize blockages, and reduce operational interruptions. However, its application must be carefully assessed to ensure

no adverse effects on the Bayer process, particularly during the critical solid/liquid separation phase, where the liquor is separated from the red mud.

An ideal handling aid should improve bauxite transport efficiency while maintaining process integrity throughout all subsequent stages. Factors such as flowability enhancement, moisture control, and chemical compatibility with Bayer digestion conditions must be considered. Thus, SNF has developed a novel range of additives specifically designed to optimize wet bauxite manipulation while preserving process stability. Experimental results demonstrate that the selected agent significantly enhances handling efficiency without affecting grinding process. These findings suggest a viable industrial solution that not only mitigates handling challenges but also ensures long-term operational reliability and Bayer process performance.

Keywords: Wet Bauxite, Clogging, Flowability, Handling Aid.

Overcome the Challenges of Usage of Low-Grade Bauxite with Higher Organic to Produce Speciality Alumina/Hydrate

Abhijeet Bandi[1], Kaushal Gupta[2]*, Rama Nahak[3], Purva Nandha[4], and Kanwarpreet Singh[5]

[1]Unit Head, [2]Head Technical, [3]Head Operation, [4]Area Head Technical, and [5]Area Head Technical,

Hindalco Industries Limited Belagavi, India

**Corresponding Author Email: kaushalkishore.gupta@adityabirla.com*

ABSTRACT

Bauxite is a critical raw material for alumina refineries to produce alumina/hydrate through a consistent and controlled process. The Belagavi Alumina Refinery, renowned globally for its specialty alumina hydrate production, was originally designed to process high-grade bauxite with a Total Available Alumina (THA) content of 40% and K Silica content of 3%, sourced from captive mines. Following the depletion of these mines, the refinery transitioned to using purchased bauxite, incorporating a blend of 20-30% low-quality bauxite to maintain a minimum feedstock quality of 37-38% THA. Considering the current global challenges in bauxite availability, the Belagavi refinery has increased the proportion of low-grade bauxite (THA 34%, K Silica 4.5%) in its feedstock where quality itself is huge variation within a source and containing higher organic content in some sources which was additional load to design limitation of oxalate destruction unit. This shift in bauxite feed source has introduced significant increase of Total Organic Carbon 9 (TOC) in liquor by around 22% from its normal level.

The increased organic loading manifested in higher liquor viscosity, hindered crystal growth, and deterioration in product brightness, whiteness, and soda content. This escalation adversely impacted key downstream operations, particularly hydrate precipitation, and final product quality—parameters that are vital to produce special-grade alumina/hydrate. Higher organic content adversely impacts over precipitation yields and impacts the physical appearance of alumina hydrate in terms of brightness.

To mitigate these challenges, extensive trials were conducted at both laboratory and plant scale, employing various chemical additives to enhance process efficiency.

The results of the intervention were encouraging. The organic removal aid effectively reduced liquor viscosity, stabilized precipitation behaviour, and enhanced product quality metrics. Additionally, a noticeable reduction in scaling frequency was observed, contributing to enhanced equipment performance and reduced downtime. These outcomes demonstrated the additive's potential to mitigate the adverse effects of organic accumulation arising from low-grade bauxite processing.

Through these rigorous efforts, the Belagavi refinery is adapting for use of 100% low-grade bauxite, meeting the demand for specialty alumina without compromising product quality. In conclusion, the trial underscores the importance of adaptive process chemistry in maintaining operational efficiency and product quality in the face of fluctuating key raw material characteristics.

This paper details the innovative methodologies and process optimizations developed to enable the effective utilization of low-grade bauxite, ensuring the refinery's operational sustainability and efficiency without compromising end product quality.

Keywords: TOC, THA, Speciality Alumina/Hydrate, Low Grade Bauxite.

De-Ironing of Bauxite Ore Via Chlorination

Sachin Arya* and Biswajit Basu
Gharda Scientific Research and Foundation
Gharda House, 48, Hill Road, Bandra (West), Mumbai-400050, India
**Corresponding Author Email: sachin.arya@gharda.com*

ABSTRACT

Calcined bauxite, a critical raw material for the refractories and abrasives markets, is traditionally manufactured from high alumina, low iron bauxite. However, the depletion of high-quality bauxite reserves in India has necessitated the adoption of beneficiation processes to reduce iron and titanium content. Conventional de-ironing methods, such as HCl acid leaching, present significant environmental challenges and economic concerns due to substantial raw material loss.

The Gharda Scientific Research Foundation (GSRF) has developed a novel, sustainable, and economically viable selective chlorination process for de-ironing bauxite ore. This process involves single-step bauxite carbo-chlorination in a fluidized bed reactor, utilizing calcined petroleum coke as a reductant. Laboratory and kilogram-scale experiments demonstrated a conversion efficiency of 93-94% for Fe_2O_3 to $FeCl_3$, over 50% for TiO_2 to $TiCl_4$, and below 10% for Al_2O_3 to $AlCl_3$. The recovery of saleable by-products, $FeCl_3$ and $AlCl_3$, further enhances the economic attractiveness of this method. This paper presents the development and experimental validation of the GSRF process, highlighting its potential to address the current challenges in bauxite beneficiation for non-metallurgical application.

Keywords: Chlorination, Fluidization, De-Ironing, Refractory Grade Bauxite.

Reducing Digestion Steam Consumption with KX Heat Exchangers from Low-Grade Heat from Calcination Stack-Gas

R. Clegg[1]*, F. Delannoy[2] and A. Furlong[3]
[1]Director of Projects, Sahl Regen, Dakar, Senegal
[2]Head of Sales, GEA Kestner, Montigny-le-Bretonneux, France
[3]Technical Director Bauxite & Alumina, Worley, Brisbane, Australia
Corresponding Author Email: Rob.Clegg@SahlRegen.com

ABSTRACT

The aluminium industry faces a dual challenge: maintaining long-term competitiveness while aligning with the global imperative to achieve Net Zero emissions by 2050. In this context, Sahl Regen, with the support of Worley and GEA Kestner, presents a novel approach to reducing energy consumption and carbon emissions in alumina production.

It has been proposed elsewhere that Calcination waste vapour can be captured, cleaned, recompressed via mechanical vapour recompression, and recycled to Digestion as useful steam. This would significantly reduce the net steam consumption of the digestion process. This paper explores a potential alternate approach to calcination stack gas waste heat recovery, applying KX Heat Exchanger technology to instead recover calciner low-grade heat indirectly into the digestion feed liquor or bauxite slurry. This approach of including indirect heat exchange lowers technical risk from compressing dirty calciner vapour with particulates in high-speed machines.

To evaluate the effectiveness and implications of recovering calcination heat into spent liquor or bauxite slurry, a SysCAD process simulation was undertaken to compare the performance of KX heat exchangers integrated into digestion against a conventional flash tank heat recovery digestion circuit.

KX heat exchange is an innovative technology solution that draws on established industrial experience and equipment, thus providing a practical pathway to decarbonising industrial operations while maintaining global competitiveness in the alumina supply chain. By integrating advanced heat recovery systems, this solution can significantly reduce refinery net energy and water consumption as well as greenhouse gas emissions. The paper provides technical insights and broader implications for the future of sustainable alumina production.

Keywords: Digestion, Recompression, Calcination, Liquor, Heat Exchange.

Performance Evaluation of Dewatering Aid (DEWA – 369)

Chinmay Pathak[1], Jagdish Sutar[2], Amol Mankar[3], and A.V. Bushan[4]
[1]Manager R&D Innovation, [2]Sr. Manager, R&D Innovation, [4]Director, R&D Innovation,
Abhitech Energycon Ltd, Mumbai
[3]HOD, Alumina Department,
Jawaharlal Nehru Aluminium Research Design & Development Centre (JNARDDC),
Nagpur
Corresponding Author Email: anwar.haque@abhitechmail.com

ABSTRACT

Alumina refineries employ slurry filtration, which is the important unit operation used for the separation of solid alumina hydrate from the liquor. In the present study, alumina slurry filtration was investigated using a novel dewatering aid developed by Abhitech Energycon Ltd. (AEL). This innovative dewatering aid, DEWA-369, enhances hydrate slurry filtration in the alumina industry. To evaluate its effectiveness, laboratory scale trials were conducted at the Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), using an industrial hydrate slurry sample provided by AEL. Filtration and hot water washing tests were performed under simulated drum filter washing conditions, and the results were analyzed for moisture content and soda reduction.

The trials demonstrated that DEWA-369 significantly improved filtration efficiency, achieving a 29% reduction in moisture content as compared to that of the blank sample. The optimized dosage was found to be in the range of 75 – 100 grams per tonne (GPT). Additionally, it contributed to a 13% reduction in soda content, enhancing product quality.

These findings highlight DEWA-369's potential as an effective solution for improving hydrate slurry filtration, reducing processing costs, and enhancing sustainability in alumina production.

Keywords: Alumina processing, Dewatering, Filtration, Filter aid, Alumina Slurry.

Effect of Temperature on Bauxite Dissolution and Silica Precipitation for East Coast Bauxite

Paul Gupta[1]*, Santunu Pathy[2], and Hari Gandham[3]
[1]Head – Technical, [2]AGM – Operations, and [3]Head – Laboratories
HINDALCO - UAIL Refinery, Doraguda, India
Corresponding Author Email: paul.gupta@adityabirla.com

ABSTRACT

The impact of temperature on the dissolution of bauxite and the precipitation of silica is a critical factor in optimizing the extraction process of alumina from bauxite ores. This study specifically examines the effects of temperature on these processes for East Coast bauxite, a significant source of bauxite in certain regions. Bauxite processing,

particularly through the Bayer process, involves the dissolution of bauxite in a sodium hydroxide solution. The dissolution kinetics of bauxite and the precipitation behaviour of silica can be influenced by various parameters, with temperature being one of the most crucial factors that governs both the rate and efficiency of these processes.

In this study, laboratory experiments were conducted to investigate the dissolution rates of East Coast bauxite under varying temperature conditions. The bauxite samples, rich in alumina and silica, were treated with a sodium hydroxide solution at temperatures ranging from 100° to 160°C. The experiments focused on understanding the temperature-dependent dissolution of bauxite, the solubility of alumina, and the subsequent precipitation of silica. Key variables, such as time, pH, and concentration of sodium hydroxide, were carefully controlled to isolate the temperature effect.

The results of the dissolution experiments demonstrated a clear positive correlation between temperature and the dissolution rate of bauxite. As the temperature increased, the rate of alumina dissolution accelerated, leading to higher yields of alumina. However, a significant observation was that temperature also influenced the behaviour of silica, a key impurity in the process. Silica precipitation was observed to increase with temperature, but the morphology and particle size of the silica varied with changes in temperature. Higher temperatures not only enhanced the rate of silica precipitation but also affected its form, leading to the formation of larger, more amorphous silica particles, which could complicate downstream separation processes. The precipitation of silica at higher temperatures also led to increased losses of alumina due to silica contamination, affecting the overall efficiency of the alumina extraction.

Furthermore, the study explored the optimal temperature range for minimizing silica precipitation while maximizing alumina dissolution. The results indicated that there is an optimal temperature window where bauxite dissolution is efficient, but silica precipitation is minimized, ensuring a higher alumina yield and lower impurity levels. Beyond this optimal range, excessive silica precipitation reduced the purity of the alumina, thereby diminishing the economic efficiency of the process.

This research provides valuable insights into the role of temperature in enhancing the dissolution of bauxite and controlling silica precipitation during the Bayer process for East Coast bauxite. The findings underscore the importance of temperature control in optimizing processing conditions to achieve better alumina recovery while minimizing impurities. The study also contributes to the broader understanding of how temperature can be strategically managed in industrial-scale bauxite refining operations, with implications for improving the sustainability and cost-effectiveness of alumina production from East Coast bauxite ores.

Keywords: East Coast bauxite, Bayer process, Alumina extraction, Bauxite dissolution, Silica precipitation, Temperature effect

Modern Efficient Alumina Refinery Digestion Design

Brad Hogan[1], David Brodie[2], Benyan Pei[1]*, and David Rubinstein[3]

[1]Senior Principal Process Engineer and [2]Principal Process Engineer
Worley, Brisbane, Australia
[3]Associate Consulting Engineer,
Worley, Melbourne, Australia
Corresponding Author Email: benyan.pei@worley.com

ABSTRACT

Safety, operability, high availability and stability, optimum alumina recovery, capital and energy efficiency are key features in any alumina refinery's digestion design. Digestion is a critical part of the Bayer process and must be designed to consider current or future production rate plans.

Worley was recently challenged by the owner of a partially constructed but stalled alumina plant expansion to redesign the digestion plant and to deliver an improved refinery-wide design that would set industry benchmark performance and product quality metrics with significantly improved safety, availability, operability and maintainability, energy efficiency, and capital efficiency. The improved digestion design includes a modified flash vessel bottom feed arrangement with specifically designed internals, targeted changes in valve, equipment, and pressure relief arrangements, as well as redesign of slurry heaters to reduce erosion and blockages.

The result of the design changes will increase heat recovery and a 40% increase in throughput to the original design from the existing design, as well as a step change in availability, reliability, stability, and safety. The improved heat recovery will contribute to reduction in overall energy consumption and carbon emission in the refinery.

Keywords: Waste Heat Minimization, Availability and Operability, Digestion throughput, Safety, and Flash Vessel Internals.

Evaluation of Nalco Water's New Washer RRA Flocculant in Indian Alumina Refinery to Improve Operational Efficiency

Chandan Kishore[1], Debabrata Mahanta[2], Shounak Banerjee[3]*, and Prasenjit Nath[4]

[1]Assistant General Manager and [2]Assistant Manager,
Utkal Alumina International, Tikiri, India
[3]Sr. Marketing Manager and [4]Account Manager,
Nalco Water, Kolkata, India
Corresponding Author Email: sbanerjee1@ecolab.com

ABSTRACT

This study outlines the strategic transition from long-standing polyacrylamide flocculant 85144 to Nalco 85295RRA in the refinery tail washer circuit of a 2.47 MTPA

alumina plant, driven by the dual challenges of production expansion and anticipated deterioration in bauxite quality. Historically, flocculant 85144 had delivered stable performance; however, with increased throughput targets and evolving ore characteristics—particularly a potential drop in tri-hydrate alumina content and higher mud loads—the need for a more efficient and robust solution became critical. In collaboration with the refinery, Nalco Water developed and proposed the use of 85295RRA, a next-generation flocculant engineered to deliver superior underflow solids concentration, improved soda recovery, and reduced chemical consumption.

Extensive laboratory tests, simulating varied plant conditions, confirmed enhanced solid-liquid separation and compaction with the new flocculant. A subsequent 20 MT plant-scale trial validated these findings, achieving a 2.5% increase in underflow solids concentration, a 25% reduction in flocculant dosage, and a 25% decrease in water usage—translating into annual savings of approximately $241K and an additional mud throughput of 10,560 MT. Importantly, the transition did not impact rake torque or mud rheology, ensuring operational stability.

This work offers a compelling case for process optimization in alumina refineries, demonstrating how tailored chemistry can support higher productivity, lower operating costs, and greater resilience to raw material variability—paving the way for sustainable long-term performance.

Keywords: Robust, Recovery, Compaction, Consumption, Mud rheology, Operational cost.

Feasibility Studies for Oxalate Removal System at Renukoot Refinery

Sagar Pandit[1], Pooja R. Kumarnaik[2]*, Rajanikant Jadhav[3] and Shweta Mishra[4]
[1]General Manager, [2]Assistant Manager, and [3]Senior Engineer,
Hindalco Industries, Belagavi, India
[4]Assistant Manager, Hindalco Industries, Renukoot, India
**Corresponding Author Email: pooja.kumarnaik@adityabirla.com*

ABSTRACT

Hindalco is the one of the leading manufacturers of value-added products and Super value-added product for non-metallurgical grade alumina in the world. Furthermore, in the year 2019-20, the plant was converted to produce 100% integrated speciality alumina. The quality of product in Bayer process is of paramount importance in the alumina manufacturing business.

One of the major requirements of precipitation circuit at Bayer plant is to control impurities during the process of Alumina hydrate precipitation. Impurities like Na_2SO_4, P_2O_5, NaCl, $Na_2C_2O_4$ and other organics tend to build up in the Bayer liquor over the period. Among these, Sodium Oxalate ($Na_2C_2O_4$) is formed in the Bayer liquor majorly due to the degradation of organic carbon, that is entered into the system through bauxite, or additives used in the process. When this $Na_2C_2O_4$ concentration exceeds the critical concentration limit, it starts precipitating along with the product hydrate and thereby hampering the quality (granulometry and impurities). Hence, it is essential to control the concentration level below its limit to avoid co-precipitation.

Renukoot refinery in recent period observed an increasing trend in oxalate and therefore, it was the need of the hour to develop a suitable process to control level of oxalate in Bayer liquor. In the first step, the test was conducted to understand the Critical Oxalate Concentration (COC) level in Bayer liquor. Further, three different streams were analyzed to understand the best feasible liquor to be used a feed to the removal system. A series of experiments were designed (DOE) and performed with varying process conditions to arrive at the best condition to achieve highest oxalate productivity and accordingly design the oxalate removal system at Renukoot refinery.

Oxalate precipitation test showed that oxalate precipitates adequately with a good productivity of 2.2 g/l and 91.7% purity at the temperature of 50°C, residence time of 3 hrs., and seeding at 20 gpl.

Experiments were conducted with varying temperatures and residence times. From the series of DOE's conducted, the above conditions were optimized for the process where oxalate removal was observed higher.

This study aims to provide all the required inputs based on the lab scale fundamental experiments to take up the proposal for setting up the oxalate removal system for Renukoot.

Keywords: Sodium oxalate, Oxalate precipitation, Critical oxalate concentration, Design of experiments.

Optimizing Energy Efficiency in Gas Suspension Calciners through Refractory Enhancements and CFD Analysis

Rajesh Khuntia[1]*, Sweta Sipra[1], Khushboo Tandan[1], Uttam Giri[1], Sapan Mohapatra[1], Swapnil Ghatage[2], and Chandrakala Kari[2]
[1]Utkal Alumina International Ltd., Utkal, India
[2]Aditya Birla Science & Technology Company Pvt. Ltd. Taloja, India
Corresponding Author Email: rajesh.khuntia@adityabirla.com

ABSTRACT

In alumina refineries, calcination plays a pivotal role in converting alumina hydrate into calcined alumina, significantly influencing both product quality and energy consumption. The Gas Suspension Calciner (GSC) is a key unit in this process, accounting for approximately 30–35% of the total energy consumption in a refinery. The primary heat sources to Calciner are heavy furnace oil (HFO) or natural gas (NG), which contribute substantially to the refinery's fuel demand. Consequently, optimizing calciner efficiency is crucial for reducing energy consumption and promoting sustainability.

This study presents design modifications implemented in the Utkal GSC, where a third layer was added to the refractory design, and the thickness was optimized with high-grade refractory material. This novel approach effectively increased the overall refractory thickness, enhancing insulation and reducing heat losses. The impact of these modifications was evaluated through temperature profile analysis, heat loss calculations, and fuel savings estimation. These changes resulted in a reduction in specific energy consumption (SEC) by 0.30–0.40 kg/T, as well as a decrease in furnace temperature,

which ensured stable product quality and a 5-6°C increase in HV03 (Holding vessel) temperature.

However, increasing the refractory thickness reduced the effective volume of the vessel, potentially altering thermal and velocity profiles and affecting process performance. To assess these effects, a Computational Fluid Dynamics (CFD) study was conducted to analyse temperature gradients and flow dynamics. The CFD results validated the feasibility of the design changes, confirming that there are no major effects on operational efficiency, product residence time and hence quality.

This study demonstrates that systematic design modifications and validation can significantly enhance calcination efficiency, reduce energy consumption, and improve equipment longevity. The findings provide a framework for future optimization efforts, supporting energy conservation and sustainability goals in alumina refineries.

Keywords: ***Gas Suspension Calciner (GSC), Refractory Modification, Energy Optimization, Computational Fluid Dynamics (CFD), and Thermal Efficiency.***

Optimization of Sodium Oxalate Removal Using Alternate Bayer Liquors in Low-Temperature Digestion

Rajanikant Jadhav[1]*, Kanwarpreet Singh[2], Purvi Ladha[3], Chimmani Srividya[4], and Kaushal Gupta[5]

[1]Senior Engineer – HIC – Alumina,
[2]Assistant Manager – Common Technical Cell,
[3]Assistant Manager – HIC – Alumina,
[4]Assistant Manager – Alumina Operation,
[5]Assistant General manager – Common Technical Cell
Hindalco Innovation Centre – Alumina, Hindalco Industries Limited, Belagavi, India
Corresponding Author Email: rajanikant.jadhav@adityabirla.com

ABSTRACT

Low-temperature Bayer digestion refineries often encounter operational challenges due to the accumulation of sodium oxalate in process liquor. This impurity, originating from the degradation of organics present in bauxite and process additives, tends to co-precipitate with product hydrate when its concentration exceeds critical limits, thereby impacting product quality and reducing process efficiency. The conventional approach to oxalate removal involves seeded precipitation using spent liquor under controlled conditions.

To enhance oxalate removal efficiency while maintaining liquor quality, a study was undertaken to investigate the feasibility of using alternate Bayer liquors—such as thick liquor and its blends with spent liquor—for sodium oxalate precipitation. Laboratory-scale experiments were conducted under simulated plant conditions to evaluate the effect of different liquor types and seed dosages on precipitation performance.

The results demonstrated that blending thick liquor with spent liquor improved oxalate precipitation efficiency, with a specific blend ratio yielding the most favourable outcome.

The study also emphasized the significance of liquor composition and seed concentration in influencing overall oxalate removal productivity.

These findings indicate that strategic utilization of alternate liquors offers a viable approach to optimizing sodium oxalate removal in the Bayer process, contributing to improved process control, hydrate quality, and refinery performance.

Keywords: Liquor blending, Sodium oxalate, Seeded precipitation, Low-Temperature digestion.

Enhancing Chemical Extraction and Overall Alumina Recovery Through Process Optimization at Hindalco Muri Alumina Refinery

Anuj Kumar Verma[1], Ravi Kiran Das[2], Rajeev Ranjan[3], Chandra Mani[4], and Rajeev Kumar[4]
[1]AGM, Red Area - Operations
[2]Dy Manager, R&D - Quality
[3]Dy Manager, Red Area - Operations
[4]Manager, Red Area – Operations
[1]*Corresponding Author Email: anuj.verma@adityabirla.com*

ABSTRACT

The Bayer process remains the cornerstone of alumina production from bauxite, relying on the selective solubility of alumina in caustic soda under temperature and pressure, followed by precipitation and calcination. Hindalco Muri is one of the refineries, which focusses on extraction of Boehmite with the help of high temperature digestion and pressure decanter.

This paper presents the optimization strategies undertaken to mitigate process deviations and enhance overall efficiency. Key interventions included improving ball mill product granulometry through grinding media optimization, ensuring continuous IBSH operation to increase pre-desilication slurry density, fine-tuning the low temperature digester slurry-to-liquor ratio to maintain a stable Alumina Caustic (A/C) ratio and changing the flocculent dosing strategy (Feedwell: Feedline:: 70:30) along with optimizing flocculant dozing in Pressure Decanter (PD) and change in operational philosophy based on PD inventory to improve underflow solids. These strategies collectively resulted in measurable performance gains, which resulted in enhancement of Ball Mill product granulometry from 60 to 65%, pre-desilication density improvement from 1.70 to 1.74 g/cc, reduction of Boehmite reversion in PD from 40 to 20%, and chemical extraction increased from 92 to 96%. As a result, the overall alumina recovery surpassed 93%, marking a significant advancement in process efficiency.

Keywords: Alumina Recovery, Chemical Extraction, Reversion, Pre-desilication, and Pressure Decanter.

ZLD – Concept to Commissioning – Innovatively Conceived Project

Ajay Popat
President, Ion Exchange (India) Ltd.
Author Email: ajay.popat@ionexchange.co.in

ABSTRACT

With freshwater scarcity escalating, alternative water sources such as desalination, wastewater recycling, and industrial wastewater recycling bridge the gap for sustainable water sources. While alternative water's use through advance technologies have gained relevance, there are significant gaps in financing projects deploying these concepts.

This presentation through case study shares technological advancements to enhance water security using alternative sources and supporting the UN's Sustainable Development Goals (SDG 6 & SDG 12) for a leader in non-steel Industry. It details use of cutting-edge biological, membrane, and thermal evaporation (option) technologies for water reclamation from complex mine water source using a very innovative Build, Own, Operate & Transfer (BOOT) model.

The project allowed the industry to focus on their core manufacturing business, saving in upfront capital expenditure, and adopt advanced reclaim technologies, for design, construction and operation of a complex effluent recycle plants. It also allowed it to meet regulatory norms and embrace Environmental, Social, and Governance (ESG) goals in its operation.

Keywords**: **Alternative Sources, Industrial Wastewater Recycling, Zero Liquid Discharge (ZLD), Build, Own, Operate & Transfer, Sustainable Development Goals (SDGs), and ESG.

Improvement of the Effectiveness of Making Alumina by the Updated ILTD Process: Alumina Refineries in India as Examples

György (George) Bánvölgyi[1]* and Ashok Nandi[2]
[1]Senior Process Consultant, Budapest, Hungary
[2]Senior Geologist Consultant, President of IBAAS, Nagpur, India
**Corresponding Author Email: gbanvolgyi@gmail.com*

ABSTRACT

For those who are familiar with alumina production by the Bayer process, it is evident that that the Cost of Production (COP) largely depends on the Available alumina (A.Al) and Reactive silica (R.Si) content of the particular bauxite. The caustic consumption, which is mainly dependent on A.Al and R.Si, constitutes the second largest cost item after the cost of bauxite in the Bayer process.

In India, there are large lateritic bauxite resources with medium available alumina content (THA – trihydrate alumina) and medium to high reactive SiO_2 content. With

the deteriorating bauxite quality, refineries are struggling to keep the alumina production cost at the low level.

The Updated Improved Low Temperature Digestion (UILTD) Process is a novel way to increase the economic and environmental effectiveness of the alumina production and is summarized in the paper.

The qualities of real bauxite feedstock's, the production levels, and estimated unit costs were used for three alumina refineries located in the Eastern part of India. The Material and Energy consumptions, the amount and composition of the bauxite residues, the same for the dicalcium silicate (C_2S) by-products were calculated and used to present the improvement in the COP of the UILTD process compared with the Conventional Low Temperature Digestion (CLTD). The coverage, i.e. difference of the Selling Price and the Cost of Production could be increased by 30, 64 and 77%, respectively by the UILTD process. The investment costs for the upgrade and the approximate payback periods are estimated for each of the alumina refineries. For the three alumina refineries the payback periods were found to be 1.9, 2.5 and 3 years, respectively, which are deemed to be fairly good returns of investments. The aluminous laterites that are reasonably considered to be sub-economic materials for the conventional Bayer process are suitable for their viable processing with the UILTD process. In this case the payback period was found to be fairly low (1.3 years).

However, each of the unit operation that should be upgraded from the conventional process has been or was on commercial scale operation, a pilot scale demonstration of the updated ILTD process as a whole is suggested so that commercialization take place with maximum confidence. It may be noted that the alumina production process on similar line as ILTD process was successfully implemented in the Sumitomo refinery of Japan, which is now closed down.

Keywords: Gibbsitic Bauxites, Reduction of Cost of Production, Wastefree Process, Recovery of Soda and Alumina from Desilication Product (DSP), Bauxite Residue with High Iron and Very Low Caustic Content, and Updated Improved Low Temperature Digestion (ILTD) Process.

Boosting Efficiency through In-house Optimization and Plant Strategies in Bayer Precipitation

Debashis Tripathy[1]*, Prasanta Bose[1], Kumar Ayush[1], Chandrakala Kari[2], and Swapnil Ghatage[2]

[1]Hindalco Industries Ltd., Muri, India

[2]Aditya Birla Science & Technology Company Pvt. Ltd. Taloja, India,

**Corresponding Author Email: debashis.tripathy@adityabirla.com*

ABSTRACT

The precipitation is pivotal to Bayer process defining product quality and yield. Muri refinery, being one of the oldest, achieving higher liquor productivity remains a persistent challenge due to several operational and process inefficiencies. Older design, variations in seed surface area, suboptimal temperature management, reduced

residence time, and insufficient slurry flow due to scaling result in lower alumina recovery rates. The limitations in the precipitation circuit leading to lower liquor productivity have an impact in terms of higher energy consumption, inefficiencies in cooling systems. This directly increases production costs, raising sustainability concerns.

The temperature profile in Bayer precipitation is defined by spent liquor cooling in Plate Heat Exchange (PHE) and water cooling in interstage coolers. The performances of these heat exchangers were evaluated to identify debottlenecks. The scaling and settling of hydrate in tanks are a major concern, reducing the residence time in the circuit significantly. The tank cleaning cycle was methodically planned, thereby reducing the dead volume by half. It improved residence time and thereby productivity. Additionally, Machine Learning (ML) based predictive model (having predictive accuracy >95%) deployed in Performance Index (PI) System is ensuring forecast Particle Size Distribution (PSD) 40 hours in advance. With visualization and automated alerts, it is facilitating real-time decision-making. It reduced PSD deviations by 50%, minimizing reprocessing and rejects. The ML model, along with pipeline redistribution providing choice of location of coarse seed addition, allowed better control over particle size distribution. The plant team followed a systematic approach, comprising lab experimentation, sustained plant practices and design modifications. This lowered steam consumption in downstream operations enabling sustainable practices in Bayer process. This study includes implementation of different strategies thereby improving liquor productivity consistently from 71-73 to 76-77 gpl.

Keywords: Bayer process, Precipitation, Optimization, Productivity Enhancement, Sustainable practices.

Promoting Differential Extraction for Sustainable Alumina Industry in India: Strategies for Effective Implementation

T. Harato
AlTech Consultant, Tokyo, Japan
Author Email: harato-takuo@jcom.home.ne.jp

ABSTRACT

Aluminium is an essential material for establishing a sustainable society. The raw material for aluminium production, alumina, must also be sustainable. The alumina industry requires the following three elements for its sustainability:

(1) Achieving carbon neutrality,
(2) Ensuring the sustainability of the bauxite resource,
(3) Addressing environmental issues and promoting effective utilization of red mud.

India's economic growth is remarkable and the growth of its aluminium industry is globally anticipated. In recent years, the quality of bauxite has been declining, necessitating the use of high-silica bauxite from the perspective of resource conservation. Despite having substantial bauxite deposits within the country, India has not yet utilized them effectively and remains dependent on imported bauxite. To

manufacture alumina while addressing industrial challenges using high-silica parts of gibbsitic bauxite found predominantly in Eastern India, the “differential extraction process” is optimal.

However, despite the extensive research conducted on differential extraction, it was industrialized only by Sumitomo. Why is there no one else following their footsteps? This stagnation stems from researchers and engineers hesitating to pursue development due to doubts about the process being "industrially viable," despite understanding its advantages.

The author experienced the industrialization of this process, solving numerous challenges encountered from development to actual operation and achieving commercial plant operations for over seven years. While the Sumitomo process had a low liquor-productivity problem, it could be resolved by introducing sweetening digestion. Additionally, this process was implemented with an annual capacity of 200,000 tonnes, raising questions about how to scale up for today's large alumina plants.

This report first presents case studies illustrating the potential advantages of applying the differential extraction process to gibbsitic bauxite in Eastern India. Using this process, even low-grade bauxite with Available alumina (AA) < 40%, R-SiO_2 (RS) > 5%, and an RS/AA ratio between 0.12 and 0.14 can achieve desilication soda-loss of only 50-60 k-NaOH per tonne of Al_2O_3, roughly half the soda consumption of conventional processes. More than 70w% of the resulting red mud would be nearly soda-free, making it safer to store and easier to utilize effectively. The remaining less than 30w%, while high in soda content, could allow for efficient soda recovery or to be used for specialized applications.

Next, the author will discuss the challenges encountered during the industrialization and how they were addressed. The discussion will focus on what needs to be elucidated through experimental methods to achieve industrialization, and what specific challenges must be overcome. Finally, an example of a process flow sheet will be presented. Through this, the paper aims to demonstrate how the application of differential extraction can offer solutions to issues such as the utilization of high-silica bauxite resources, the environmental problem of red mud, and energy challenges related to decarbonization. With the current period of industrial expansion, now is the ideal opportunity to introduce and implement new technologies to drive further growth. Through this report, the author hopes to encourage Indian engineers and researchers to confidently engage in the development of this process.

Keywords: Industrially viable, Differential extraction, Recovery, Desilication.

Process Optimization for Enhanced Effluent Quality in a Conventional ETP

Chiradip Roy[1]*, Santanu Dey[2] and Rama Nahak[3]
[1]Manager - Red Mud Management
[2]Asst. General Manager - Alumina Operations
[3]General Manager - Alumina Operations
Hindalco Industries Limited, Belagavi Works, Karnataka, India
*Corresponding Author Email: chiradip.roy@adityabirla.com

ABSTRACT

The Belagavi Alumina Refinery, located in a water scarce region, previously relied on conventional water-based sprinkling for dust suppression over red mud storage areas. The treated effluent from the refinery's 400 m^3/h Effluent Treatment Plant (ETP), which processes a mix of process waste water and red mud runoff, was effectively reused for this purpose. However, a recent shift to chemical dust suppressants significantly reduced the demand for treated water, resulting in prolonged storage. This led to issues such as algal growth, green discoloration, foul odour, and elevated Total Dissolved Solids (TDS) levels due to excessive sodium hypochlorite dosing. As a result, the quality of treated water deteriorated, making it unsuitable for reuse in plant operations due to increased suspended solids, unpleasant odour, and discoloration.

To address these challenges, a phased non-CAPEX intervention strategy was implemented. Sodium hypochlorite was replaced with a selective biocide, effectively controlling algal growth while improving odour and reducing TDS accumulation. Subsequently, a new coagulant flocculant combination, Tacelene Chem 4571 and Tacelene Chem 4326, was introduced. Optimal dosages were determined at 15 ppm and 0.6 ppm respectively, resulting in over 90 percent turbidity reduction and an 85% decrease in Total Suspended Solids (TSS) during plant trials.

These chemical interventions significantly improved the quality of treated water, enabling its reuse for multiple operational applications and reducing dependence on fresh water. This case study demonstrates that targeted chemical optimization can successfully revitalize conventional treatment systems without capital investments, offering a scalable model for water intensive industries operating under resource constraints.

Keywords: Effluent treatment, Biocide, Turbidity, TDS, Chemical optimization.

Boosting Security Filtration Flux with Specialty Chemical Aid while Ensuring PGL Quality Compliance

Santanu Dey[1]*and Rama Nahak[2]
[1]Asst. General Manager, Alumina Operations
[2]General Manager, Alumina Operations
Hindalco Industries Limited, Belagavi, Karnataka, India
*Corresponding Author Email: santanu.dey@adityabirla.com

ABSTRACT

Security filtration operations in an alumina refinery play a crucial role in impurity control and in maintaining steady plant production volumes by ensuring adequate liquor filtration flux. Hydrate production can be significantly disrupted if security filters underperform, either due to suboptimal process conditions or the challenging rheology of bauxite. For older refineries with vintage Kelly filtration technology, this challenge becomes more prominent, making process optimization essential to sustain liquor filtration flux without compromising strict impurity control related to red mud content in pregnant liquor (PGL).

Hindalco's Belagavi Alumina Refinery, with a legacy of more than 55 years, operates with ageing mud clarification and security filtration systems. The complexity is further increased with the use of bauxite ores sourced from various mines, each with different geological characteristics. As a fully integrated specialty alumina and hydrate production facility, the Belagavi unit manufactures high-end value-added products and super value-added products under very stringent quality norms. In recent years, the refinery has been operating entirely on domestic bauxite, which has comparatively lower alumina content and highly variable processability. This has posed a major challenge for processing in an older refinery setup, especially in the areas of mud clarification and security filtration.

With an increase in domestic bauxite charge of varying quality and characteristics, Kelly liquor filtration has become a significant bottleneck in maintaining the required hydrate production volume, due to a notable drop in liquor filtration flux as well as in the quality norms of PGL. This paper outlines how the plant team engaged in extensive brainstorming to develop and implement various process control and optimization strategies to increase the liquor filtration flux and improve the PGL quality control. After multiple laboratory trials, a specialty chemical aid was successfully introduced to enhance the liquor filtration rate. This allowed the refinery to maintain steady hydrate production volumes while meeting strict quality standards, even under challenging raw material conditions.

Keywords: Security Filtration, Process Optimization, PGL, and Chemical Aid.

Development of a New Crystal Growth Modifier for Controlling Particle Size Distribution in High Solid Hydrate Precipitation Circuit

Paul Gupta[1], Subha Banerjee[2], Hari Kishan Gandham[3], Nayan Kumar[4], Prasenjit Nath[5], and Shounak Banerjee[6]*

[1]Functional Head-Refinery Technical, [2]Manager -Refinery Technical,
[3]Head Laboratory -Refinery Technical, [4]Manager -Refinery Technical,
Utkal Alumina International, Tikiri, India
[5]Account Manager, [6]Sr. Marketing Manager,
Nalco Water, Kolkata, India
Corresponding Author Email: sbanerjee1@ecolab.com

ABSTRACT

Crystal Growth Modifier (CGM) plays a major role in Particle Size Distribution (PSD) control in High Solid Alumina tri-hydrate precipitation circuit is very critical as it impacts final Product Alumina fines (particles of size less than 45 microns). Nucleation crisis is a challenging phenomenon in high solid precipitation circuit as it affects in over Coarsening of circuit. Over-coarsening can result in very high nucleation (both primary & secondary) and thus finer circuit. To avoid this a CGM was developed which was used to grow Ultrafine particles at a faster rate into its next fraction than normal which can subsequently shorten the finer phase of the precipitation cycle and thus final Product quality remains unaffected. A detailed study was conducted in both Lab scale and Plant scale with different dosing of Crystal Growth Modifier to analyse the impact of particle size distribution of hydrate particles at different phases of precipitation circuit in both agglomeration and Growth conditions.

Keywords: ***Precipitation, Particle Size Distribution, Ultrafine, Crystal Growth Modifier, Agglomeration***

Reimagining Bauxite Mining: Making the Most of Low-Grade Reserves

Sudhansu S. Mishra[1]*, Abinash Jena[2] and Bikash Ch. Mohanty[3]
[1]Deputy Manager, [2]Asst. General Manager, [3]Asst. General Manager,
NALCO, Damanjodi, India
Corresponding Author Email: sudhansu.mishra@nalcoindia.co.in

ABSTRACT

The aluminium industry's attention is increasingly turning to low-grade bauxite deposits as high-grade bauxite supplies are being depleted. With the depletion of high-grade sources, the growing demand for aluminium worldwide, and the growing emphasis on environmental responsibility, the sustainable use of low-grade bauxite is becoming more and more significant. Low-grade bauxite has always been regarded as inappropriate for classic alumina extraction procedures like the Bayer technique due to its high silica and low alumina concentration. However, there is increased interest in the beneficiation and alternate uses of low-grade bauxite due to the rising demand for

aluminium and the depletion of high-grade bauxite reserves. This study examines several methods for efficiently using low-grade bauxite, such as thermal activation, chemical leaching, physical beneficiation, and usage in non-metallurgical processes such adsorbents, cement, and refractories. There are encouraging opportunities to turn this neglected resource into a lucrative raw material thanks to recent developments in mineral processing technologies and the creation of economical, ecologically friendly techniques. In order to support resource conservation and sustainable development in the aluminium industry, the study highlights the possible financial and environmental advantages of using low-grade bauxite.

Keywords: Mining bauxite, Low-grade bauxite, Physical beneficiation & Bayer technique.

Carbon Foot Print Reduction in Alumina Calciners

Pungkuntran Jaganathan,
Global Product Line Manager
FLSmidth Private Limited,
Author Email: jp-in@flsmidth.com

ABSTRACT

As the creators of the most advanced alumina calciner systems in the industry, we value staying at the forefront of research and development. Our engineers analysed every aspect of our Gas Suspension Calciner (GCS) system and discovered opportunities to address energy efficiency, economy of scale

Building on a world-class design, we made numerous enhancements to improve performance while reducing costs. Our recent developments are a direct result of our customers' desire to maximize throughput, cost efficiency, and alumina quality. The following improvements bring our customers better control and consistent results without a premium price. Improved cyclone design, Better refractory, Smarter digital interface, Lower building height.

And in keeping with our Mission Zero goals, our latest technological and digital solutions help customers move towards greener processes by reducing thermal energy and power consumption as well as CO_2 emissions.

After research and development of Hydrogen firing in Alumina calciners, now into to real time projects to meet our goals of mission zero.

Keywords: Alumina, Calciners, Thermal energy consumption.

Energy Savings, Flow Improvement and Erosion Control of Gas Suspension Calciner in Alumina Refinery using Computational Fluid Dynamics Analysis

Saprativ Basu[1]* and Rosalin Pradhan[2]
[1]Lead Scientist, R&D, Vedanta Aluminium Ltd., Jharsuguda, Odisha, India
[2]Dy. Director Technical, Digitalisation, Vedanta Aluminium Ltd., Lanjigarh, Odisha, India
Corresponding Author Email: Saprativ.Basu@vedanta.co.in

ABSTRACT

Energy saving in gas suspension calciner (GSC) for the alumina extraction system via fluid flow and erosion control mechanisms have been studied using computational fluid dynamic analysis with experimental validations. CFD analysis predicted the velocity, pressure, and temperature distribution of air/gas within the cyclones and ducts from the FD fan outlet to the ESP inlet. The single-phase flow approach has been used for this CFD analysis of GSC. For the CFD analysis, the material flow was not considered directly; however, the porous medium approach has been used to model the pressure drop by material flow across the ducts and cyclones based on the pressure values obtained from the site condition. The optimum design modifications have been found out from the modified designs to improve the flow and erosion control of cyclones and riser ducts for the gas suspension calciner. The pressure drop value has been reduced by up to ~2.5% from the forced draft fans (FD Fan) outlet to the electrostatic precipitators (ESP) inlet. The power saving of the GSC system has been found ~2% while using the proposed design.

Keywords: ***Power saving, Erosion control, Gas suspension calciner, Computational fluid dynamics, Flow control.***

Mechanical Vapour Recompression Technology for Alumina Refineries

F. Delannoy
Process and Sales Dpt, GEA Process Engineering - Kestner, France
Author Email: francois.delannoy@gea.com

ABSTRACT

Mechanical Vapour Recompression (MVR) technology has been used for evaporation units in different mineral refineries such as salt industry, pulp and paper industry as well as sodium carbonate and bicarbonate industry. This technology enables to save energy compared to steam driven systems and via electrification it is also adapted for decarbonization of the alumina industry. In this article we will present how to implement this technology at the evaporation stage of the refinery: (a) as a pre-concentration, (b) retrofit of a multiple effect unit, (c) for falling film trains of

evaporation, and (d) for forced circulation trains of evaporation. COP calculation will be given and OPEX comparison between steam driven systems and MVR systems will be discussed. An important point for validation of this technology is the availability of the electrical power considering captive power plants in place in different alumina refineries of Odisha and others.

Keywords: Mechanical vapour recompression, Energy savings, COP, Evaporation.

Optimized Airflow Management in PPT (White-1) Tanks for Enhanced Operational Efficiency and Safety

Anurag Pathak[1]* and Devendra Narayan Jha[2]
[1]Project Leader, VLL, Lanjigarh, Kalahandi
[2]HOD, VLL, Lanjigarh, Kalahandi
Corresponding Author Email: Anurag.Pathak@vedanta.co.in

ABSTRACT

Vedanta Limited's 3 MTPA alumina refinery successfully implemented a process improvement initiative to normalize airflow to Precipitation (PPT) tank dip tubes, addressing critical safety and operational challenges. Excessive and inconsistent air charge had been causing slurry overflow, foam formation, equipment damage, and production losses.

Using the PDCA (Plan-Do-Check-Act) methodology, the team designed and installed calibrated orifices in dip tubes to regulate airflow. This passive, low-maintenance solution significantly reduced slurry spillage, improved process stability, and enhanced safety by preventing major failure incidents by acting as a flow governor. The intervention was completed four days ahead of schedule, reducing plant air consumption from 100 to 85%.

Key outcomes included ₹7.6 million in savings from avoided production loss, improved equipment reliability, reduced human exposure to hazardous slurry, and better environmental compliance. The solution is scalable across similar units and serves as a sustainable model for process control in metallurgical operations.

This project highlights the effectiveness of structured problem-solving and cross-functional collaboration in delivering high-impact, cost-efficient engineering solutions.

Keywords: Normalize airflow, Slurry overflow, Calibrated orifices, Avoided production loss, Environmental compliance, PDCA.

Reduction in Turn Around Time for Precipitation Tanks

Manabendra Mishra
Deputy Manager, VLL, Lanjigarh, Kalahandi
Author Email: manabendra.mishra@vedanta.co.in

ABSTRACT

In the 3 MTPA Precipitation Plant, slurry transfer between precipitators is managed via launders controlled by launder gates. During Turnaround (TA) or Caustic Cleaning (CCL) of any precipitator, complete isolation is essential to prevent slurry ingress. However, due to scale deposition beneath the gates, effective sealing is compromised, making isolation unreliable. The current workaround—welding plates to block launders—requires approximately 192 hours (8–10 days) for preparation and normalization, significantly extending the TA duration to nearly 19 days. This extended downtime threatens the annual TA target of 40 tanks and reduces overall plant efficiency.

With the plant commencing operations in Q1 FY25 and the first TAs scheduled from Q3 onwards, a reliable and time-efficient isolation method is urgently needed. Failure to address this issue results in reduced precipitation tank availability, lower residence time, decreased net liquor productivity, and increased risk of production loss. Financially, this inefficiency could cost ₹427 lakh annually and reduce hydrate/alumina production profitability by approximately $0.25 per ton.

This project aims to develop a robust, scalable, and time-saving isolation solution to enhance operational reliability, reduce TA duration, and safeguard production targets.

Following a structured and periodic review of each action plan, the project was successfully completed within the targeted timeline. The implementation of an effective launder sealing mechanism significantly enhanced operational ease and instilled confidence in the team to manage unforeseen Precipitation tank breakdowns. The initiative led to noticeable improvements in plant cleanliness, optimal resource utilization, and overall area efficiency. Additionally, it contributed to creating a safer workplace, boosting employee satisfaction, and fostering better planning, teamwork, and coordination across departments. These outcomes collectively support sustainable operational excellence and long-term productivity in the precipitation process.

Keywords: Turnaround (TA), Precipitator, Net Liquor Productivity, Reduced precipitation tank availability, Lower residence time.

Cost of Production Reduction via Soda & ALF_3 Optimization in Alumina & Smelter for Fulfilment of ESG Commitment

Amarnath Pandit[1]*, Biswa Ranjan Lenka[2] and Divya Dixit[1]
[1]Assistant Manager, [2]Associate Manager,
Vedanta Limited, Lanjigarh, India
*Corresponding Author Email: Amarnath.pandit@vedanta,co.in

ABSTRACT

Vedanta Limited, a global diversified natural resources company, initiated a process improvement project to reduce total soda content in product alumina. Elevated soda levels were contributing to increased production costs, higher ALF_3 and fluoride salt consumption, excessive electrolyte volume in pot cells, and accelerated pan filter cloth wear due to scaling.

Using the DMAIC(Define-measure-Analyse-improve-control) methodology, the project identified two primary contributors: high bound soda in precipitation solids (~0.2% as Al_2O_3) and limitations in the pan filter's ability to control leachable soda (0.025–0.03%), resulting in a total soda level of ~0.33%. Data collected over a 13-month period revealed a baseline sigma level of 1.48.

Root cause analysis highlighted key process variables including agglomeration temperature, residence time, hydrate fines, and weak wash flow. Targeted improvements—such as installing a V-notch washing system, optimizing agglomeration conditions, and enhancing filter maintenance—reduced leachable soda to 0.02% and bound soda to 0.17%. These changes improved washing efficiency, reduced moisture, and minimized cloth consumption, raising the sigma level to 4.96.

Post-implementation, total soda in product alumina was reduced to 0.295%, resulting in annual savings of ₹1.07 crore from soda loss reduction, ₹95 lakhs from in-house system upgrades, and ₹10.8 lakhs from reduced cloth consumption. Additional benefits included improved product quality and equipment reliability.

This project demonstrates the effective application of Six Sigma tools in alumina refining, delivering measurable gains in quality, cost efficiency, and operational sustainability.

Keywords: Soda loss reduction, Alumina refining, Pan filter's ability, High bound soda, V-notch washing system, Process improvement, DMAIC (Define-measure-Analyse-improve-control).

Reliability Improvement & Energy Efficient Operation of Interstage Slurry Cooler

Sambit Kumar Routray[1] and Manabendra Mishra[2]
[1]Manager, VLL, Lanjigarh, Kalahandi
[2]Deputy Manager, VLL, Lanjigarh, Kalahandi
Corresponding Author Emails: sambitkumar.routray@vedanta.co.in
manabendra.mishra@vedanta.co.in

ABSTRACT

In the Bayer Process of alumina refining, maintaining a precise temperature gradient—from 78°C in the initial tank to 52°C in the final tank—is critical for efficient precipitation of dissolved alumina. Inter-Stage Slurry Coolers[1] (ISCs) play a vital role in achieving this temperature profile. However, frequent V-belt failures in ISC feed pumps—occurring approximately every 180 hours—led to reduced ISC availability, elevated final tank temperatures, and a consequent drop in Net liquor Productivity. This also resulted in increased resource consumption, operational instability, and a rise in the cost of production (COP) of alumina.

The project aimed to eliminate these recurring failures and support the plant's production ramp-up from 2 MTPA to 3.5 MTPA, while achieving benchmark energy efficiencies. A comprehensive root cause analysis (RCA) was conducted using historical data, identifying key failure drivers. An impact assessment matrix guided the development of a time-bound action plan, combining quick wins through process optimization and medium-term system improvements.

As a result, the project achieved zero V-belt failures in Q4 FY25, reduced specific energy consumption to 1.4 kWh/T, and delivered a business impact of ₹2.1 crores. Intangible benefits included enhanced equipment availability, improved operational safety, and consistent throughput across the precipitation circuit.

This project not only resolved a critical operational bottleneck but also laid the foundation for sustainable growth and efficiency in alumina production. By aligning technical improvements with strategic production goals, the initiative demonstrated how targeted reliability enhancements can drive significant business value and operational excellence.

Keywords: Inter stage slurry cooler, Net liquor productivity, Cost of Production (COP), Reduced specific energy consumption, Improved operational safety.

Advanced Process Control for Settler-Washer Circuit

Sasmita Samal[1]* and Srijita Podder[2]
[1]Head Technical, Vedanta Limited, Lanjigarh, India
[2]Lead Red Area-Technical Cell, Vedanta Limited, Lanjigarh, India
Corresponding Author Email: sasmita.samal@vedanta.co.in

ABSTRACT

The alumina sector has been driven to increase output while maintaining maximum efficiency due to a number of factors, including price variations, bauxite ore variability, volatile market circumstances, growing emphasis on zero waste, and efficiency improvements. Increased market competition, rising commodity prices, unstable raw materials and quality, and stricter environmental regulations necessitate adjusting manufacturing and processing methods to minimize specific consumptions and maximize output. Data driven technologies – AI/ML, Robust Multivariable Predictive Control Technology (RMPCT), mobile based apps, automation and robotics, the Internet of Things (IOTs), modern data architecture (including the Cloud) can provide solutions to many such problems and open a plethora of potentials to unlock the true value of any operation. Settler-Washer circuit operations contribute to a recovery of most amount of caustic loss from the circuit.

This paper outlines the development and implementation of Advanced Process Control (APC) in Settler washer circuit in Vedanta Lanjigarh with an understanding of the design considerations and potential of the unit along with the current and future operating constraints of the unit.

The circuit consists of 4 no. of Settlers & 6 no of Washers, where one settler & one Washer are standby. To produce high-purity alumina from bauxite by dissolving the alumina content into a caustic solution, forming aluminate liquor, while ensuring the effective removal of insoluble impurities. The separation process is executed in two stages: initial gravity settling in settlers, followed by pressure filtration. Additionally, the settled impurities undergo washing in washers to recover residual caustic solution, thereby enhancing process efficiency and minimizing caustic loss. Since the operating variables in Settler & Washer unit are interactive with each other, Honeywell Advance Solutions' Robust Multivariable Control Technology (RMPCT®) has been used & proven its stability and superiority in the field. To ensure safe and reliable operations while achieving unit optimization objectives, two Profit Controllers have been deployed for the Settler and Washer units. These controllers are designed to maintain process variables within specified constraints and enhance overall operational performance with caustic saving of 0.5 kg/T of alumina production.

The implementation of Profit Controllers, based on Model Predictive Control (MPC), enables tighter regulation of operating targets and stabilizes process behaviour. By minimizing the standard deviation of controlled variables, the system effectively reduces process variability. This reduction allows the units to operate closer to their key constraints without compromising safety or reliability.

To meet the defined operational goals, the Profit Controllers dynamically adjust independent process variables, driving the units toward optimal operating conditions.

This approach not only improves process stability but also contributes to increased unit profitability through enhanced efficiency and constraint management. The focus points are safe and stable operations with longer life to settler & washers' decanter and reduction in LW caustic by balancing caustic profile.

Keywords: Robust Multivariable Predictive Control Technology (RMPCT), Model Predictive Control (MPC), Internet of Things (IOTs), Advanced Process Control (APC).

Enhancement of Heat Transfer Efficiency in Plate-Type Heat Exchangers through Multi-Stage Acid Cleaning

Manish Kumar Yadav[1]* and Tanya[2]
[1]White-1 Sub area In charge, Vedanta Limited, Lanjigarh, India
[2]White-1 In Charge-Technical Cell, Vedanta Limited, Lanjigarh, India
**Corresponding Author Email: Manishkumar.yadav@vedanta.co.in*

ABSTRACT

The aluminium industry is experiencing significant growth in the current market and is projected to continue expanding rapidly in the future. Plate-type Heat Exchangers: ISC (Interstage Coolers) are vital components in the alumina recovery process, as they facilitate the precipitation of alumina tri-hydroxide by reducing the temperature of the slurry. However, the deposition of hard scales on the cooling media side of these heat exchangers has been observed thus reducing the overall heat transfer coefficient, leading to a decrease in net liquor productivity. To address this issue, Vedanta Lanjigarh Alumina Refinery conducted detailed studies aimed at understanding the factors contributing to scale formation and its impact on heat transfer efficiency. This paper presents the findings from these studies, including the chemical and physical characteristics of the scales, the operational conditions that promote their formation, and the extent to which they impair thermal performance. Furthermore, it proposes targeted strategies for dissolving and preventing hard scale buildup—such as chemical cleaning protocols. These interventions have demonstrated measurable improvements in heat transfer efficiency and overall productivity. The findings have significant implications for the optimization of alumina refinery operations and the future growth of the aluminium industry.

Keyword: Interstage coolers (ISC), Alumina recovery, Heat transfer efficiency, Hard scale removal.

Overcoming Operational Challenges during Startup and Stabilization of 3 MTPA Alumina Refinery

Priyadarsini Dash[1]* and Vikey Kumar[2]
[1]Red-1 Technical Incharge-3MTPA, Vedanta Limited, Lanjigarh, India
[2]White-1 Technical Incharge-3MTPA, Vedanta Limited, Lanjigarh, India
Corresponding Author Email: priyadarsini.dash@vedanta.co.in

ABSTRACT

Alumina refineries are scaling up their production capacities in response to the continuous growth in alumina demand worldwide. However, commissioning and stabilizing large refinery expansions is a complex and challenging process. Stabilizing a newly commissioned 3 MTPA alumina refinery requires close monitoring, quick response to process deviations, continuous improvement in system performance and continuously tracking the equipment performance and its stabilization to meet production goals.

Real-Time Process Control and Troubleshooting: This paper presents a structured approach to managing these challenges using real-time process control and data-driven troubleshooting during the early stabilization phase. Multiple issues such as process fluctuations, equipment unavailability, and system delays were encountered during the initial months of startup. To address these issues, major downtime reasons were identified, and the corresponding production losses were calculated to prioritize areas needing immediate attention.

A real-time data monitoring system was established using Process Historian Database (PHD), which enabled live tracking of critical process parameters and trend analysis. This helped in identifying abnormalities early and taking timely corrective actions. To ensure consistent data access, dedicated dashboards and databases were developed for finding and troubleshooting deviations. Additionally, important process calculations and equations were integrated into the Distributed Control System (DCS) using analysis tools, which helped streamline parameter calculations and improved decision-making during unstable conditions.

Even with several power plant blackouts and the absence of full infrastructure readiness, significant operational improvements were achieved through optimizing several critical parameters in just three months. Blow off ratio (BOR) improved from 1.11 to 1.27; Mill throughput increased from 345 to 540 TPH and Slurry charge to digestion rose from 350 to 495 m^3/h.

These results highlight the effectiveness of real-time process monitoring, structured troubleshooting, and smart target setting in stabilizing alumina refinery expansions under challenging conditions.

Keywords: ***Process Historian Database (PHD), Distributed Control System (DCS), Blow off ratio (BOR).***

MVR Compression System Design Criteria for Liquor Evaporation in the Alumina Industry

Jens-Holger Schmidt
CEO
SEP Salt & Evaporation Plants Ltd.
Author Email: jens-holger.schmidt@sepwin.ch

ABSTACT

MVR evaporative systems in an alumina refinery require continuously working compression systems. Energy efficiency is an important design criterion. But reliability and maintenance costs are also very important issues to be assessed.

Various types of compression systems can be used, but they all have specific properties, behaviour, monitoring and maintenance requirements.

The aim of this paper is to examine the main differences between state-of-the-art compression systems regarding important criteria and characteristics. It provides a guideline for the selection, on one hand for the conversion of existing steam heated multiple effect evaporation system to MVR (Mechanical vapour recompression) units, and on the other hand for the installation of new MVR based evaporators. It addresses design requirements like compression ratio depending on liquor concentration and boiling point elevation and LMTD / heat transfer area, design solutions for long lifetime without scaling, space constraints for changing over to MVR. It highlights advantages and disadvantages of different compression systems and gives an overview about difference of CAPEX and OPEX between new MEE and MVR.

Keywords: Efficiency, Reliability, Live cycle cost, Turbo compressor, Blower, Fan, VFD, MVR, Mechanical vapour recompression, Evaporation, Falling film, Conversion, Spent liquor, Green liquor, Energy saving, CO_2 Emission.

Technological Breakthrough in the Utilization of Indian Low Grade Bauxite Ore

Y. Occello[1] and R. Girbal[2]
[1]IB2 Founder, [2]IB2 CEO and Co-Founder
Corresponding Author Email: contact@ib2.com

ABSTRACT

How can IB2 technology help India leverage its strengths to meet the challenges of Aluminium sector transformation?

India stands at a pivotal moment in the transformation of its bauxite-to-alumina value chain. With abundant yet under-utilised domestic resources—especially low-grade bauxites—the country enjoys a unique opportunity to enhance self-reliance and sharpen cost competitiveness in the global aluminium landscape. At the same time,

demographic and economic growth, rapid urbanisation, and expanding automotive & aerospace industries are amplifying demand pressures that only technology can relieve.

Leveraging advanced solutions is therefore urgent on three fronts: unlocking low-grade ores through innovative and reliable solutions, boosting energy and resource efficiency across alumina refining, shrinking the environmental footprint.

IB2 Technology by responding to these 3 challenges will be the decisive enabler—converting geological potential into industrial performance.

By accelerating its adoption, India can secure strategic autonomy while contributing to the decarbonisation and diversification of global aluminium supply chains.

Key Words: Low-grade bauxite, Alumina refining technology, Energy & resource efficiency, Industrial competitiveness, Sustainable aluminium supply chain, Decarbonisation strategies, Strategic autonomy.

Standardization of Raw Material and Transparency of Pricing through E-commerce - The Way to the Future.

Alay Thanki
Director, Mag-Al Electrominerals Pvt. Ltd.
A refractory raw material supplier, Ahmedabad, Gujarat.
Author Email: Alay@hemalay.com

ABSTRACT

The paper explores the critical challenges and emerging trends in the raw material category, with a specific focus on the refractory industry. It delves into the transformative potential of standardization and transparency facilitated by e-commerce platforms.

In the contemporary industrial landscape, the procurement of raw materials presents multifaceted challenges ranging from inconsistent quality standards to opaque pricing mechanisms. Such challenges not only impede operational efficiency but also hinder strategic decision-making processes. Through an in-depth analysis of the current scenario, this paper underscores the urgent need for standardization in raw material procurement and pricing transparency.

Drawing insights from the refractory industry, which is highly reliant on specialized raw materials, the paper elucidates how standardization can mitigate the risks associated with variable product quality and performance. By establishing uniform specifications and benchmarks, standardization fosters consistency across the supply chain, enabling manufacturers to optimize production processes and enhance product reliability.

Furthermore, the paper advocates for the adoption of e-commerce platforms as a catalyst for transparency in pricing mechanisms. Traditional procurement channels often lack transparency, leading to price discrepancies and negotiation challenges. Leveraging the digital infrastructure of e-commerce, organizations can promote fair pricing practices and provide stakeholders with real-time access to

market-driven pricing data.

Through case studies and industry insights, this paper highlights the transformative impact of standardization and pricing transparency on the refractory industry's competitiveness and sustainability. By embracing these principles, manufacturers can streamline procurement operations, mitigate supply chain risks, and foster collaborative partnerships across the value chain.

In conclusion, "Standardization of Raw Material and Transparency of Pricing through E-commerce - The Way to the Future" offers actionable recommendations for industry stakeholders to navigate the evolving landscape of raw material procurement and achieve sustainable growth in an increasingly competitive marketplace.

Keywords: Standardization of value chain, Bauxite, Transparency, E-Commerce.

Anthropogenic Soils through CCU of the Red Mud

Sharad Pandey and Devendra Narain Singh*
Department of Civil Engineering, IIT Bombay, Powai-Mumbai-400076
**Corresponding Author Email: 24m0564@iitb.ac.in, dns@iitb.ac.in*

ABSTRACT

Red Mud (RM), a by-product generated from the aluminium refineries, comprises oxides of silica, aluminium, and iron oxides. Due to the usage of caustic soda, in Bayer process, RM exhibits pH ranging between 11-13. The particles of RM are extremely fine and hence exhibit very high specific surface area. The higher alkalinity and extremely fine particles of RM pose significant challenges to its handling, transportation, and storage, which requires huge areas of the land, apart from its adverse environmental and geoenvironmental impacts. One of the pathways to come out of this situation would be to purge carbon dioxide and flue gases coming out of the stacks, a process known as carbon capture and utilization (CCU), which results in neutralization and/or mineralization of RM. It is our hypothesis that this state of RM can be treated as *anthropogenic soil* and its different utilization schemes should be thought of. This exercise would champion the *Net-Zero* efforts and support the circular economy and fulfilment of the sustainable development goal (SDGs), as well. With this in view, and to better understand the CCU potential of RM before conducting laboratory and real-life experiments, it is essential to simulate the entire process, by employing Monte Carlo (MC) simulations and Molecular Dynamics (MD) by imposing different operational conditions (viz., pressure and temperature). In this paper, details of the efforts initiated at Environmental Geotechnology Laboratory, Dept. of Civil Engg., IIT Bombay, will be presented and discussed.

Keywords: Red mud, Carbon capture and utilization, Neutralization, Mineralization, Net-zero, Circular economy, SDGs, Anthropogenic soils, Molecular dynamics, Monte Carlo Simulation.

Sustainable Upgrading of Bauxite and Valorisation of Bauxite Tailings

Thomas Baumann
Sales and Business Development, AKW Apparate + Verfahren GmbH,
Hirschau, Germany
Author Email: tbaumann@akwauv.com

ABSTRACT

The world production of bauxite is reported in 2022 with 400 mill. t/a. More than half of it is coming from Australia and Guinea. A lot of other bauxite reserves need an upgrading to meet the requirements regarding the main ingredients of Al_2O_3 and SiO_2, to make it suitable for the Alumina refinery extraction process. Therefore, upgrading by washing and classification processes could be the solution to disintegrate and to separate unwanted impurities.

Due to the typical composition in the PSD (particle size distribution) of such bauxite deposits the valuable fractions need to be identified and the specifically liberated and separated. The main tasks for the upgrading are the designing of the process route, selection and sizing of suitable equipment and the overall plant layout.

Additionally, the valorisation of tailings, from existing old washing plants, could be considered to recover valuable fractions in the sense of sustainable usage. Due to unavailability or improper classification processes old bauxite washing plants focus mainly on coarse fractions >4 mm. Whereas by specific investigations in existing old tailings dams it could be found that still a remarkable amount reflects the required quality standards. The task, therefore, is to define the referring cut size and to design the resulting process route. Based on practical case studies by realized plants referring enhanced results will be shown.

Keywords: Upgrading, Tailings valorisation, Quality demand.

Red to Green: Ecological Restoration of Bauxite Residue Disposal Area at Hindalco Muri

Prashanta Bose[1], Sujit Anand[2], Aparna Singh[3], Deepak Singh[4], and Kishore Babu[5]*
[1]Head of Operations, [2]Manager-Environment, and [3]Environment Engineer,
Hindalco Industries Ltd, Muri Unit, India
[4]Project Engineer and [5]Lead-Corporate Sustainability,
Hindalco Industries Ltd, Bhubaneswar, India
**Corresponding Author Email:* kv.babu@adityabirla.com

ABSTRACT

The "Red to Green" initiative at Hindalco's Muri Refinery demonstrates a pioneering example of industrial land rehabilitation through ecological restoration of a 41-acre bauxite residue disposal site (RMP3). Formerly a barren and lifeless expanse, the site has

been transformed into a thriving green ecosystem, reflecting Hindalco's commitment to sustainability, biodiversity enhancement, and responsible industrial stewardship.

The project leveraged integrated land contouring techniques—benching and sloping—to control erosion and support stable vegetation. A combination of native flora plantation and Miyawaki afforestation was employed to accelerate vegetation density and improve ecological resilience. Irrigation was established using treated wastewater from the on-site Sewage Treatment Plant (STP), distributed via drip irrigation and sprinkler systems. This minimized dependence on freshwater sources and exemplified circular water use.

Significantly, no external topsoil was imported. Instead, land rejuvenation was accomplished through targeted application of organic soil amendments such as gypsum, vermicompost, fly ash, and mycorrhiza. These inputs enhanced soil fertility and microbial activity. The use of coir mats on sloped areas further stabilized the terrain, reduced runoff, and retained soil moisture.

Outcomes include a marked reduction in airborne dust pollution from Red Mud Pond (RMP), the emergence of self-sustaining vegetation and a notable increase in local biodiversity, with observations of various bird, insect and small mammal species.

Within the restored area, approximately 3 to 4 acres have been developed into a designated bio-park, serving both ecological and recreational functions.

This project stands as a scalable model for eco-restoration of industrial waste land, delivering measurable environmental, aesthetic, and social benefits without reliance on resource-intensive inputs. It reinforces the viability of cost-effective, nature-based solutions in achieving long-term land-use sustainability in the aluminium and mining sector.

Keywords: Industrial land rehabilitation, Afforestation, Sustainable irrigation, Soil amendment, Biodiversity enhancement.

Innovative R&D for Red Mud Utilization at Hindalco: Circular Economy, Product Development and Ecological Rehabilitation

Abhishek Dash[1], Kishore Babu[2]*, and Kumud Yadav[3]
[1]Asst Manager-Corporate Sustainability,
Hindalco Industries Ltd, Bhubaneswar, India
[2]Lead-Corporate Sustainability, Hindalco Industries Ltd, Bhubaneswar, India
[3]Asst Manager-Corporate Sustainability, Hindalco Industries Ltd, Renukoot, India
**Corresponding Author Email: kv.babu@adityabirla.com*

ABSTRACT

Red mud, a highly alkaline by-product of the Bayer process in alumina refining, presents significant challenges in terms of handling, storage and long-term environmental impact. Recognising the criticality of addressing this issue, Hindalco Industries Ltd. has adopted a research-driven and partnership-based approach to red mud utilization, focusing on scalable, sustainable, and circular economy-aligned

solutions.

This paper presents Hindalco's advanced Research and Development (R&D) initiatives in red mud utilization, with a focus on material innovation, ecological rehabilitation and industrial symbiosis. A flagship area of R&D includes the development of polymer composites using red mud and plastic waste in collaboration with IIT Bombay. These efforts aim to convert waste into value-added construction products such as paver blocks, tiles and bricks. Another significant collaboration with Carbon8 Systems (UK) and Greenwich University focuses on producing construction-grade aggregates from bauxite residue through carbonation, enabling long-term carbon sequestration and low-cost flue gas usage.

Hindalco is also progressing in eco-restoration of legacy red mud ponds, including large-scale projects such as the "Red to Green" programme at Muri and Renukoot. These involve slope stabilisation, plantation over degraded dump areas, and enhancing green belt coverage, in partnership with TERI, IITs, CBRI, and other leading agencies. The rehabilitation of the 46.7-acre RMP-1 site in Belagavi and the enrichment of an additional 28.3 acres stand as examples of transforming industrial residue zones into green assets.

In the domain of land and material improvement, Hindalco is conducting field trials on reclaiming low-lying lands using red mud and phosphogypsum in collaboration with IIT Bombay, IIFCO, and AMNS. Another key area is the in-situ neutralization of red mud in residue disposal areas (RDA), showing promising results in pH reduction and unlocking future reuse options.

Emerging collaborations are also exploring the chemical transformation of red mud into ALFERROCK, a fire-retardant construction material (with Proferro GmbH), as well as the use of red mud in sound barriers for highway infrastructure (with BambooCrete and Xynteo). Furthermore, trials on converting Flue Gas Desulphurisation (FGD) waste into fertilizer-grade gypsum and composite plaster (CBRI Roorkee) exemplify Hindalco's integrated waste valorization strategy.

Through a multidisciplinary and multi-agency approach, Hindalco's R&D pipeline is positioning red mud as a versatile secondary resource, supporting India's broader goals of industrial decarbonization, resource efficiency, and sustainable development.

Keywords: Red mud, Circular economy, Composite materials, Ecological rehabilitation, Carbon sequestration, Sound barriers, Sustainability.

Brown Fused Alumina - Strength and Stability in Every Grain

Chaitali Pattankude
R&D, Assistant Project Coordinator
Dharti Group of Industries.
Author Email: chaitali.pattankude@dhartigroup.in.net

ABSTRACT

Brown Fused Alumina (BFA) stands as a cornerstone of modern industrial materials, renowned for its exceptional hardness (Mohs 9), thermal resistance (melting point ~2,250°C), and chemical inertness. Synthesized through the high-temperature reduction of calcined bauxite in electric arc furnaces, BFA primarily consists of Aluminium Oxide (Al_2O_3) in concentrations ranging from 94–97%, along with controlled amounts of Titanium Dioxide (TiO_2), Iron Oxide (Fe_2O_3), and Silicon Dioxide (SiO_2). These compositional attributes contribute to its superior mechanical strength, thermal shock resistance, and wear performance, making BFA indispensable across various sectors including abrasives, refractories, surface conditioning, and anti-skid systems.

A defining hallmark of BFA is its grain size distribution, which directly influences its functional performance. Coarser macro-grits (F4–F220) are employed in grinding wheels and heavy-duty abrasives, while finer micro-grits (F240–F1200) support high-precision applications such as micro-machining, semiconductor polishing, and aerospace surface treatments. The grain structure enhances both cutting efficiency and thermal stability, underscoring BFA's reliability even in the most demanding operating environments.

The production process integrates carefully selected high-alumina bauxite, carbonaceous reductants (e.g., coke), and iron filings, ensuring thermal efficiency and impurity segregation during high-temperature fusion. Recent advances focus on energy optimization and environmental stewardship, incorporating technologies like waste heat recovery systems, high-efficiency heat exchangers, and Organic Rankine Cycles (ORCs) to minimize energy consumption and reduce carbon footprint. Further innovations in dust management, slag optimization, and automated sorting technologies ensure higher material purity and yield consistency.

Despite its high energy demands, BFA is favoured for its recyclability, chemical stability, and long service life, aligning well with modern sustainability targets. The material exhibits resistance to corrosion, erosion, and mechanical degradation, making it an ideal candidate for refractory linings, precision machining tools, ceramic binders, and transportation-grade anti-skid coatings.

The global BFA market, valued at USD 1.56 billion in 2023, is projected to reach USD 2.07 billion by 2030, driven by expanding industrial applications, advances in production technology, and increasing demand for high-performance abrasives. Asia-Pacific remains the dominant region due to its robust manufacturing base, while North America and Europe are witnessing growing interest from the automotive, aerospace,

and electronics sectors. Concurrently, stricter environmental regulations are reshaping production practices, necessitating greener alternatives and more efficient processes.

This paper delves into the mineralogical composition, microstructural advantages, manufacturing innovations, and global market trajectory of Brown Fused Alumina, emphasizing how "strength and stability in every grain" encapsulates its enduring value across modern industries.

Keywords: High alumina bauxite, Bauxite fusion, Grain size, Abrasives, Refractory, Ceramic binders, Anti-skid coatings.

Mullite: A Versatile Choice for Refractory Application

Gajanan Thakare[1] and Shivani Dinde[2]
[1]Asst. General Manager (R & D)-Mahakoshal Refractories Pvt. Ltd.
[1]Author Email: gajananthakare2001@gmail.com
[2]Author Email: shivani.dinde200397@gmail.com

ABSTRACT

Mullite is high-performance refractory raw material renowned for its exceptional thermal stability, good shock resistance, abrasion resistance, chemical resistance and excellent properties such as low density, superior strength, low conductivity, low thermal expansion, and good fracture toughness. Therefore, mullite is a versatile choice for refractory and ceramic application.

The mineral mullite is an alumina (Al_2O_3) and silica (SiO_2) compound extensively used in traditional and as well as technical applications. The mineral mullite has $3Al_2O_3{\cdot}2SiO_2$ as its stoichiometric composition and is found very rarely in natural rocks. Mullite is becoming an essential material because of its suitability for optical, electronic, and high-temperature structural applications. While calcined bauxite is widely used in refractory applications, its high-temperature properties can be limiting. For high-performance applications in steel, glass, and cement industries, Mullite is often the preferred material for refractory manufacturers.

Classical mullite ceramics are broadly used for porcelain, pottery, whitewares, cement manufacturing, glass production, refractories, kiln slabs, lining for high-temperature reactors, *etc*. The industry relies on synthetic mullite which are achieved by melting or 'calcining' various alumino-silicates such as kaolin, clays, rarely andalusite or fine silica and alumina to high temperatures. One of the best natural sources of mullite is kaolin (as kaolinic clays). It is ideal for the production of refractories such as fired or unfired bricks, Castables and plastic mixes. Sintered mullite and fused mullite are primarily used for the production of refractories and the casting of steel and titanium alloys. Mullite melting point is too high; hence, it uses high-temperature exposed parts and has adequate strength and creep resistance at elevated temperatures. In Mullite, creep resistance, bending strength and are affected by the presence of quartz or glass in grain boundaries, but in the absence of glass into grain boundary, mullite ceramics shows excellent strength at room temperatures and up to 1400˚C.

This paper details the manufacturing processes, properties, and applications of Mullite in both refractory and ceramic contexts.

Keywords: Alumina, Versatile, Creep resistance, Kaolin, Strength, Refractories.

Low-Viscosity Hydrate Composites: Advancements and Applications in Multifunctional Materials

G.C. Basak[1]*, J. Bhure[2] , H.N. Revankar[3], and H. Mitra[4]
[1]Manager, [2]Assistant Manager, [3]Deputy Engineer, [4]Vice President – HIC – Alumina
Hindalco Innovation Centre – Hindalco Industries Limited, Belgaum, India.
**Corresponding Author Email: ganesh.basak@adityabirla.com*

ABSTRACT

Low viscosity aluminium trihydrate (ATH) is prepared by apposite blending of coarse and milled hydrate. Compared to standard ATH, this has several advantages, especially for applications where mechanical properties, processing efficiency, and flowability are crucial in nature. It exhibits a range of unique properties that make them suitable for various multifunctional applications like flame retardant, composites, paints, adhesives etc. Their optimized rheology enhances workability and dispersion, leading to improved material performance. Besides, the combining coarse and milled ATH provides a calculated method for enhancing a material's processing, mechanical, and thermal qualities. However, while low viscosity ATH is highly beneficial for flame retardancy, coatings, plastics, and composites, challenges like settling, storage volume, and potential cost increases should be considered when selecting it for an application.

This study investigates the effects of varying ratios of coarse and milled ATH on the overall performance of the material, dispersion in polymer matrices, and particle packing efficiency. Experimental analysis reveals that a controlled blending (e.g. fine 80% and coarse 20%) enhances flame retardancy, improves surface finish, and balances mechanical strength with processability. The study further explores that loading low viscosity can be raised from normal hydrate loading of 65 to 115% maximum in the polymer matrix and even at higher loading, the viscosity of the polymer doesn't change much (e.g. reduction of viscosity, say, ~35-40% occurred when 150 phr of blended ATH was loaded in lieu of normal ATH into polymer matrix specifically unsaturated polyester resins). Furthermore, blended ATH can enhance sustainability in multiple ways, especially in manufacturing, energy consumption, material efficiency, and environmental impact.

Keywords: Aluminium trihydrate (ATH), Blending, Flame retardant, Viscosity, Sustainability.

IBAAS-IMMT-IIM 2025

ALUMINIUM SMELTING

Improving Carbon Anode Quality and Performance through Process and Equipment Modifications

Khalil Khaji
Consultant
Falcon Consultancy Services for Carbon Anode Plants LLP
Author Email: khajikm@hotmail.com

ABSTRACT

Carbon anodes for aluminium production are made using calcined petroleum coke and coal tar pitch. These materials are byproducts of crude oil refineries and steel plant coke ovens. Due to changes in the sources of feed stocks, and the operations of refineries and coke ovens, the quality of coke and pitch available for anode production has changed. The adverse changes in the quality of raw materials have posed challenges for carbon plants in producing anodes that meet the quality requirements of electrolysis cells. This paper discusses strategies to overcome the impacts of coke and pitch quality changes, and how to improve the anode quality and, performance in electrolysis cells. The strategies include blending of coke, reducing segregation of coke particles entering paste plant, high temperature paste mixing, vacuum vibrocompaction, combustion of pitch volatiles during anode baking, providing slots in the anodes, to name a few. The results achieved have been indicated.

Keywords: C.P. coke, C.T. pitch, Dry aggregate, Baking furnace, Electrical resistivity, Anode slots.

Enhanced Anode Performance in Aluminium Smelter through In-house Process Upgrades

Suryakanta Nayak[1]* and Shashikant Tiwari[2]
[1]Head Improvement Cell and [2]Carbon Plant Technical,
Hindalco Industries Ltd (Unit-Renukoot), Renukoot, India.
**Corresponding Author Email: Suryakanta.n@adityabirla.com*

ABSTRACT

The production of aluminium from alumina through the Hall-Héroult process requires carbon anodes as a key input. These anodes are primarily composed of calcined petroleum coke and coal tar pitch, along with reusable anode butts. Anode production involves three critical stages: green anode manufacturing, anode baking, and anode rodding. This paper presents a comprehensive study of enhancing anode performance in potroom by implementing a series of in-house process upgrades. The research was conducted at Hindalco Industries Ltd, unit-Renukoot, where significant improvements were observed in both the quality and performance of the anodes used in the smelting process. This study highlights the necessity of high-quality anodes for efficient aluminium production. The performance of anodes directly impacts the purity of the aluminium produced and efficiency parameters of the smelting process.

To address the challenges associated with anode performance, a series of process upgrades were implemented. These upgrades were focused on various aspects of anode production, including raw material selection, green anode quality, anode baking quality, and Anode Rodding Operation practices. Each upgrade aimed at addressing specific issues identified in the existing process and optimizing the overall anode quality.

The in-house process upgrades implemented at Hindalco Industries Ltd Renukoot Smelter have significantly enhanced quality of anodes as well as the performance of anodes in the Potroom. The study underscores the importance of continuous process optimization and quality control in achieving superior anode performance and overall efficiency in aluminium production.

Keywords: Anode performance, Aluminium smelter, Process upgrades, Quality control, Efficiency parameter.

Influence of Anode Layout and Cathode Rodding Design on Aluminium Reduction Cell Performance

Pankaj Bohra[1]*, Thalagani Venkannababu[1], Amit Jha[1], Amit Gupta[1], and Vilas Tathavadkar[1,2]

[1]Aditya Birla Science and Technology Company Pvt Ltd, Maharashtra, India

[2]Hindalco Industry Limited, India

**Corresponding Author Email: Pankaj.bohra@adityabirla.com*

ABSTRACT

The efficiency and operational stability of aluminium reduction cells are highly dependent on the internal electrical and magnetohydrodynamic (MHD) behaviour, which in turn are significantly influenced by the anode layout and cathode rodding design. This study presents a comprehensive computational investigation how anode layout by varying side channel gap and the length of the cast-iron joint between the cathode and collector bar impact current distribution and magnetohydrodynamic stability in an aluminium reduction cell. The aim is to identify design configurations that minimize horizontal current components, which are primary contributors to MHD instabilities affecting cell performance. A series of 3D computational simulations were conducted to evaluate three anode footprint positions: (i) fully inside the cathode, (ii) aligned with the cathode edge, and (iii) extending beyond the cathode. For each case, variations in the cast-iron joint length were introduced to assess their effect on electrical and MHD behaviour. Electrical modelling was used to map horizontal current patterns across the cell, followed by MHD simulations to quantify interfacial wave amplitudes and assess overall cell stability.

The results show that horizontal current is highest in the metal when the anode shadow lies inside the cathode and vice-versa, whereas reducing cast iron joint length reduces the horizontal current (maximum and average values) across the cell width. MHD simulations further reveal that the lowest interfacial wave amplitudes occur with the anode footprint lies inside the cathode edge and with reduced length of cast iron joint.

These findings contribute to identifying optimal cathode assembly and anode layout design to enhance cell stability and improve the overall performance of aluminium reduction cells.

Keywords: Aluminium smelting, Anode layout, Cast-iron joint, Horizontal current, MHD stability.

Sustenance of Low Amperage Potlines Under Frequent Power Disturbances

Alok Singh*, Pramod Kumar, Mahesh Sahoo, and Rupesh Pandey
Hindalco Industry Limited, Renukoot, Uttar Pradesh, India
**Corresponding Author Email: alok.s@adityabirla.com*

ABSTRACT

The Hall–Héroult process, central to primary aluminium production, is a highly energy-intensive process. For smooth operation of aluminium reduction cells, it is necessary to maintain bath temp of 960°C. To achieve this temperature, heat energy is supplied to resistive cryolite heating. Stable and continuous supply of electric current plays an important role in maintaining desired thermal state inside the pot. Even a small interruption in power supply can lead to decrease in bath temperature. Such power outage, if persists for long time, can lead to severe effects such as freezing of bath around anodes, increased ledge thickness, cooling of cathode blocks, muck formation due to inefficient alumina dissolution, freezing of metal etc. The operational stability of potlines, particularly low-amperage lines (~70 kA), is therefore strongly sensitive to the frequency, intensity and duration of power disturbances.

This study presents a detailed analysis of 63 recorded power interruptions across 11 potlines comprising 2138 pots between May to August 2025. A comprehensive analysis of power outage on thermal behaviour of pots is studied through computational modelling and real time measurements. Based on findings from this analysis mitigative actions such as maintaining proper bath chemistry and anode cathode distance (ACD). Results demonstrate that rapid normalization protocols and targeted operational adjustments can reduce pot failure rates during high-disturbance periods. The findings reinforce the necessity for aluminium smelters to implement comprehensive outage preparedness frameworks, incorporating real-time monitoring and predictive failure modeling. Ensuring power continuity is not merely operationally advantageous but is a fundamental prerequisite for maintaining the thermal and chemical stability of aluminium electrolysis reduction cells.

Keywords: Aluminium electrolysis, Hall–Héroult process, Power interruption, Potline stability, Low-amperage smelter, Pot recovery, Thermal balance.

Improvement in Anode Quality by Stage Wise Iron Recovery

Anamit Deb Gupta
Deputy General Manager,
Aditya Aluminium Ltd (A unit of Hindalco Industries Ltd)
Author Email: anamit.gupta@adityabirla.com

ABSTRACT

The Carbon Division at the ADITYA Plant plays a critical role in aluminium production by manufacturing high-quality anodes required for the electrolysis process in the potroom. These anodes are not only utilized in the ADITYA Smelter but are also supplied to the HIRAKUD Smelter, ensuring a reliable and consistent supply across both operations.

To enhance operational efficiency and ensure superior anode performance, several initiatives have been implemented focussing on reducing impurities and improving overall anode quality.

At the ADITYA Plant, the anode manufacturing process encompasses the entire raw material and process chain - from the receipt of Calcined Petroleum Coke (CP Coke) to the final forming and baking of the anode blocks. Recognizing the critical impact of impurity control on anode performance and potroom efficiency, a series of strategic initiatives have been undertaken.

Key among these is the installation of magnetic separators at carefully selected points along the value chain. These locations were strategically defined based on material flow and impurity risk analysis to effectively eliminate metallic and ferromagnetic contaminants from the process stream. This proactive approach ensures that the final anodes are of high purity and meet the stringent quality standards.

Keywords: Carbon, Anodes, Initiatives, Magnetic separators.

Laboratory Testing of Silicon Carbide Sidelining Materials for Corrosion Resistance

Andrey Yurkov
Mendeleev University of Chemical Technology, Moscow, Russia
Author Email: And-yur@mail.ru; yurkov.a.l@muctr.ru

ABSTRACT

In Aluminium industry, the laboratory corrosion testing of Si_3N_4-SiC side lining is a sort of a check-in control of material before the use at aluminium smelter.

The damage of N-SiC side lining of the reduction cells due to corrosion may sometimes be the cause of shut down or at least of local repair of the reduction cell. The quality of Si_3N_4-SiC side lining is critical and is one of the key factors affecting the service lifetime of reduction cells.

There are several variants of laboratory corrosion test of Si_3N_4-SiC material for the use in aluminium reduction cell.

SINTEF corrosion test is the most popular. Si_3N_4-SiC rods are exposed to molten aluminium and cryolite in the laboratory reduction cell.

In another test Si_3N_4-SiC samples are pre-oxidized in steam and then subjected for some period of time to the molten cryolite (without electrolysis). Certain companies prefer this kind of testing.

The corrosion test of Luoyang Institute for Refractory Research (LIRR) may be considered as a continuation of SINTEF test; the atmosphere of carbon oxide is taken into account. Si_3N_4-SiC rods contact with aluminium and cryolite during the reduction process.

Recently a new kind of testing had appeared. This kind of test takes into account the change of the level of the bath in the reduction cell. Si_3N_4-SiC rods are dipped in molten cryolite and are lifted from cryolite to air according to certain regime during the whole period of the testing time.

The experiments on corrosion resistance were made according to corrosion test, where the rods are dipped in molten cryolite and are lifted from cryolite to air.

The investigation of the corrosion resistance of industrial Si_3N_4-SiC side lining was made together with the investigation of the microstructure of corroded materials (SEM) and the analysis of the phase transformations (XRD) during corrosion. Different parts of corroded samples (above the level of cryolite, in the corrosion zone and below the level of cryolite) corrode in a different way.

The results of lab corrosion testing are compared with the analysis of porosity and the microstructure of Si_3N_4-SiC side lining after the service in industrial reduction cells.

Keywords: Lab Corrosion Testing, Silicon Carbide, Silicon Nitride, and Side lining.

Amperage Increase at Vedanta Aluminium Smelter GP Prebake Technology Potlines

Vibhav Upadhyay[1], Pratap Singh[2], Bibhudatta Mohanty[3], Ajay Sharma[4], and Prapti Varshney[5]*

[1]Head Potline, [2]Deputy Head SEZ Potlines, [3]Head Innovation and Potline Services, [4]Head Operation Line-4 & 5, [5]Innovation Engineer,
Vedanta Aluminium Limited, Jharsuguda
**Corresponding Author Email: Prapti.varshney@vedanta.co.in*

ABSTRACT

Vedanta Aluminium's Jharsuguda Smelter, one of the largest aluminium production facilities globally, operates six potlines based on GP Prebake Technology, encompassing 1922 reduction cells. The smelter has achieved a significant milestone by successfully increasing the operating current from 340 kA to 350 kA across the SEZ potlines. This

amperage creep has resulted in an overall production uplift up to 1829 KTPA in 2024, registering a 2.7% increase in metal output.

Achieving such a substantial performance gain required a multi-faceted approach that integrated indigenous technological developments, process excellence, and advanced predictive facilities.

The current increase was enabled through a combination of in-house innovations in control systems, optimized pot lining configurations, and advanced process monitoring strategies. These efforts allowed for improved thermal and magnetic stability of electrolysis cells under elevated amperage conditions. The deployment of a proprietary pot control technology contributed to precise process regulation and current efficiency retention, while refined lining designs ensured structural resilience and extended pot life. Modelling and simulation of pot dynamics played a crucial role in pre-empting operational challenges, minimizing energy losses, and ensuring smooth transition to higher current regimes. Throughout the creep program, Vedanta maintained current efficiency above 94.5%, underscoring the robustness of its technical strategy.

This achievement demonstrates Vedanta's capability to drive sustainable performance improvements through self-reliant technology development and data-driven decision making. It also reflects the potential for further current creep in GP Prebake Technology potlines without compromising cell life or operational stability.

Keywords: GP prebake technology, Amperage creep, Aluminium smelting, Process optimization, Predictive modelling.

Mitigating Challenges in Anode Baking Furnace to Accommodate Longer Anodes

Sudhir Patel[1], Prashant Gokhe[2], Girish Choudhary[3], Dibyendu Ghosh[4]* and S. Sasikumar[5]

[1]Deputy General Manager, Anode Baking Furnace
[2]Manager, Anode Baking Furnace
[3]Assistant Vice President, Head Carbon
[4]Manager, Carbon Technical
[5]Joint President, Head Smelter
Hindalco Industries Ltd., Mahan Aluminium, Singrauli, Madhya Pradesh, India
Corresponding Author Email: dibyendu.g@aditabirla.com

ABSTRACT

Mahan Aluminium have AP 36 potline, designed for 360 kA operation. In recent past it had raised the amperage up to 376 kA to cater the rise in demand for aluminium. Such increase in amperage leads to rise in anode current density from 0.893 Amp/cm^2 to 0.933 Amp/cm^2. The anode consumption rate in the pot also increased from 1135 to 1184 kg/pot/day, which had adverse impact on anode butt height as well as operation time i.e., number of shifts. Consequently, the anode height was increased from 650 to 685 mm which helped the pot-room operate with the same shift schedule. To mitigate the

challenge of increased current density, anode length is increased by 30 mm. This paper discusses the equipment retrofitting as well as process modifications done in Anode Baking Furnace (ABF) to accommodate these longer anodes. To ensure smooth handling of longer anodes from central conveyers to the pit of ABF, Furnace Tending Assembly crane was raised up by 200 mm. Operational and mechanical adoptions to carry out this retrofitting are discussed in detail. Due to increase in anode's length its mass also increases. This leads to the release of higher mass of pitch volatiles in preheating sections and higher fuel consumption in heating sections of ABF. To take care of these aspects, draft settings were tuned accordingly. An experiment was performed to check the impact of increase in anode length on baking level of top layer anodes. Procedure and findings from this experiment are also discussed.

Keywords: Anode baking, Aluminium smelting, Amperage creep, Anode current density, Longer anode, Furnace tending assembly.

Aspects to Consider for the Design of Preheating Screw of Anode Paste Plant in Aluminium Smelters for Sustainable Operation and Maintenance

Maheswar Behera
Consultant – Aluminium Industries, Bhubaneswar.
Author Email: mkbuce81@gmail.com

ABSTRACT

The preheating screw raises the temperature of proportioned dry aggregate to a suitable temperature to ensure the optimum mixing of the dry aggregates and liquid pitch. The preheating generates steam by action of high temperature thermic fluid. The steam needs to be extracted by an independent circuit in place of present practice of extraction by proportioning dedusting system. The up-stream generates dusts and is being handled by the proportioning dust collector. The preheating screw down-stream process generates dust, pitch fume and vapour, which are being handled by dedicated pitch vapour treatment system. The above steam of the preheating screw should not enter proportioning dedusting system. The pitch fume and vapour should not enter into preheating screw. This entry can be minimised by installation of a plug screw after preheating screw in the plants where it is not designed. The feeding chute of dry aggregates should not be compromised because of upstream equipment improper layout. The poor feeding arrangement causes the wear-out of the flights of the preheating screws. This leads to leakage of the heating medium. Sometimes it is unsafe as it causes fire. These issues were experienced in operation of different Green Anode Paste plants at different locations with different supplier of preheating screws. The possible solutions like independent steam extraction system, plug screw and the improved feeding chute are presented in this paper.

Keywords: Dry aggregates, Thermic fluid, Steam, Extraction system, Feeding chute, Rotary joints, Screw feeder, and Plug screw.

Opportunities and Challenges in Carbon Plant Upgrade for Smelter Amperage Creeping

Christophe Bouche[1], Gnanaprakasam Mahavishnu[2]*, Aswini Mishra[3], and Katharbatcha Mohideen[4]
[1]Product Director, [2]Projects and Services Head, [3]GAP O&M Head - Hindalco Mahan, and [4]Senior Manager-Carbon Process, Fives
**Corresponding Author Email: mahavishnu.gnanaprakasam@fivesgroup.com*

ABSTRACT

Amperage creeping in the Aluminium smelters aims to increase the metal production at a lower cost without affecting the performances of the smelter (Energy efficiency, Net Carbon Consumption, Stability etc.)

The general trend of aluminium smelters all around the world is to increase amperage in the reduction cells in order to increase profitability through higher metal output

As a consequence of this creeping activity, the aluminium smelters facing lot of challenges in Reduction and Carbon area. To cater to the additional carbon consumption, carbon plant shall increase the anode size to accommodate higher amperage.

Hindalco, one of the major primary aluminium producers in India, is one of the first to implement this change in the Indian smelters

This paper describes the opportunities and challenges through the recent upgrade done by Fives in Carbon plant of the Hindalco MAHAN.

Key interventions include the installation of DYNPAC, Intermediate Weighing Hopper, and Mould Imprints in Green anode plant and the height increase of Furnace Tending Assembly at Anode baking furnace aiming to reduce process variation and to increase productivity and stability

Keywords: Amperage creeping, Anode Size creeping, Sustainability.

Technology Implementation to AI/ML-based Camera Installation in Belt Conveyors for Detection of Larger Butts for System Downtime Reduction in Carbon

Pathivada Chakradhar
Bharat Aluminium Company, Korba, India
Author Email: pathivada.chakradhar@vedanta.co.in

ABSTRACT

In carbon processing plants, belt conveyors play a critical role in transporting materials. However, larger butts or oversized materials can cause system downtime, leading to reduced productivity and increased maintenance costs. This abstract presents an innovative solution using AI/ML-based camera installation in belt conveyors to detect

larger butts and prevent system downtime. The AI/ML-based camera system offers an innovative solution for detecting larger butts in conveyors belt, reducing system downtime and improving productivity in carbon processing plants. By leveraging computer vision and machine learning algorithms, the system provides real-time detection and alert capabilities, enabling prompt corrective action and improving overall efficiency.

Early detection of larger butts prevents system downtime, reducing losses and increasing productivity, The system enables predictive maintenance, allowing maintenance teams to schedule repairs and reduce unplanned downtime. Automated detection of larger butts streamlines the material handling process, improving overall efficiency. The system detects larger butts in real-time, enabling prompt corrective action. AI/ML algorithms provide high accuracy in detecting larger butts, reducing false positives and negatives. The system can be easily integrated with existing conveyor belt systems. Integrating the camera system with other sensors, such as vibration or temperature sensors, to provide a comprehensive monitoring solution. Developing more sophisticated AI/ML algorithms to detect complex patterns and anomalies.

Keywords: AI/ML-based camera system, Belt conveyors, Larger butts' detection, System downtime reduction, Predictive maintenance, Real-time detection.

Technology Implementation to IOT Sensors

Kondepati Vasanthi
Bharat Aluminium Company, Korba, India
Author Email: kondepati.vasanthi@vedanta.co.in

ABSTRACT

IoT (Internet of Things) sensors are devices that detect and measure physical parameters such as temperature, pressure, vibration, and flow rate. These sensors are connected to the internet, enabling real-time data transmission and analysis. IoT sensors use various communication protocols, such as Wi-Fi, Bluetooth, and cellular networks, to transmit data to cloud-based platforms or local servers. IoT sensors have revolutionized industrial monitoring and control, enabling real-time data transmission and analysis. By leveraging IoT sensors, industries can improve efficiency, reduce downtime, and enhance safety. As technology continues to evolve, IoT sensors will play an increasingly critical role in shaping the future of industrial operations.

IoT sensors have numerous applications across various industries, including:

1. Predictive Maintenance: IoT sensors enable real-time monitoring of equipment condition, predicting potential failures and reducing downtime.
2. Process Optimization: IoT sensors provide real-time data on process parameters, enabling optimization and improvement of industrial processes.
3. Quality Control: IoT sensors monitor product quality in real-time, detecting defects and anomalies.

4. Improved Efficiency: IoT sensors enable real-time monitoring and control, improving industrial efficiency and productivity.
5. Reduced Downtime: Predictive maintenance enabled by IoT sensors reduces downtime and maintenance costs.

Integrating IoT sensors with edge computing capabilities to enable real-time processing and analysis. Integrating IoT sensors with AI algorithms to enable predictive analytics and decision-making. Developing robust security measures to protect IoT sensors and data from cyber threats.

Keywords: IoT sensors, Industrial monitoring, Predictive maintenance, Process optimization, Quality control, Real-time data, Remote monitoring, Scalability.

Online Riser Repairing and Welding in BALCO (GAMI Potline)

Sudhakar Bonu
Bharat Aluminium Company, Korba, India
Author Email: sudhakar.bonu@vedanta.co.in

ABSTRACT

Electrolysis process is a continuous process and requires an uninterrupted DC power supply, otherwise electrolyte, liquid metal will freeze in pot and major losses may occur.

As per GAMI design, no risk mitigation plan exists for online repairing of damaged Riser (at location where current bypass to next pot) unless and until entire pot line current is reduced to zero KA. If pot is to be cut out with this condition, then joint drop will be high due to less cross section area (or not able to connect shunt block to riser because uneven surface of riser and shunt block) for current bypass to the next pot, means one riser current load will be distributed to remaining 4 risers. This distributed current will increase the riser load (increases riser temperature & joint plate drop) and may result in aluminium plate welding joint failure. Such failure often leads to failure of the remaining plates, ultimately entire joint, and it may lead to open circuit which results to shut down of entire pot line.

To solve the above problem with high magnetic fields in cells, a kind of contingency tools and equipment are to be used for reducing the magnetic induction intensity of welding position in risers of the pot. The principle of magnetic field is reduced by installing an alternative current bypass busbar system.

By using the online bypass system, we have completed two pots riser repairing rectification and after rectification the shunt drop (joint drop) is found less than 10 mV (Under normal range).

This paper will describe the methodology used to do Risk Management of the critical tasks by innovation of contingency current bypass system.

Keywords: Reduction of Magnetic field Intensity, Riser repairing.

PTM Hopper Replacement

Mritunjay Singh* and Altaf Ansari
Bharat Aluminium Company, Korba, India
**Corresponding Author Email: mritunjay.singh@vedanta.co.in*

ABSTRACT

In the Indian aluminium melting industry, the continuous and efficient operation of Pot Tending Machines (PTMs) is critical to maintaining productivity and safety within the smelter. One of the core components of the PTM, the hopper, plays a vital role in the controlled delivery of materials such as alumina during pot tending operations. Over time, the hopper experiences wear and tear due to harsh operating conditions including high temperatures, abrasive materials, and frequent usage. This degradation can lead to reduced efficiency, safety risks, and unplanned downtime. Addressing these challenges, the PRM (Pot Room Maintenance) team at BALCO (Bharat Aluminium Company) undertook the complex and high-risk task of replacing a PTM hopper.

The hopper replacement task was particularly challenging due to the structural complexity of the PTM, tight spatial constraints, and the necessity of ensuring zero damage to surrounding equipment and operational infrastructure. Furthermore, the replacement had to be performed with minimal disruption to production, which added significant pressure to complete the work swiftly and with high precision. Through meticulous planning, rigorous safety measures, and coordinated teamwork, the PRM team successfully dismantled the old hopper and installed the new one within a tight timeframe of just 18 hours.

This operation marked a significant achievement in the field of plant maintenance and equipment reliability. It demonstrated not only the technical competence of the PRM team but also their ability to manage time-sensitive and high-risk tasks effectively. The entire replacement activity was executed without any safety incidents or equipment damage, adhering strictly to BALCO's operational and safety standards.

The successful completion of the PTM hopper replacement sets a benchmark for similar maintenance tasks across the Indian aluminium industry. It showcases the importance of skilled manpower, pre-task planning, and the application of best practices in industrial maintenance. Furthermore, the operation contributes to improved equipment availability, process reliability, and overall operational efficiency. The initiative underscores BALCO's commitment to operational excellence and continuous improvement in plant maintenance.

Keywords: ***Pot Tending Machine (PTM), Hopper Replacement, Equipment Reliability, Operational Efficiency, Safety Management, and Time-Bound Execution.***

Full Copper Collector Bar Cathode

Rakesh Singh
Bharat Aluminium Company, Korba, India
Author Email: rakesh.singh@vedanta.co.in

ABSTRACT

The aluminium industry is continuously seeking ways to improve the efficiency and performance of its reduction processes. Traditional steel collector bars, while effective, contribute to higher cathode voltage drop (CVD) and energy consumption. To address these challenges, the industry is exploring the use of full copper collector bars, which have the potential to significantly reduce CVD and improve current distribution.

Electrolysis process generates horizontal & vertical components of electric current between anode & cathode. High horizontal component indicates high noise and voltage swing. High vertical component indicates pot stability means high CE & high life. This vertical component can be increased and horizontal component can be reduced by inserting the copper plate in collector bar or used by copper collector bar. Through this, collector bar resistivity will also reduce. Copper is high thermal conductive material, so that heat dissipation will be more in this collector bar and to compensate the heat extra insulation is provided by modified relining design.

The advantages of using Copper collector bar are:

- Lower cathode voltage drops.
- More even cathode current density distribution.
- Increase life expectancy of the cells.
- Copper collector bar helps improving the cell magneto-hydrodynamic *(MHD) state.*

Keywords: Copper collector bar, Lower cathode voltage drops, and Magneto-hydrodynamic (MHD) state.

Technology Implementation to Reduce Generation of Hazardous Paste (Shot Blast Dust)

Ratnesh Tripathi
Bharat Aluminium Company, Korba, India
Author Email: ratnesh.tripathi@vedanta.co.in

ABSTRACT

Sodium is considered as impurity for carbon. Cover bath which is used for covering of anode (contains sodium) got stuck on top surface of spent anode during electrolysis process in pot room. To remove sticky bath layer from top of spent anode, in rodding shop there is shot blasting machine which removes the thin layer of sticky bath and carbon from top surface. In the process of butt cleaning in shot blast machine, shot blast dust is getting generated, which contain mixture of carbon, sodium and iron and its

monthly generation is approx. 270 MT. Shot blast dust fall under hazardous waste category and currently we are disposing it in a secured land field at a cost of ₹ 14300/MT.

Air blowing chamber with dedusting unit installed before shot blast machine resulted in benefit of Reduction of 62 MT shot blast dust generation by recovery of cover bath. Potential saving – ₹ 20.3 Million/year.

Keywords: Shot blast dust, Air blowing chamber, and Spent anode.

Business Excellence Innovation Portal

Jitendra Ahiwar
Bharat Aluminium Company, Korba, India
Author Email: Jitendra.ahiwar@vedanta.co.in

ABSTRACT

Recognizing the need for a centralized, efficient, and collaborative platform, the Business Excellence Innovation Portal has been conceptualized and developed as a comprehensive digital solution for tracking, managing, and approving all improvement-related initiatives across the site.

This portal serves as a unified platform that brings together various key components of continuous improvement, including Improvement Projects, Quality Improvement Projects (QIPs), Focused Improvement Projects (FIPs), Success Stories, and Collaborative Initiatives. The primary objective is to streamline the workflow of project submissions, evaluations, approvals, and impact tracking while fostering a culture of innovation and knowledge sharing within the organization.

The development of the portal is driven by the need to eliminate silos, ensure transparency, and enhance governance in the implementation of improvement projects. It provides a structured interface for employees at all levels to submit project ideas and document outcomes, which are then routed through predefined approval hierarchies based on scope, investment, and strategic alignment. Additionally, the portal enables real-time tracking of project status, key performance indicators, and measurable benefits, thereby ensuring accountability and facilitating data-driven decision-making.

A notable feature of the portal is its capability to archive and showcase successful case studies and best practices, promoting cross-functional learning and replication of high-impact solutions. The system also supports interdepartmental and inter-site collaborations by enabling visibility of ongoing initiatives, fostering synergy and innovation across teams.

From a technical standpoint, the portal is designed with scalability, user-friendliness, and security in mind. It includes customizable dashboards and analytics tools to monitor trends and generate insights.

The Business Excellence Innovation Portal is not just a tracking tool—it is a strategic enabler that aligns with the organization's long-term vision of excellence, efficiency, and innovation. By digitizing and centralizing the management of improvement

activities, the portal empowers teams to contribute more effectively, recognize efforts transparently, and drive continuous progress towards operational excellence.

Keywords: Business Excellence Innovation Portal, Focused Improvement Projects (FIPs), Success Stories and Collaboration.

Advancements in Slot Cutting Technology for Baked Anodes

M. Masiero
Project Manager
Tomorrow Technology S.p.A. – Italy
Author Email: mmasiero@tomorrowtechnology.it

ABSTRACT

This article explores the technological advancements in the production of Anode Cutting Machines by T.T. Tomorrow Technology, a leader in the field, over the past 25 years. It highlights the importance of these innovations in addressing the energy and environmental challenges faced by the aluminium industry. The incorporation of slots in baked anodes enhances energy efficiency during the electrolysis process, significantly improving productivity and pot management conditions. The article details the evolution of Automatic Anode Slots Cutting Machines (ASCMs), emphasizing the flexibility in slot design and the adoption of climb cutting technology, which allows for the production of up to 60 anodes per hour.

Recent developments include the introduction of state-of-the-art 6-mm blades that create 8-mm slots, resulting in a productivity advantage and carbon savings of up to 32% compared to traditional methods. The implementation of an Automated Visual Inspection system (AVI) has further enhanced operational efficiency by monitoring blade wear and facilitating timely maintenance, thus extending blade lifespan and ensuring consistent slot quality.

The article concludes that T.T. Tomorrow Technology's commitment to research and development has established new benchmarks in precision, reliability, and operational efficiency in anode slotting. The advancements in slotted anode technology not only contribute to a reduced carbon footprint but also improve workplace safety and operational flexibility, making it a significant advancement in aluminium smelting.

Keywords: Slots design in baked anodes, Anode slots width reduction, Automatic Anode Slots Cutting Machines, Automated Visual Inspection system, Reduced carbon footprint, Tomorrow Technology.

Auto Cast Slab Casting

Patrik Pålsson
Area Manager – Sales & Engineering
Precimeter Controls AB, Sweden
Author Email: patrik.palsson@precimeter.com

ABSTRACT

Precimeter offers products and technology that help their customers to have hands free casting solutions through their level sensors, flow control actuators, metal level control system and integration.

Through the product and integration support, the customer can achieve process automation, optimize initial fill rate, achieve adjustable metal level, high precision level control and improved metal distribution.

This solution will not only benefit to the customer to have a constant quality in every cast, but it will also help in getting flow control, metal level analysis and thus improvement into the same.

Automatic level and flow control including all above features is a powerful tool providing quality improvement, increased productivity, raw material savings and improved safety

The presentation covers the successful case of Granges, Finspang, which has achieved significant sustainability strides for personnel, environment, and production by implementing Precimeter solutions for more than fifteen years.

Keywords: ***Hands-free Casting solution, Process automation, Quality improvement, Productivity.***

Raising the Standards of Metal Cleanliness in the Casthouse

Jean Christophe Boucher
Internal Sales Manager
STAS INC., Canada
Author Email: boucher.jc@stas.com

ABSTRACT

In an industry where product integrity and downstream performance begin at the casthouse, achieving exceptional metal cleanliness is no longer optional, it's essential.

This presentation will unveil an integrated approach that empowers aluminium producers to control inclusions, optimize fluxing practices, and validate cleanliness with confidence.

Through a combination of innovative processes such as RFI (Rotary Flux Injection) in the furnace or FFD (Flux Feeder for Degasser) in the degasser, we'll show how strategic

interventions during metal treatment can dramatically reduce variability and elevate quality.

The recent introduction of AluClean coupled with the use of Batscan®, a revolutionised inclusions measurement technique, attendees will gain insights into our proven methods to decrease alkalis and inclusions helping to meet the most demanding cleanliness requirements by reducing while enhancing operational efficiency.

Whether your focus is metal quality, casting productivity, or customer satisfaction, this session will provide the know-how to make cleanliness a competitive advantage.

Keywords: Inclusions measurement solutions, Metal cleaniness, Rotary Flux injection, and Batscan.

Pot Turnaround Time Reduction at Hirakud Smelter to Enhance Productivity

Pratap Sahu[1]*, Piyush Mishra[2], Jaydeb Behera[3], Chinmaya Sarangi[3], Ambika Nayak[4], Ritesh Chandel[5] and Kazi Arshad Ansari[6]
[1]Plant Head, [2]Production Head, [3]Lining Manager,
[4]Head Mechanical, [5]Head Electrical, [6]Head Operation Potline,
Hindalco Industries Ltd., Hirakud Smelter, Hirakud, India
*Corresponding Author Email: Pratap.s@adityabirla.com

ABSTRACT

Hirakud Smelter a unit of Hindalco Industries Limited is a part of Aditya Birla Group. Hirakud Aluminium is an integrated aluminium smelting complex which uses GAMI technology and one of the oldest smelters in India, established in 1959. The original potlines were converted from Soderberg to prebake pots in 2009, which had inherent challenges in terms of technology and retrofitting the old pots into prebake.

Aluminium production is a continuous process, and productivity depends on the number of operating pots. Hirakud Smelter maintains pot life cycle of 6 years by relining proactively approximately 10 - 12 pots/month to prevent from any sudden pot failure. To do this we have to achieve pot turnaround time (TAT) below 8 days. As pot replacement is carried out in situ, many challenges are faced during the relining of cells to maintain the pot turnaround time within target.

After lots of brainstorming sessions and analyses, various initiatives were implemented to improve day-to-day operations and maintenance. As a result of it, the TAT has dropped, and production increased. When the project of TAT reduction started, in the financial year (FY) 2021, TAT was 12.7 days, and it was gradually reduced to 7.5 days in FY 2025, compared to the target of 9.0 days. This is the best TAT ever achieved by Hirakud Smelter through continuous improvements in procedures and co-ordination among the teams.

Keywords: Pot idle time, Pot relining, Pot life, Pot changeover, Productivity.

IBAAS-IMMT-IIM 2025

ALUMINIUM DOWNSTREAM

An Effective Interaction of Grain Refinement by TiBAl, TiCAl and Modification by AlSr for Eutectic Modification in Aluminium Foundry Alloys

Pallavi Deshmukh*, Sharath Kumar[1], and S.B. Misra[2]
Manager R&D
Minex Metallurgical Co Ltd
*Corresponding Author Email: pallavi.deshmukh@minexindia.com

ABSTRACT

The present paper explores the application of Al base master alloy containing Sr, Ti and B in simultaneous refinement of coarse columnar α-Al dendrites to fine equiaxed α-Al dendrites and modification refines the morphology of primary and eutectic Si crystals of Al alloy. Ti has a high growth restriction factor (GRF) which correspondingly decreases the grain size without undergoing fading phenomena. A master alloy consisting essentially of, in weight percent: 4-20% Sr, 0.2-5% Ti, up to 1% B, the balance being Al and impurities, to improve the casting and mechanical properties. Moreover, the SrAl4 intermetallic particle size is reduced which, in turn, improves ductility and dissolution time. This is due to the presence of more efficient nucleating particles {(Al, Ti) B2, Al3Ti and commonly formed SrB6 and AlTiBSr particles of the two master alloys in the combined addition}. The presence of Sr does not influence grain refinement and similarly the presence of a grain refiner does not influence the modification of eutectic Si. Titanium boron aluminium (TiBA1) is widely used for the grain refinement of Al alloys and has proved very effective. However, there are some aluminium alloys which are difficult to grain refine with TiBA1. Among these are Al-Li alloys containing Zirconium in which grain size control is particularly difficult. The microstructure of TiCAl contains a dispersion of TiA13 and TiC. The TiC is typically present as evenly dispersed small particles (0.5 to 3 microns). The phase volume of TiC in an alloy containing 1 wt% C is just under twice that occupied by TiB2 in an alloy with 1wt%B. TiAl3 is present as fine needles. TiCAl shows less test to test variation as a grain refiner for 8090 alloy than does TiBA1. TiCAl at 0.4wt% addition rate can provide grain refining of 8090 alloy to a grain size of about 200 microns.

With the addition of 0.2-0.5% of TiBAl in LM series of aluminium alloys enhances the hardness by 10% and the ultimate tensile strength also achieves a significant improvement of 39%. With the addition of AlSr master alloy there is a significant reduction in the porosities in Al foundry alloy by modification in the eutectic Si phase from long needle structure to fine fibers.

Keywords: Grain refinement, Modification, Boron, Titanium, Carbon, Strontium, Growth restriction factor, Microstructure, Mechanical properties.

Optimized Production Planning in Primary Aluminium Cast Houses Through Machine Learning-Driven Order Sequencing

C.A. Jagadish
Principal Consultant, q-Maxim LLP, Bangalore, India
Author Email: qmaximo01@mail.com; Jagadish.chandra@qmaxim.com

ABSTRACT

In a typical primary Aluminium cast house, a range of products is manufactured, including round billets, wire rods, standard ingots, Properzi ingots, horizontally cast T-bars, and rolling ingots, etc. Each of these products possesses distinct characteristics such as specific dimensions, designated production stations, tailored process steps, unique alloy codes, and varied processing times. These variations significantly influence production planning, scheduling, and resource allocation.

Customer orders generally include details like the customer's name, product type, specifications, dimensions, quantities, chemical composition, alloy code, shipping details, and dispatch date. In most cast houses, production planning is usually carried out manually by assigning customer orders to various production stations. This process is not only time-consuming but also relies heavily on the experience and expertise of the planner, often resulting in suboptimal plans.

To address these challenges, a method for automating the sequencing of orders across different production stations is proposed. This method accounts for various properties and constraints, such as minimizing mould and alloy changeovers while ensuring dispatch dates are met. Machine learning/ AI is leveraged to achieve these objectives quickly and enhance production efficiency. Same methodology can be used in many other metallurgical production processes and in smaller production setups.

Keywords: Production Planning, Automatic Production Sequencing, Machine Learning, Primary Aluminium Cast House, and Optimization.

Production of Aluminium Alloy Powders through the Gas-Atomization Process: A Numerical Simulation Study

S. Tejas and Lipak Kumar Sahoo*
Department of Metallurgical and Materials Engineering,
NITK Surathkal, Mangaluru, Karnataka-575025, India
**Corresponding Author Email: lipak@nitk.edu.in*

ABSTRACT

Gas atomization is widely used to produce aluminium alloy powders. In this method, a high-velocity inert gas impinges on a molten metal stream to break it into droplets. The droplets further cool and solidify to form powders. The production of aluminium alloy powders using the gas atomization technique has been investigated using experimental and analytical methods. The experimental methods are very costly, and analytical

methods do not give detailed information about the process. The numerical simulation technique can be a better choice to overcome these limitations. However, limited studies are available on the numerical investigation of the gas atomization process to produce aluminium alloy powders. Therefore, the present work aims to study the production of aluminium alloy powders through the gas atomization process by conducting numerical simulations. The nitrogen has been employed as an atomizing gas. The gas flow field has been obtained from the simulations. The obtained gas field has been employed further to simulate the breakup of aluminium melt stream into droplets for powder formation. The droplet breakup is modelled using the Discrete Phase Model (DPM) coupled with droplet breakup models. The simulations were carried out using Ansys Fluent® software, where the governing equations were solved using the Computational Fluid Dynamics (CFD) method. The final particle size distribution is obtained from the simulations and compared with the published literature. Based on the simulations, it was found that the gas flow field is supersonic, which affects the droplet breakup. The present work will help produce a digital twin for the gas atomization process to produce aluminium alloy powders in various industries. The digital twin can further be employed for design and process optimization with reduced cost, time, and effort.

Keywords: Aluminium alloy powders, Gas atomization, Discrete phase model, Numerical simulation, Computational fluid dynamics, Digital twin.

Evaluation of 5000, 6000 and 7000 Series Aluminium Alloys for Enhanced Metal Air Battery Performance

Biswajeet Tripathy[1], Priyabrata Nayak[2], Goura Prasad Panda[3], and U. Balaji[4]*
[1]Project Associate II, [3]Project Intern, and [4]Principal Scientist,
CSIR – Institute of Minerals and Materials Technology, Bhubaneswar, India,
[2]Research Scholar,
Academy of Scientific & Innovative Research, Ghaziabad, India
**Corresponding Author Email:* balaji@immt.res.in

ABSTRACT

Aluminium-air batteries (AABs) are attracting significant attention as high-energy-density power sources, theoretically surpassing conventional lithium-ion batteries, making them perfect candidates for applications ranging from off-grid installations to electric vehicles. However, the practical realisation of AABs is hindered by inherent challenges associated with several technology bottlenecks. While issues such as the cell stability, susceptibility of reactions to passivation and composition of reaction products are solved by optimising the cell design including anode-cathode-electrolyte combination, the primary performance inhibitor is the higher hydrogen evolution reactions in aqueous electrolytes, cost of high purity aluminium anode, metal utilisation rates, all of which directly contributes either to material loss through corrosion or increases the cost of power and energy density per kg of the anode. Aluminium alloy series, such as 5000 series, 6000 series, 7000 series, containing specific elements, such as silicon, zinc, magnesium, or copper in a certain ratio, have emerged as a highly

effective solution to suppress hydrogen evolution and corrosion; however, they have not been widely researched. The choice of a suitable alloy in terms of performance and cost will lead to substantially improved anode utilisation, higher and more stable operating voltages, enhanced discharge capacity & energy density, paving the way for higher battery performance at an affordable cost per unit energy generated. Among the chosen alloys we report here the lowest hydrogen evolution rate of 0.37 ml/cm²/min in 6082 alloy system with an energy density of 3500Wh/Kg. The cost of using this alloy system is beneficial because it costs INR 375/Kg in comparison to 4N7 aluminium which costs INR 6800/Kg for a similar energy density of 3540 Wh/Kg at a hydrogen evolution rate of 0.13 ml/cm²/min. The cost to benefit ratio is highest when 6082 alloy is used as an anode in AAB.

Keywords: Aluminium alloy, Anode, AAB, Hydrogen evolution reaction, Cost-to-benefit.

Systematic Analysis of Corrosion Resistance and Creep Behaviour of Additively Manufactured and Heat-treated $AlSi_{10}Mg$ Alloys

S.K. Sayeed Ahmed[1], Deepak Adhikari[2], Sourav Ganguly[3], Mayadhar Debata[4], Silani Sahoo[5], Anindya Basu[6], and Pradyut Sengupta[5]*

[1]Final year Int. MSc. Student, CIPET, Bhubaneswar, India

[2]PhD scholar, [3]Scientist, [4]Senior Principal Scientist, and [5]Principal Scientist, CSIR-IMMT, Bhubaneswar, India

[6]Professor, NIT, Rourkela, India

**Corresponding Author Email: pradyut.immt@csir.res.in*

ABSTRACT

Additive manufacturing through the selective laser melting (SLM) technique has assisted the fabrication of complex aluminium alloy components with precision, thereby minimizing waste generation. $AlSi_{10}Mg$, a hypoeutectic Al-Si alloy, is widely used due to its excellent mechanical performance and corrosion resistance. This study aims to assess the influence of two different heat treatments (solutionizing followed by artificial ageing) on the evolution of phase, microstructure, mechanical properties, creep resistance, and corrosion behaviour of additively manufactured $AlSi_{10}Mg$ alloys prepared under an optimized processing condition of 350 W laser power, 1600 mm/s scan speed, 0.04 mm layer thickness, and 0.08 mm hatch spacing. Detailed microstructural analysis revealed modification in the structure from a fine, cellular eutectic Si network (in as-built condition) to coarser Si precipitates (in heat-treated samples). The mechanical characterization indicated that T6-like heat treated sample demonstrated excellent creep resistance with enhanced ductility despite slight reduction in hardness. The corrosion test revealed an improved corrosion resistance in heat-treated sample, particularly for T6-like condition. This establishes that additive manufacturing followed by optimized heat treatment leads to formation of dense, defect-free components with superior combination of microstructure and mechanical properties.

Keywords: Heat treatment, Phase, Microstructure, Creep, Mechanical, and Corrosion.

Additive Manufacturing of Al-based Alloys – A Review

K.G. Prashanth
Department of Mechanical and Industrial Engineering,
Tallinn University of Technology, Tallinn, Estonia
Author Email: prashanth.konda@taltech.ee

ABSTRACT

Additive manufacturing (AM) has emerged as a transformative technique for the fabrication of complex geometries while enabling precise control over material properties. The resulting microstructures exhibit significant deviations from their conventionally processed counterparts, thereby presenting opportunities for targeted microstructural manipulation through post- processing heat treatments. Despite the widespread industrial utilization of Al-based alloys – attributable to their low density and exceptional strength-to-weight ratio—their adaptation for AM has remained relatively constrained. This is primarily due to metallurgical challenges associated with rapid cooling rates and directional solidification. Current research has predominantly centred on castable and weldable AlSiMg-based alloys, which, despite their processability, exhibit limitations in high-performance structural applications. Concurrently, efforts have been directed toward the development of AM-specific AlMgSc alloys derived from the 5xxx series, tailored to enhance printability and mechanical performance. High-strength wrought Al alloys, on the other hand, have historically demonstrated incompatibility with AM due to their susceptibility to microstructural instabilities under rapid solidification conditions. Nevertheless, recent investigations indicate substantial potential in overcoming these material constraints. This presentation provides a comprehensive review of the current state of AM for Al-based alloys, with an emphasis on microstructural evolution and its correlation with mechanical performance. Furthermore, prevailing metallurgical theories concerning defect formation during AM processing are examined, alongside emerging strategies aimed at refining microstructural characteristics. The discussion concludes with an exploration of remaining challenges and prospective advancements in the AM of high-strength Al alloys.

Keywords: ***Additive manufacturing, Aluminium alloys, Rapid solidification, Microstructure, Mechanical properties, Defect formation, Powder bed fusion, Post-processing, Metallurgy.***

Effect of Zirconium on Microstructure and Mechanical Properties of A356 Aluminium Alloy

A.K. Chaubey[1,2]*, Abhishek Barua[1,2] and Anirvan Giri[3]
[1]CSIR- Institute of Minerals and Materials Technology, Bhubaneswar-751 013, India
[2]Academy of Scientific and Innovative Research (AcSIR), Ghaziabad- 201002, India.
[3]Vedanta Limited, Jharsuguda, Odisha
Corresponding Author Email: anil.immt@gmail.com

ABSTRACT

A356 alloy is widely used in automotive manufacturing, aerospace components, rail transit, and other industrial sectors due to its excellent casting properties, including good fluidity, low density, and high specific strength. However, there are α-Al with coarse dendrites and eutectic Si with needle sheets in the microstructure of A356 alloy without refining modification, which breaks the continuity of the matrix and seriously affects the strength and plasticity of the alloy. Research shows that the addition of Sc and Zr in A356 alloy can greatly refine the grain, change the harmful coarse eutectic Si structure and the harmful acicular Fe-containing phase morphology.

In this study, the effect of varying Zr additions on the microstructure and mechanical properties of A356 alloy was investigated. The alloys were prepared through melting and casting, followed by standard heat treatment. Detailed characterization was performed using X-ray diffraction (XRD), optical emission spectroscopy (OES), optical microscopy, and scanning electron microscopy (SEM). Mechanical behaviour was evaluated through tensile testing and micro-hardness measurements. Microstructural analysis revealed that Zr addition resulted in grain refinement and morphological modification of the alloy. This is attributed to the formation of Al_3Zr compounds at grain boundaries due to the reaction between Al and Zr. Room temperature tensile testing showed that the addition of 0.3 wt.% Zr enhanced the tensile strength to over 280 MPa, compared to 240 MPa for the Zr-free alloy, along with a notable plasticity of approximately 5% in the T6 heat-treated condition. These improvements are primarily due to grain refinement and the precipitation of Al_3Zr strengthening phases.

Keywords: A356 alloy, Tensile test, Grain size, Hardness, and Heat-treatment.

Treatment & Recovery Process for Scrap Vehicles and Aluminium

Mattia Molena
Marketing Manager
Panizzolo Recycling Systems, Italy
Author Email: m.molena@panizzolo.it

ABSTRACT

Panizzolo Recycling Systems, founded in Italy in 1946, is internationally recognized as a reliable partner for innovation, efficiency, and long-term performance. The company offers scrap recycling solutions with processing capacities of up to 30 tonnes per hour.

Panizzolo scrap recycling solutions have adopted an approach of analyzing the type of scrap, segregation, shredding, reducing the size of the scrap, separation of difference material of scrap and getting the required ferrous and non-ferrous scrap segregated from the received scrap material.

Scrap recycling by Panizzolo includes pre-shredding, crushing, segregation, sieving, X-ray analysis and separation of various types of scrap in to difference end outputs in order to take every type of scrap towards different process requirement.

With the broadest technology portfolio dedicated to scrap treatment and secondary raw material recovery, Panizzolo offers both standalone machines and turnkey installations, complete with automation software. The high level of engineering allows for quick upgrades and seamless adaptation to evolving production needs.

In the scenario today of increasing demands and requirement of going towards circular economy, Panizzolo scrap recycling solutions help our customers to recover more than 80% aluminium from the scrap, re-melt it and use it for production of aluminium primary / secondary products.

By helping companies increase operational efficiency and sustainability, Panizzolo enables them to maximize their investment and secure a lasting competitive edge in the circular economy.

Keywords: Scrap recycling solutions, Circular economy, Metal recovery through recycling.

Transforming DROSS as By-products into High-value Resources – How New Technology is Recovering Aluminium and other Materials and Creating Circular Revenue Streams

Matthew Swales[1] and Brent Mahoney[2*]
[1] Senior Sales Manager
[2*]Business Development Director
ALTEK Europe Ltd, UK
**Corresponding Author Email:* bmahoney@harsco.com

ABSTRACT

In today's world of sustainability drive, every Cast House, be it as attached to Smelter, or a stand-alone, is focused on Furnace Management.

Typical Furnace Management expectations are

(a) High Melt rate
(b) Higher Yield
(c) Maximum Aluminium Recovery from Dross
(d) Correct Alloy Formation.
(e) Less Door Opening.

EMS technology for contactless Liquid Aluminium Bath stirring can achieve Higher melt rates of melting solids by more than 15%. It also ensures homogeneous temperatures and

mixing across bath for alloy formations. Most of these EMS are as unique as Air cooled and offers safe and longer life keeping furnace door closed. In usual proactive, before each Heat drop, furnace is skimmed to remove generated dross. This dross is collected in Dross Pans.

It is meaningful and scientific to press HOT dross in less than 30 Minutes in dross press chamber, to extract Liquid Aluminium at 15 to 20% recovery of the weight of the dross. The Hot dross pressing also helps in quick cooling down in Press Chambers as it prevents further oxidation and loss of metal. The recovered Aluminium is collected in Dross pan and it is ready for melting. This avoids Dross disposal at Cost.

The secondary recovery is a closed loop ALUSALT process using Rotary Tilt Furnace and 100% Salt Recovery process. Once Maximum Aluminium is recovered by ALUSALT process or RAME (Salt less) Technology, the NMP (Non-Metal Particles) are further sent to Steel Industry.

Altek equipment are used worldwide including India and offers quick payback.In order to achieve correct alloy formation, Altek offers ONSPEC, a patented Online Spectro Analyzer which can measure Alloy Composition in the furnace keeping door closed. This replaces conventional time-consuming Alloy formation measuring technique. As Sustainability and Green Aluminium is driving Customer's demand, it is imperative to adopt Closed Loop Dross Management, Contactless Liquid Aluminium Bath Circulation EMS and ONSPEC analysier to save energy and time.

Keywords: Aluminium cast house, Alloy formation, Melt loss, Dross, Green Aluminium

IBAAS-IMMT-IIM 2025

SUSTAINABILITY, DECARBONIZATION AND ALUMINIUM INDUSTRY 4.0

Decarbonization of Aluminium: Emerging Industry Trends

Adhiraj Seth and Edgardo Gelsomino
Research Associate, Wood Mackenzie, Delhi, India
Research Director, Wood Mackenzie, London, UK
Corresponding Authors' Email: adhiraj.seth@woodmac.com, edgardo.gelsomino@woodmac.com

ABSTRACT

The aluminium industry, responsible for approximately 2% of global carbon emissions, is at the forefront of efforts to reduce greenhouse gas emissions. This paper begins by discussing the sources of emissions — mines, refineries, and smelters — followed by an exploration of the pathways adopted to curb emissions in these sub-segments. These include green technology adoption, renewable energy integration, and the development of circular economies, as well as the shortcomings and limitations of the decarbonisation quest.

The paper highlights key facts, such as the share of emissions originating from bauxite mining and how miners have invested in expanding their fleets of electric vehicles, replacing diesel-powered equipment to reduce emissions. It discusses the challenges of scalability and how such solutions may not be suitable for all miners.

The paper also addresses emissions from alumina refineries and how companies in this space are adopting green technologies to reduce carbon emissions. It will include case studies from Australia, Brazil, and Ireland.

For smelting — the most power-intensive segment of the aluminium value chain—the paper explores the opportunities and challenges producers face in their efforts to incorporate renewable energy into their operations. It discusses examples of smelters from regions, such as Oceania and Europe that have agreed to source green energy or are working on enhancing smelter technologies to allow greater flexibility in power load variations.

Finally, the paper examines the benefits of circular economies and the difficulties the industry encounters in fully incorporating scrap into production flows. Some of these challenges are rooted in technical limitations, while others arise from traditional business models that have historically kept primary and secondary value chains separate.

Overall, this paper delves into the intricacies of the aluminium industry's efforts to reduce carbon emissions, examining the challenges and opportunities that lie ahead in the pursuit of a more sustainable future.

Keywords: Decarbonization, Circular economies, Power-intensive, Green technology.

GRIPS Framework: Operationalising Sustainability Through Green Readiness

Keerthan Jayaramu
Senior Engineer, Bhoruka Extrusions Pvt. Ltd., Mysuru, India
Author Email: keerthan_j@bhorukaextrusions.com

ABSTRACT

In today's industrial landscape, aluminium extrusion manufacturers face growing pressure to embed environmental, social, and governance (ESG) principles into their operations. Yet for many mid-sized plants, meaningful implementation is hindered by unstructured systems, limited digital infrastructure, and reactive management styles.

This paper introduces the GRIPS Framework, a practical model developed at Bhoruka Extrusions to evaluate and accelerate Green Readiness and Implementation Potential (GRIPS). GRIPS comprise five pillars: Governance of Process Discipline, Resource Flow Efficiency, Information Visibility, Partner Transparency, and Sustainability Culture. These pillars align operational systems, ESG goals, and cultural practices into a unified approach for sustainable transformation.

Unlike models reliant on technology or external certification, GRIPS reflect Bhoruka's real-world progress, structured policies, resource optimization, employee engagement, and partner collaboration — all reoriented toward measurable sustainability outcomes. It enables assessment of maturity across key areas and offers clear guidance on improvement priorities.

GRIPS provide a structured lens to view, measure, and integrate sustainability into daily operations. It fosters alignment across governance, resource use, and culture, embedding sustainability into core business functions and value creation. Presented here as both a case study and a replicable model, GRIPS offer aluminium manufacturers a practical, outcome-driven roadmap, grounded in what they already do, but approached smarter, cleaner, and more consciously.

Keywords: Sustainability, ESG, Aluminium Extrusion, Operational Systems, and GRIPS Framework.

Reducing Carbon Footprint in Aluminium Extrusion Industry

B.S. Pavan Kumar
Deputy Manager, Bhoruka Extrusions Pvt. Ltd., Mysuru, India
Author Email: pavan_kumar@bhorukaextrusions.com

ABSTRACT

The aluminium extrusion industry, an important part of infrastructure, transportation, and renewable energy sectors, is also a major source of carbon emissions due to its energy-heavy processes. These emissions, mainly from burning fossil fuels and electricity use, have harmful effects on the environment and contribute to global warming.

This paper explains the main areas where carbon emissions happen during aluminium extrusion and suggests practical ways to reduce them. It looks into common issues like furnace heating, fuel usage, and inefficient energy practices. The paper also discusses possible solutions such as using renewable energy, improving energy efficiency, recycling aluminium, and adopting better production methods. Basic cost details of these improvements are also included.

By taking a broad view of the industry, this paper aims to offer useful ideas that can help aluminium extrusion companies lower their carbon footprint and move toward eco-friendlier and sustainable operations—aiming to support manufacturers in aligning with global sustainability goals while ensuring business continuity.

Keywords: ***Carbon emissions, Energy efficiency, Renewable energy, Sustainability, Emission reduction, Green manufacturing, and Industrial decarbonisation.***

Primary Aluminium Industry Offers Both Challenges and Opportunities for Global Sustainable Solutions

Amit Chatterjee
Advisor-ESG, NPD, Modelling & Simulation
Author Email: Amitac21@outlook.com

ABSTRACT

Manufacturing of Primary Aluminium starts from Bauxite to Alumina and subsequent electrolytic reduction of alumina to metallic aluminium brings challenges which can be converted into opportunities to build a strong Circular Economy. About 4-5 tonnes of bauxites processed to obtain about 2 tonnes of alumina from which about 1 MT (Million Tonne) of aluminium metal can be made. Approximately 1.3 tonnes of Red Mud is generated per tonne of alumina. Also 175 MT of red mud are generated globally which is perhaps the biggest sustainability issue with an estimated accumulation of 4 billion tonnes. Reduction of alumina in Electrolytic Cell by use of coal based electrical energy is one among top three CO_2 emitters in the world. Alumina refinery can be considered as secondary source of Ga and also rare earths like, Scandium, Neodymium from red mud which are big opportunities. Also, electrolytic reduction for alumina to produce aluminium gives rise to wastes with high quality graphite which is an important mineral for decarbonization. This paper will discuss in more detail on how the challenges can be overcome with proper technology, scientific force and strategic economic actions to build a strong circular economy-based Business Model.

Keywords: Rare earth, Red mud, Critical mineral, Sustainability.

Sustainable Mining: Importance of ESG in Bauxite Mines - An Overview

Sudhansu S. Mishra[1]* and Ajaya Choudhury[2]
[1]Deputy Manager and [2]General Manager,
NALCO, Damanjodi, India
Corresponding Author Email: sudhansu.mishra@nalcoindia.co.in

ABSTRACT

The Mining industry has long been associated with environment challenges, community relations and the risks pertaining to investors. The mining industry, particularly bauxite mining, is increasingly under pressure to align with sustainable development goals due to its significant environmental and social footprint. In order to ensure responsible mining activities, environmental, social, and governance (ESG) frameworks have become essential instruments. ESG has changed from being a trendy term to becoming a key factor in determining the survival and destiny of mining companies. This study examines how ESG may support sustainable bauxite mining, highlighting the importance of ethical governance, community involvement, environmental stewardship, future proofing operations and talent attraction and retention. Key focus areas include land rehabilitation, biodiversity conservation, water and air quality management, community engagement, labour rights, and transparency in operations. It looks at how integrating ESG effectively might improve social license to operate, reduce ecological degradation, and promote long-term economic viability. The best approaches and difficulties in implementing ESG are highlighted by case studies from top bauxite-producing regions. In order to achieve sustainability, the study emphasizes the significance of open reporting, stakeholder participation, and regulatory compliance. In the end, the study shows that ESG-driven tactics are essential for guaranteeing the future of bauxite mining in a world that is changing quickly, in addition to reducing risks and increasing operational effectiveness.

Keywords: Mining, Bauxite, ESG (Environment, Social & Governance), Sustainability, SDG (Sustainable Development Goals) & ESG Risk.

Recovered SPL Graphite as a Potential Hybrid Cathode Material in High-Performance Aluminium-Air Batteries

S.K. Mahanta[1]* and U. Balaji[2]
[1]Research Scholar, Academy of Scientific and Innovative Research, Ghaziabad, India,
[2]Principal Scientist, CSIR – Institute of Minerals and Materials Technology,
Bhubaneswar, India.
Corresponding Author Email: balaji@immt.res.in

ABSTRACT

Graphite, a well-known material for manufacturing batteries and electric vehicles, is used as electrodes because of its novel thermal, electrical and mechanical properties. The global market size of graphite in 2024 was 12.2 billion USD, and the projected market will

be approximately 17.8 billion USD by 2030 at a growing CAGR of 6.7%. However, the present market for battery-grade graphite is plagued with supply chain bottlenecks, variability in the quality of synthetic graphite, and elevated cost of synthetic graphite. The Government of India has identified graphite as one of the "Critical minerals" due to its high future supply risk, with special reference to the critical role of graphite in energy storage technologies. The concern for battery-grade graphite is global, and it is essential for the exploration of alternative sources of graphite to satisfy the present market demand. The spent pot liner (SPL) can be a viable source of electrode-grade graphite as it contains a substantial amount of graphite (40-50%). In this work, we utilised SPL to detoxify it and recover high-purity graphite and further exfoliated it partially, to prepare a hybrid graphite-graphene mixed material for use as a cathode in the aluminium-air battery (AAB). The purity and structural integrity of the recovered graphite were analysed using Inductively coupled plasma-optical emission spectroscopy (ICP-OES), fixed carbon analysis, Raman spectroscopy and X-ray diffraction. The performance of this material as a cathode was measured by galvanostatic charge-discharge (GCD) techniques. An energy density and capacity density of about 1800 $WhKg^{-1}$ and 1300 $mAhg^{-1}$ respectively were achieved with a working potential of about 1.3 V per cell. The higher stability and working potential of this cathode prepared from the hybrid cathode sourced from SPL surpasses that of synthetic graphite, owing to higher active catalytic sites for ORR. The reported performance of this recovered graphite from SPL makes it an ideal cathode material for AAB batteries and holistic utilisation of the waste material.

Keywords: SPL, Graphite recovery, Graphene, Aluminium-air battery and Cathode.

Reduction of Carbon Footprint through Optimization of Steam Consumption in Vedanta Alumina Refinery

Bhumika[1]* and Debadutta Ray[2]
[1]Technical In-Charge and [2]Area Manager,
Vedanta Limited, Lanjigarh, India
Corresponding Author Email: bhumika@vedanta.co.in

ABSTRACT

The Vedanta Alumina Refinery is a significant industrial facility that plays a crucial role in the production of aluminium. A vital component of a refinery's operations is the consumption of steam, with excessive steam demands increasing energy prices and having an adverse effect on the environment. This study focuses on the specific steam consumption of the refinery's carbonization process, a critical step in the production of alumina. Reducing the consumption of energy and environmental impact is a critical task for the Vedanta Alumina Refinery, a major alumina producer. The specific steam consumption (SSC) in the refinery, a crucial factor influencing energy economy and profitability, is the subject of this study. One promising method that has been investigated to reduce SSC is decarbonization. This study offers a thorough analysis of the SSC reduction attained at the Vedanta Alumina Refinery.

As a part of the decarbonization roadmap 2030, major initiatives include the transition of the HFO usage in Calciners & coal in Powerplant can be alternated by use of Natural Gas in Calciners & Boilers with part utilization of Biomass firing in boilers, which in return would lead to -30% reduction in T-CO_2, one of the projects is the reduction in the energy consumption across the alumina refinery which accounts to the 25% of the total T-CO_2 reduction.

Thus, with the same vision the team has taken up the project for the reduction in the specific steam consumption from 1.68 to 1.64 tons of steam consumption per ton of alumina production. Achieving this reduction will not only improve the operational efficiency of the plant but also contribute to cost savings and a lower environmental footprint.

Keywords: Specific steam consumption, Decarbonization, Alumina refinery, Process optimization.

Smart Aluminium Smelters – Opportunities, Challenges & Success Stories

Pradip Ranjan Choudhury
Former Executive Director, Smelter and Power
National Aluminium Company Ltd.
Consultant, Sustainable Technology- Aluminium
Author Email: pradiprc01@gmail.com

ABSTRACT

The Aluminium industry is undergoing a significant transformation with the advent of digitalization. Leveraging advanced technologies such as Industry 4.0, artificial intelligence, and data analytics, Aluminium manufacturers can enhance operational efficiency, reduce costs, and improve product quality while significantly improving their environmental footprint. Digitalization enables real-time monitoring and predictive maintenance, reducing downtime and increasing productivity. Advanced analytics and machine learning algorithms can optimize production processes, improve yield, and minimize waste. Moreover, digitalization facilitates the development of smart factories, where production is highly automated, and processes are optimized for sustainability and efficiency.

The backdrop for digitalization has been the global concern for unabated GHG emissions with 1.1 billion tonnes of CO_2 equivalent emitted annually by Aluminium sectors alone. The transition strategy spelt out by Mission Possible Partnership and International Aluminium Institute is making net zero possible by 2050 on a 1.5^{o}C-aligned pathway for Aluminium. Thus, the potential of digitalization is being explored for achieving sustainable practices within the Aluminium value chain consisting of Bauxite Mining, Alumina Refinery and Smelter. Several Aluminium manufacturers have already successfully implemented digitalization strategies, achieving significant benefits. For instance, some companies have used digital twins to simulate production

processes, while others have implemented advanced analytics to optimize smelting and refining operations.

This paper will discuss the opportunities, challenges associated with digitalization specifically in the Aluminium smelters, highlighting success stories and best practices. The insights and implementation strategies provided in this study can serve as a roadmap for Aluminium industries seeking to leverage digitalization for sustainable growth. The next gen Smelter powered by digitalization on the Industry 4.0 platform has been presented, specifying the focused interventions in the four major areas, namely, Substation, Potlines, Carbon Plant and the Cast House for achieving the highest degrees of asset performance, process optimisation, energy efficiency, and reduction in GHG emissions. The challenges faced while embarking upon digitalization of Smelters like technological barriers, legacy system integration, equipment integration and interoperability, data management, cybersecurity and above all the return on investment are discussed in this paper.

The salient steps for digitalization of a legacy Aluminium smelter, namely, assessment of current status and digital maturity, setting up sustainability goals, identification of key data points, implementation of sensor technology, data integration and management, data analysis and visualisations, automation and control systems for real-time adjustments to processes and equipment have been explored.

Notable success stories include implementation of digitalization by some of the global aluminium industries like Hydro's, Emirates Global Aluminium, Alcoa as well as the aluminium majors in India. Digitalization in these plants include use of digital twins to optimize smelting operations for reduction in energy consumption, advanced analytics to predict and prevent equipment failures, thus reducing downtime substantially, and also machine learning algorithms to optimize production processes, resulting in significant yield improvements. Implementation of a digital platform to monitor and optimize production in real-time enables data driven decision making in some of the smelters. These success stories demonstrate the potential of digitalization to drive efficiency, sustainability, and competitiveness in the aluminium industry.

Keywords*: *Digitalization, Industry 4.0, GHG emissions, Process optimisation, Digital twin, Advanced analytics.

Digital Prescription Modelling for Smart Steam Optimization in Evaporator Circuit of Alumina Refinery

Parth Kamani[1]*, Bharathesh Kumar[1], Chandrakala Kari[1], Kumar Ayush[2], Richa Sharma[2], Debashis Tripathy[2], and Prasanta Bose[2]
[1]Aditya Birla Science & Technology Company Pvt. Ltd. Taloja MIDC Panvel, India,
[2]Hindalco Industries Ltd., Muri, India
Corresponding Author Email: parth.kamani@adityabirla.com

ABSTRACT

The rise of Industry 4.0 has accelerated the integration of advanced digital technologies into industrial operations, enabling smarter decision-making, optimized resource utilization, and greater control over complex processes. In alumina refineries, the adoption of machine learning (ML) and real-time analytics are driving significant gains in productivity, energy efficiency, process safety, and environmental performance.

This study presents the successful implementation of a machine learning-based steam prescription model at evaporator circuit of alumina refinery utilizing the Bayer process to extract alumina from bauxite. Among the critical stages, evaporation circuit plays a key role in the plant's operational economics. A key parameter here is the thick liquor concentration and steam economy, which must be strictly controlled. Steam economy determines the economics of unit, hence its critical parameter that needs to be controlled. Variations in thick liquor concentration can lead to cascading issues such as poor alumina recovery, mismanagement of liquor volumes, and operational disturbances in upstream and downstream units. Traditionally, these parameters are monitored via laboratory analysis of thick liquor concentration with few hours lag often resulting in retrospective and suboptimal process adjustments.

To address these challenges, a machine learning solution based on the Extreme Gradient Boosting (XGBoost) algorithm was implemented to predict key process parameters such as thick liquor concentration and steam economy with over 90% accuracy using live Distributed Control System (DCS) data. Unlike conventional models that require periodic retraining and often lose relevance under changing operational conditions, this model is trained in real time, enabling it to continuously adapt to variations in process behaviour and operational scaling without manual intervention. Beyond prediction, the solution incorporates a prescriptive layer that dynamically recommends optimal steam input based on current process conditions. These recommendations are further validated through embedded rule-based logic to ensure operational safety and compliance with plant standards. Both predictive and prescriptive outputs are displayed in a web-based graphical user interface (GUI) integrated with PI Aveva, updated at five-minute intervals, providing operators with actionable insights for proactive decision-making. This approach significantly enhanced process agility, reduced dependency on delayed laboratory data, and supported consistent quality and energy efficiency. Most importantly, it exemplifies the application of artificial intelligence and autonomous control strategies to build resilient, self-optimizing refinery operations.

Keywords: Industry 4.0, Prescriptive analytics, Machine Learning (ML), Steam optimization, Bayer process, Evaporation circuit.

A Machine Learning Model for Aluminium Pot Longevity: Sustainable and Cost-Efficient Operations

Rohit Chaudhari* and Amit Gupta
Aditya Birla Science and Technology Company (P) Ltd, MIDC, Taloja, Panvel, Maharashtra, 410208, India
**Corresponding Author Email: rohit.chaudhari@adityabirla.com*

ABSTRACT

Maximizing the lifespan of aluminium reduction cells or pots is critical for improving operational efficiency and reducing costs in Aluminium industries. Traditional preventive maintenance often results in premature shutdowns, thereby limiting cell utilization effectively. In this study, a Machine Learning (ML) based model is developed to predict the Remaining Useful Life (RUL) of aluminium reduction cells. For the model development, plant historical data and smelting process knowledge were used to create a Threat Index, that quantifies discrete degradation events such as power outages and impurity spikes. This threat index was used along with other process data, while integrating a similarity and survival-based models to predict the RUL. This ML model development also had utilised certain core algorithms like, Principal Component Analysis, Random Forest Regression, and Cox Proportional Hazards modelling for accurate model prediction. The model was trained on data from more than 300 pots and validated on 14 pots shutdown data, achieving a mean absolute error of just about 11 days. This model has its utility in extending the cell / pot life, resulting in lowering cell lining cost per year and better-informed decision for pot shutdown, with critical pot being shut first. It would also benefit in reducing the generation of spent pot lining (SPL), a hazardous waste, thereby enhancing process sustainability and cost effectiveness. This paper demonstrates a significant advancement toward machine learning based real-time health monitoring of aluminium smelting pots, while also offering pointers for developing solutions for prognostics in other high-risk industrial processes.

Keywords: Aluminium reduction cells, Spent pot lining, Remaining useful pot life, Machine Learning, and Predictive maintenance.

Measurement of Bauxite Stockpile Volume through Vision AI

Sanjeev Mishra[1] and Bhumika Khare[2]
[1]AGM and [2]AM
Vedanta Limited, Lanjigarh, Orissa, India
Corresponding Authors' Email: sanjeev.mishra3@vedanta.co.in
Bhumika.Khare@vedanta.co.in

ABSTRACT

Bauxite Stockpile management has always been a critical component of inventory control in Vedanta that rely on raw materials, such as Bauxite and Coal. Efficient stockpile volume measurement plays a pivotal role in ensuring that inventory is accurately tracked, material waste is minimized, and operational costs are optimized. However, traditional methods of measuring stock volumes are fraught with challenges. These techniques are not only inefficient but can also lead to inaccurate data and safety risks.

This study offers review to explain the concept of Vision AI and LiDAR (Light Detection and Ranging) by offering precise volumetric measurement and real-time monitoring.

We are planning to utilize combination of LIDAR's 3D mapping and IP camera feeds which will allow for accurate stockpile volume estimation, even in complex material environments. This technology automates the process, providing operators with continuous data on volume, weight, and material density, significantly reducing human error. IMUs are used to measure the orientation and motion of the LiDAR system. This data helps compensate for any movement or vibrations during data collection.

The laser scanner sends out laser pulses at high frequencies that bounce back when hitting an object. It sweeps over a wide area, and sensors detect the reflected light, measuring the time for each pulse to return. This data, combined with GNSS receivers for precise positioning, allows for accurate distance measurements and georeferencing. LiDAR technology improves speed, accuracy, and safety in measuring large stockpiles across industries.

Further study in under progress to implement LiDAR-based measurements, which can improve inventory management, and production planning, and ensure compliance with regulations while reducing costs associated with traditional measurement methods. As technology continues to advance further in this field, we can expect even more efficient and accurate solutions for managing large-scale stockpiles in the future.

Keywords: Vision AI and LiDAR (Light Detection and Ranging), LIDAR's 3D mapping, IP camera.

Touching Lives, Since 1960

About Ashapura Group

With a legacy of more than 60 years, Ashapura is a leading multi-mineral solutions provider with a global footprint, having a wide network of operations in several states within India and in 7 other countries.

We at Ashapura provide a wide range of solutions that touch billions of lives, every moment, every day! From soaps to steel, energy to edible oils, metal to medicine and from cement to ceramics, we have vicariously become an integral part of your life by offering intermediate mineral solutions, ores and additives to several industries.

Our captive mineral resources, state-of-the-art manufacturing base, cutting edge research capabilities, logistical prowess and 4,000 dynamic, progressive, result oriented employees accord us global leadership in several segments.

Ashapura means "Fulfilling Aspirations"; we believe that sustainable growth occurs only when we fulfill aspirations of all our stakeholders such as customers, employees, shareholders, the environment and the society at large.

Domain Leadership

- → World's 3rd largest producer of BENTONITE
- → World's 3rd largest BLEACHING CLAY producer
- → Leading Exporter of BAUXITE
- → India's largest producer of REFRACTORY MATERIALS
- → India's largest producer of PROPPANTS

Ashapura Group of Industries
278, Jeeven Udyog Building, Dr D. N. Road, Fort, Mumbai - 400 001, India
Tel - +91-22-6665 1700
info@ashapura.com www.ashapura.com

ASHAPURA
Group of Industries

SYENSQO
ADVANCING HUMANITY

Proud Innovator & Pioneer for Alumina Industry

- Comprehensive and proven product offerings in Bayer chemicals
- Strong focus on breakthrough innovations
- Deep applications know-how & tech services
- Dedicated and global team at your service

CYFLOC®
Red Mud Flocculants
(HXPAM, EPAM, DPAM)

CYBREAK®
Defoamers

MAX HT®
Scale Inhibitors

AEROSPRAY®
Dust Control

CYFLOC® HF
Hydrate Flocculants

AERODRI®
Dewatering Aids

CYQUEST®
Processing Aids

SYENSQO.COM

ALTEK
AN ENVIRI COMPANY

Industry leading air-cooled furnace stirring technology

Increasing productivity, reducing energy and improving operational efficiency

The ALTEK Electro-Magnetic Stirrer (EMS) is the most versatile and advanced air-cooled furnace stirring system available to the industry. Pioneers in this field, Altek's EMS has been installed around the world on a variety of furnace types and sizes, from reverbatories up to 145T capacity, to curved EMS designs for dome furnaces, and applications for scrap submergence as well.

Benefits include

- Increased furnace productivity – up to 25%
- Reduced energy consumption – up to 15%
- Reduced metal loss – up to 25%
- Guaranteed temperature and chemical homogeneity
- Bottom and side-mounted applications available
- 100% air-cooled inductor

PART OF OUR LEADING END-TO-END DROSS MANAGEMENT SOLUTION

altsales@harsco.com | www.altek-al.com

THANK YOU

OUR HEARTFELT THANKS
FOR YOUR PRESENCE AND SUPPORT AT THE
IBAAS-IMMT-IIM 2025 CONFERENCE & EXHIBITION.

WE ARE DEEPLY GRATEFUL
TO OUR SPEAKERS, EXPERTS, SPONSORS AND PARTNERS FOR
THEIR GENEROUS BACKING,
AND TO
EVERY ATTENDEE FOR CONTRIBUTING TO
THE VIBRANT DISCUSSIONS AND NETWORKING
THAT MADE THIS CONFERENCE SO SPECIAL.

IBAAS-IMMT-IIM 2025

ROMCO
ALUMINATES
PVT. LTD.

RomAlux

Premium Grade White-Fused Alumina

Sustainable by Design : Produced through energy-efficient processes, offering a lower carbon footprint for eco-conscious operations

Proudly Made in India : Manufactured using high-purity indigenous raw materials for complete value addition & self-reliance

Performance You Can Rely On : Proven across diverse refractory applications for consistent quality, durability, & customer trust

AA-15, Civil Township, Rourkela
769 012, Odisha, India

+91 9861200735 | +91 9437043403

marketing@romco.co.in

VENUS ENGINEERING WORKS

"Solutions You Can Trust"

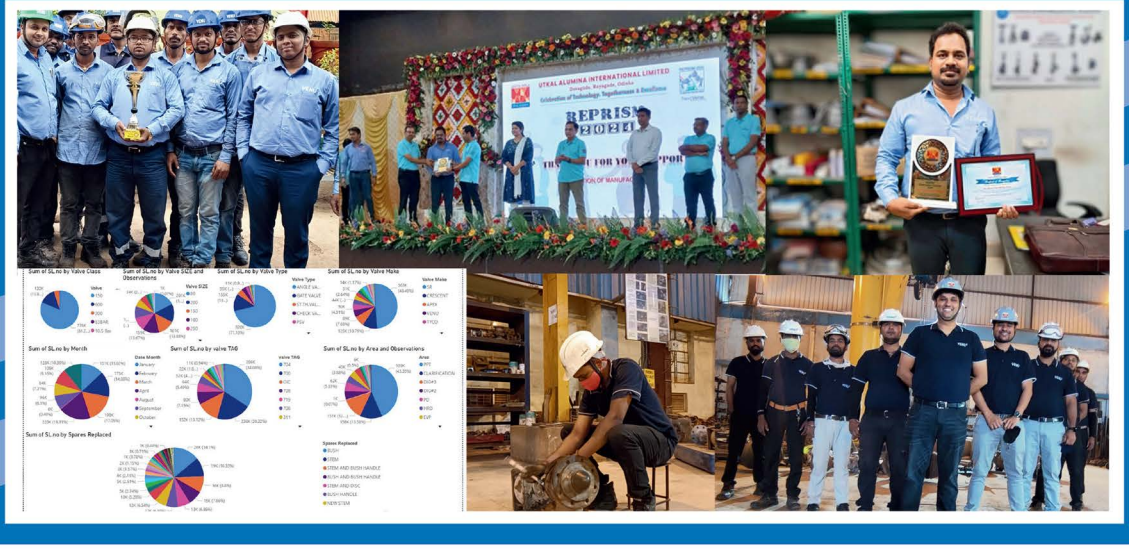
VENU®

Comprehensive Process Flow Control solution for the Alumina Plants

One Stop Solutions for Manual & Instrumentation Valves
Pressure Range Upto 2500# and Size Range Upto 2100mm NB

OUR SERVICES:

INSTALLATION || SHUT DOWN || AMCs FOR VALVES & PUMPS



VENU®

Check Out Our AI-Enabled Valve Assistant Bot

23-24, Shiv Aradhna Industrial Park, Kuha, Ahmedabad-Indore Highway, Ahmedabad - 382433
+91 94291 29327 (Office) / +91 91736 62251 (Sales) sales@venusengineering.co.in www.venusengineering.co.in

THANK YOU

GOLD SPONSORS

SNF WATER SCIENCE

ROMCO ALUMINATES PVT. LTD.

SILVER SPONSORS

TOKAI COBEX

FLS

SUPPORTERS

NALCO Water An Ecolab Company

EPIQ MACHINERY | MACHINERY

LUNCH SPONSOR

fives

LUNCH CO- SPONSOR

DHARTI GROUP

DINNER SPONSORS

ASHAPURA Group of Industries

SVENSQO ADVANCING HUMANITY

EXHIBITORS

SNF WATER SCIENCE

WESTECH SWIRE WATER

RIEDHAMMER CARBON BAKING TECHNOLOGY

ALTEK AN ENVIRI COMPANY

ADHITECH

Heraeus Electro-Nite

INDFAB PROJECTS

ROMCO ALUMINATES PVT. LTD.

U3S

Parker DISTRIBUTOR HYDRAULIC TECHNOLOGY CENTER

ELMECH BBI

Drache

PRECIMETER Molten metal level control

TOMORROW TECHNOLOGY

BRUNO PRESEZZI

skamol

GOUDA refractories

DUCON CONSISTENCY IN PERFORMANCE

STAS

panizzolo recycling systems

MEDIA PARTNERS

AL CIRCLE THINK ALUMINIUM. THINK AL CIRCLE.

INTERNATIONAL ALUMINIUM Aluminium, shaping a better tomorrow

ALUMINIUM INTERNATIONAL TODAY

METALWORLD Devoted to Foundry & Non-Ferrous Metals Industry

METAL ASIA

MINES & MINERALS REPORTER A MONTHLY MAGAZINE ON MINES & MINERALS

Minerals & Metals Review

MTLEXS