IBAAS 2014

INTERNATIONAL BAUXITE, ALUMINA & ALUMINIUM SYMPOSIUM

SOUVENIR

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VISAKHAPATNAM, INDIA

Table of Contents

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in the service of aluminium industry

25 years of Commendable Service

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Develop indigenous technologies and provide value addition services to both primary and secondary aluminium industries with a special emphasis on energy reduction and environmental sustenance through scientific research and development for industrial growth and socio-economic development.

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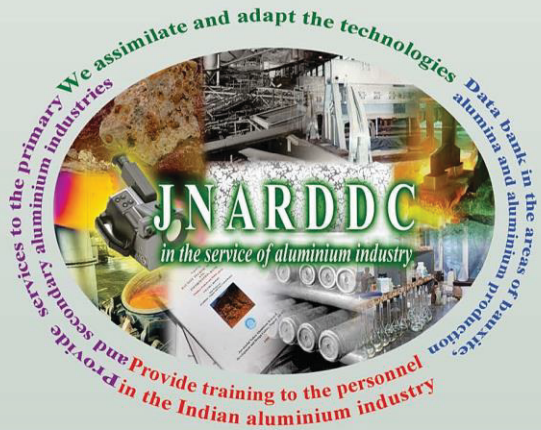

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Jawaharlal Nehru Aluminium Research Development and Design Centre
(Autonomous Body under Ministry of Mines, Govt. of India)
Amravati Road, Wadi, Nagpur-440 023 (MS)
Phone : 07104- 220017, 220476, Fax: 07104-220942
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Furnace to Finish Solutions for Your Casthouse Needs

Almex USA Inc. Company Profile

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Furnace to Finish Solutions

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With the understanding that one-size doesn't fit all, Almex designs all of its equipment and technology to be fully customizable to meet the customer's specifications and requirements. The solutions offered by Almex today reflect this extensive knowledge and are born from the rigorous requirements of aluminum production for aerospace applications. Through these guiding principles, Almex continues to develop solutions that equip aluminum producers with the capability to develop new products and new markets to reach new levels of quality, productivity, and efficiency.

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- Degassing & purification system: **LARS®**
- Casting machines: **MEGA™ + MiniCast™**
- Automation software: **CASTRIGHT II™ + SCADA**
- Inspection & testing equipment: **ULTREX™, Z-MET™, and LUMEX™**
- Metal transfer launders: **MOLDEX™**
- Grain refiner wire rod feeders
- Melting furnace technology
- Ceramic foam filtration: **FILTREX™**
- Deep bed filtration (DBF)
- Alloy development services
- Complete turnkey casthouse supply
- Engineering services
- Complete cooling water systems
- R&D partnerships
- Modernization packages
- Technology training services

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SESA STERILITE Ltd.

Company Profile

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Sesa Sterlite Limited ("Sesa Sterlite") is one of the world's largest diversified natural resource companies. Our business primarily involves exploring, extracting and processing minerals and oil & gas. We produce zinc, lead, silver, copper, aluminium, iron ore, oil & gas and commercial power and have a presence across India, South Africa, Namibia, Ireland, Australia, Liberia and Sri Lanka. Sesa Sterlite has a strong position in emerging markets with over 80% of its revenues from India, China, East Asia, Africa and the Middle East.

Sustainability is at the core of Sesa Sterlite's strategy, with a strong focus on health, safety and environment and on enhancing the lives of local communities.

Sesa Sterlite is a subsidiary of Vedanta Resources Plc, a London listed company. Sesa Sterlite is listed on the Bombay Stock Exchange and the National Stock Exchange in India and has ADRs listed on the New York Stock Exchange.

About Lanjigarh Refinery

The Alumina Refinery at Lanjigarh includes other associated facilities such as; a 75 MW Captive Co- Generation Power Plant (CCGPP), 65 Kilometer Water Pipeline from Kesinga to the Plant and 16 Kilometer long Railway Corridor connecting the Refinery to nearby Ambodala Railway Station.

The Company is planning to expand the Plant from 1 Million to 6 Million TPA. This is the only Alumina Refinery in the Country having successfully implemented Zero Discharge System and actively working on the Zero Waste Project for the first time across the Globe An investment of approximately Rs. 5,000 Crores already has een incurred for the existing Project and on completion of the expansion, the total capital outlay will be to the tune of Rs. 12,000. The project provides direct and indirect employment/ livelihood to nearly 7,000 people i.e. supporting a population of 35,000.

SECTION I

Bauxite Geology, Mining and Beneficiation

An Overview on Bauxite of Gujarat State – [India]

D.U. Vyas1, R.L.Bhatt2 & P.R.Shah3
General Manager (GEOLOGY & TECHNICAL)
General Manager BAXUITE MINES – KUTCH
SR. MANAGER- GEOLOGY
GUJARAT MINERAL DEVELOPMENT CORPORATION LIMITED
(A Government of Gujarat Undertaking)
Ahmedabad, Gujarat, India
Email – geo@gmdcltd.com, duvyas@gmdcltd.co.in

ABSTRACT

Although India is well endowed with bauxite resources and ranks 5th among all nations in terms of identified bauxite resources, there is great deal of research on beneficiation of bauxite and for manufacturing value added products out of bauxite.
As Gujarat is having very good infrastructure facility and the deposits are also close to sea shore & Gujarat has already shown generosity in framing investor friendly policy and a large number of industrialist have roped in and there are further scopes in bauxite based industries.
Gujarat a vibrant state, have bauxite resources and bauxite based industries in Kutch, Jamnagar districts etc. and its scope for surveys, exploration, mining, beneficiation, R & D work & manufacturing value added products are enough with the help of latest technology.

EXPERIMENTAL TRIAL OF SITE MIXED EXPLOSIVES IN DEP HOLE BLASTING – A CASE STUDY OF BAPHLIMALI BAUXITE MINES

Singam Jayanthu* and Y V Rao**
Professor, Mining Engineering Department
National Institute of Technology, Rourkela-769008 –Orissa
** Former Director, NIT-Warangal

ABSTRACT

This paper presents the details of experimental trial of bulk explosives in bauxite mines and evaluation of explosive properties in the field. Blast vibration study was conducted in Baphlimali Bauxite Mines under M/S Utkal Alumina International Limited for estimation of Explosive charge per delay for keeping the ground vibrations within the safe limits of Peak particle velocity and frequency. A number of blasts were monitored during 24th September, 2013 to 1st October, 2013 to study various blast parameters related to blasting of Overburden and benches and to understand the effect of blast on the surrounding structures.

Peak particle velocity and frequency of ground vibrations due to blast at different distances from the blast site were measured with suitable instruments in the field. Blasting operation with bench heights of 5.5 – 8.0 m was observed to be safe and productive with powder factor of 2.41 to 4.22 ton/kg of explosive with 520 kg of SME charge per delay, and 80 kg of SME charge per hole with 3.5- 4.5 m spacing, and 2.5 – 3.5 m burden. Emulsion matrix is a non-explosive material having density of 1.40 g/cm^3. The density of emulsion matrix is reduced by chemical gassing and for density below 1.30 g/cm^3 detonation was observed. The density was 1.3 g/cc with gassing, and reduced to a minimum of 1.04 g/cc even after 4 hours of gassing. Ground vibration levels and air overpressures were within the safe limits for a distance beyond 110 m from the blast site with good fragmentation, muck profile, and acceptable fly rock.

Significance of grain size of Bauxite and Laterite during Beneficiation

P G Bhukte & S P Puttewar

Jawaharlal Nehru Aluminium Research Development and Design Centre
Amravati Road, Wadi, Nagpur, India - 440 023

ABSTRACT

JNARDDC have been evaluated bauxite and laterite deposits of India and carried out extensive beneficiation studies on East coast, Central India, West coast and Gujarat bauxite and laterite. The studies carried out with an aim to reduce iron and silica content as well as enrichment of alumina. It comprises techniques such as screening/sieving, magnetic separation, chemical leaching and roasting. The characteristic of bauxite as well as laterite varies from deposit to deposit. It is observed that apart from common parameters such as magnetic intensity (gauss), temperature, acid concentration etc., the ore characteristics and grain size plays an important role in beneficiation processes. The results indicated that during beneficiation processes, a particular grain size achieve the optimum result in relevant to reduction of impurities, enrichment of alumina and recovery of ore.

In this paper an attempt is being made to focus on salient characteristics of various beneficiation studies carried out at JNARDDC and importance of grain size of ore in beneficiation techniques.

Key Words: Bauxite; Laterite, Beneficiation, Grain size, Physical separation, Leaching

Review of Resources, Past Mining and Future Prospects of Jamnagar Bauxite Deposits of Gujarat

P.K. Raichura
Saurashtra Calcine Bauxite & Allied Industries Ltd.

ABSTRACT

In 1979-80, Bauxite of Jamnagar District of Gujarat was de-reserved & given to private sectors for development of mines and captive use. Many rotary kilns & small vertical shaft kiln were set up for Bauxite Calcination in the Gujarat state. Since then, the mining of high grade Bauxite, also known as Plant feed grade started and initially the recovery was around 80/90% in 1952-60, then this has come down to 10/12% right now. To fulfil the total demand for captive high grade bauxite of 700,000 tonnes per annum for all existing Calcination Plants of Jamnagar area, considering very poor recovery, it has become necessary to mine at least 6 Million tonnes bauxite per annum and selectively take high grade white ore. After 700,000 tonnes of captive consumption, remaining low grade ores of about 5.3 Mt (Non Plant Grade) can be used for Value Addition.

But according to technologies available in the market, out of 5.3 Mt of NPG Bauxite, hardly 1.3Mt can be used for its Value Addition. Emery, Alum, Zeolite, and Cement industries are the main buyers. Balance 4 Mt NPG becomes surplus and occupy large storage area every year. This quality bauxite can be very well consumed by alumina refineries of India (after simple beneficiation) or exported as it is to alumina refineries and cement plants abroad. As domestic logistic cost is quite high & unsuitability of quality, domestic Alumina Plants keeping themselves away to buy these materials.

Of course for last 2/3 years export in controlled quantity is allowed, it should be completely de-controlled as low grade has no use inside the country. On an average, at present about 3 Mt NPG Grade Bauxite is exported every year, this can easily reach to 5-6 Mt per annum. If low grade ores are allowed to export freely huge stock pile up at mines can be freed and country can also earn valuable foreign exchange.

Study on Autogenous Dissolution of Bauxite for Estimation of Alumina

P.A. Mohamed Najar*, P.G. Bhukte, U. Singh, M.S Ansari, P.V.Nageshawar, M.T Nimje and S.P.Puttewar
Jawaharlal Nehru Aluminium Research Development and Design Centre
Amravati Road, Wadi, Nagpur, India - 440 023

ABSTRACT

Leaching studies have been carried out for selective dissolution of alumina from bauxite and laterite of different geological origin. Polar solvents of mineral acids and carboxylic acids and their combinations have been used as dissolution medium. The sample components of different size fractions varying from 25 to 200 mesh have been studied at normal temperature and (30-45 °C). The alumina content extracted in the leach solution was analyzed by titrimetry and quantitative thin layer chromatography (QTLC). The experimental conditions were optimized for maximum dissolution of alumina with respect to size fraction of sample, leaching time and chemical nature of the leaching medium. The analytical studies for determination of alumina at normal temperature range have shown good reproducibility and repeatability for 150 -200 mesh fractions of bauxite and laterite samples with sulphate containing leach solutions. The analysis results obtained for selective leaching of alumina were compared with the actual concentration of alumina present in the bauxite and laterite samples as well as with the mineralogy. The paper describes the technical details of the study and discusses its scope of analytical and geological utility.
Key Words: Bauxite; Fraction, Alumina, Leaching, Analysis, TLC

Beneficiation of High Silica Bauxite Ores of India

Dr Mukesh Kumar, Bimalananda Senapati, C. Satish Kumar and Sai Sankar. R
Sesa Sterlite Limited, Lanjigarh-766027, Odisha, India

ABSTRACT

The alumina and silica content in bauxite ore play an important role in Bayer's process for economic point of view. It has been observed that, bauxite with Al_2O_3/SiO_2 ratio, more than 10 can be directly processed without any difficulty. However many bauxite reserves in India have Al_2O_3/SiO_2 ratio of 4 to 6 and hence pose difficulties in production of alumina through the Bayer process and also increase in cost of production. The extraction of alumina from bauxite in low temperature digestion circuit frequently involves a desilication step in which kaolinite dissolves and reprecipitates as sodalite, a caustic insoluble sodium alumino silicate. Thus formed insoluble sodium alumino silicate gets separated from the process into the red mud, thereby entailing the loss of valuable caustic soda and alumina. The more is the silica, higher is the soda consumption which increases the cost of alumina production. Through laboratory studies were conducted by using physical beneficiation techniques to reduce the reactive silica content of bauxite. Based on several investigations it had been made possible to remove ~30% of silica with 92% recovery depending on the characteristics of the ore. For economical processing of high silica bauxites, Vedanta developed a process flow sheet to attain the desired results. The results of detail studies are presented in this paper and it is expected that these findings will lead to improved bauxite resource utilization, minimize caustic consumption and helps towards viable alumina refinery operations.

Keywords: Beneficiation, High silica, Recovery and Soda Consumption

Trade-Off Study on the Characteristics and Washing Technologies of Two Different Types of ROM Bauxite

YANG Biao
(Changsha Engineering & Research Institute Ltd. of Nonferrous Metallurgy, Hunan, Changsha, China, 410011
A Chalieco Company)

ABSTRACT

The main ROM bauxite currently applicable in China alumina industry include the karst accumulative bauxite, sourced from Northwest Guangxi , China and lateritic bauxite sourced from Kalimantan, Indonesia. Investigation is made on the geologic mineralization conditions of the mineralization age/ environment and process and the ore characteristics of the above –mentioned two types of the bauxite .Description is made of the bauxite washing principles and the series washing equipment developed by Changsha Engineering and Research Institute Ltd. of Nonferrous Metallurgy for the development of Northwest Guangxi bauxite deposits. And analysis is made of the different washing technologies. The trade-off study on the ROM bauxite characteristics and washing technologies is good for insight into the differences and investigation on the similarities and differences between the ROM processing process and equipment sizing to provide some technical back-up for the improvement of the development efficiency of the different types of bauxite mines.

Keywords: karst accumulative bauxite, lateritic bauxite, mineralization condition, ROM characteristics, washing technology, trade-off study

SECTION II

Non-Metallurgical Bauxite

FUTURE PROSPECTS OF NON- METALLURGICAL GRADE BAUXITE FOR DEVELOPING SPECIALTY ALUMINA PRODUCTS

Dr. T. Seetaramaiah (Managing Director)
Sree Hari Special Refractories (P) LTD
3f2, Anjana Towers, Balaji Hills,
Vishakapatnam – 530013

ABSTRACT

Stringent physico – chemical specifications for components like alumina, iron oxide and titanium oxide are desired for non metallurgical grade bauxite. At present high grade bauxite in Gujarat is getting exhausted fast and some of the good refractory grade bauxite deposits of Kutch area are reserved for proposed aluminum refinery. The production of refractory grade bauxite is led by china contributing to about 65% of the total world output followed by Guyana. There is a scarcity of non metallurgical grade bauxite and the prices are rapidly increasing.
The technical inputs required for developing and production of specialty alumina materials like reactive alumina, high purity alumina cements, white fused and sintered alumina, sintered and fused mullite and various grades of spinels as downstream industries using calcined – technical alumina as the base material have been included in this paper.

This paper deals with some of the innovative processes for developing value added specialty alumina products by conserving the available Indian high grade bauxite. Production of various grades of brown fused alumina and brown sintered alumina for abrasive and refractory industries is possible from Gujarat bauxite. The technical inputs required for using calcined bauxite with relatively higher iron content for producing various grades of ceramic proppants are enumerated in this paper. The value chain for developing specialty alumina products from the available high grade Indian bauxite in terms of obtaining premium prices, avoiding hassles and higher cost of imports and conserving indigenously available high grade reserves of bauxite are narrated in this paper.

Key words: CALCINED BAUXITE, SINTERING, SPECIALTY ALUMINAS, BROWN FUSED ALUMINA, REACTIVE ALUMINA, PROPPANTS

Indian bauxite: How processing can improve its high temperature properties

H. S. Tripathi*, S. Sinhamahapatra & A. Ghosh
Refractories Division, CSIR-Central Glass & Ceramic Research Institute
196 Raja S. C. Mullick Road, Kolkata – 700032, India

ABSTRACT

Indian bauxites, due to its high impurity content, are not suitable for high temperature application. Indian refractory industries are largely dependent on imported bauxite. Though good quality bauxite is not available, but the country has huge reserves of inferior grade bauxite spread over a number of states. When these bauxite are calcined at high temperature it form corundum together with large amount glassy and other low melting phases, which impairs its high temperature properties.

Normal routes of bauxite beneficiation have not yielded suitable techno-economically viable products till date. This paper describes the microstructure development of Indian bauxite with sintering temperature vis-à-vis its high temperature properties. Attempts were made to highlight how phase assemblage can be modified without beneficiation to reduce both the low melting phase and glass phase formation of the sintered aggregate. In this endeavor, the high temperature refractory properties do not fall below acceptable level.

Prospects of Aluminum Chemicals Projects from non-metallurgical grade Bauxite in Gujarat State

Mr. J V Bhatt
Mineral Consultant

ABSTRACT

Laterite – Bauxite belt extends for about 250 kms. with width varying from 100 m to about 6 Kms. in Gujarat State. These bauxite deposits are located at close proximity of 50 to 100 Kms. to all weather deep water ports Porbandar, Okha, Bedi, Mundra, Kandale. Bauxite mining centres in Jamnagar and Kachchh districts are well-connected by rail and roads. Geological agencies have proved 1050 locations reserves in the state, out of which 100 million occurs in two prominent producing districts.

Gujarat Mineral Development Corporation (GMDC) and private sector are engaged i9n Bauxite mining in potential districts producing an average annual 8 lac tons all grade Bauxite.

Kachchh Bauxite is reserved for the GMDC proposed ***alumina project.***

At present, GMDC is actively exploiting an average 6 lac tons at ***Gadhshisha Group of Mines*** Bauxite in Kachch distr5ict.

Pocketary Bauxite exploitation generates 80%low grade Bauxite below 56% Al_2O_3 and upto 10% SiO_2. All these exploited dumps are stacked at mine sites. High grade Bauxite is used for refractory abrasive applications by private sector.

To encourage industrial applications of non-plant grade Bauxite, GMDC advertised for expression of interest for JV projects on the accumulated stocks for NPG Bauxite.

Few mineral houses came forward for the aluminium chemicals JV projects with long term agreement of supply of low grade Bauxite for the project.

Gujarat Credo Mineral Industries, Alumina refinery (P) Ltd and PSK Mineral Development Pvt Ltd have shown interest and during vibrant gujrat 2009 and 2013 signed MOU for the ***Detergent Grade Zeollite, Allumina Trihydrate items projects***, which are in pipeline. PMDPL has also planned to go for aluminium stearate chemical in Kachchh district.

GCMI has tied up for the technology with ***Central Salt and Marine Institute, Bhavnagar ARL*** is considering to tie up with Orbit (Canada). Private sector sector exploites Bauxite in other districts. High grade reserves are depleted, so low grade is accumulated at mine site. Few companies export these stacks to overseas cement market from Porbandar Okha ports. Scope for alumina chemical also lies in the resume areas.
Aluminium sulphates plants are in operation at Vapi, Kandla, Ahmedabad in Gujarat. GMDC active exploitation of Bauxite at ***Gadhshisha*** group of mines generates large quantity of low grade Bauxite (NPG).

Assurance of raw material, technology tie up, good infrastructure and promising market prospects for aluminium chemical commercial projects is bright in the state.

Development of Phosphate bonded Castable for Alumium Melting Furnaces

P.Sengupta, Santanu Mondal
SKG Refractories Ltd, Nagpur

ABSTRACT

Aluminium is one of the most important Metal, finds wide applications in all walks of human civilization. Although the melting point of Aluminium is quite low, only 660C, but melting and processing of clean Aluminium metal in Furnaces poses great challenge to the Refractory technologist to develop a Refractory with specific properties required.

SKG Refractories Ltd has developed the high Alumina Phosphate bonded Castable, which has got the unique properties of non-wetting character and corrosion resistance towards molten Aluminium and its alloys. Moreover the Castable can be customized to have desired flow property, workability, setting time. It is found to be much superior product over the conventional Cement bonded Castable products and is an ideal material for the lining of the Aluminium melting furnaces.

SECTION III

Waste Management & Utilization

EXTRACTION OF V_2O_5 FROM VANADIUM SLUDGE-AN OVERVIEW

Pratima Meshram✉, Jyotsna Kumari, Abhilash, B.D. Pandey
CSIR-National Metallurgical Laboratory, Jamshedpur, INDIA
Tel: +91-657-2345277; Fax: +91-657-2345213; Email: pratima@nmlindia.org

ABSTRACT

A by-product containing high quantity of vanadium (10-20%) as vanadium pentoxide is obtained during Bayer's process. This vanadium sludge till date is the only indigenous source of vanadium in India. Vanadium has many industrial applications such as in stainless steel production, ferro-vanadium, and a variety of catalysts.

The Bayer's liquor in addition to alumina contains vanadium salts along with minor amounts of fluoride, phosphate and arsenates, which has deleterious effect on alumina precipitation and quality of the final product. The concentration of these salts is variable on the bauxite quality used. Thus, separation of these constituents and simultaneous enrichment of vanadium content is very important. There has been plenty of work on extraction of vanadium from sludge via with precipitation of ammonium vanadate from sodium aluminate solution, by calcium to enrich vanadate, SX, IX or electrolysis. However, there is much more scope for better understanding of this raw material and develop new methods for complete utilisation of sludge. Apart from vanadium, alkali content in sludge can be recovered for reuse which proves a major economic advantage to the industry.

This article gives an overview of the various processing available for treatment of this sludge, its parameters, and governing economics. Also will be highlighted the recent attempt carried by CSIR-NML in extraction of vanadium from sludge in association with NALCO.

Keywords: Bayer's sludge; vanadium; alkali; extraction; precipitation; yellow salt

UTILISATION OF RED MUD FOR EXTRACTION OF RARE EARTH ELEMENTS

Abhilash[1]✉, Shivendra Sinha1, Pratima Meshram1, B.D. Pandey1, P.K.Behera2, B.K.Satpathy2
1CSIR-National Metallurgical Laboratory, Jamshedpur, INDIA
2National Aluminium Company Limited, Bhubaneswar, INDIA
Tel: +91-657-2345274; Fax: +91-657-2345213; Email: abhibios@gmail.com

ABSTRACT

Red mud is a solid waste of the Bayer process and is considered to be a harmful waste when it is stock-piled in huge amounts. By the year of 2015, the alumina industry is estimated to produce 4 billion tons red mud worldwide at its current production rate (Samal et al., 2013). In India, alumina plants have 1.692 million tons of annual capacity with aluminum metal production of 0.6 million tonne per annum and generate about 2 million tons of red mud every year. It contains six major constituents, namely, Fe_2O_3, $A_{12}O_3$, SiO_2, TiO_2, Na_2O and CaO and small quantities of numerous minor/trace elements (as oxides) such as V, Ga, Cr, P, Mn, Cu, Cd, Ni, Zn, Pb, Mg, Zr, Hf, Nb, U, Th, K, Ba, Sr, rare earths (La ,Ce, Pr, Nd, Sm , Eu , HREE including Sc ,Y Disposal of red mud brings an environmental risk taking into consideration of the huge quantity.

On the other hand, scattered efforts have been put worldwide for extraction of significant amounts of REE's such as La, Ce, Y, Sc (Abhilash et al., 2014). It is difficult to directly recover REE's from red mud due to its low levels and presence of major minerals of Fe, Al, Ti (Ochsenkühn-Petropulu et al., 1996). This has been reported acid consuming and un-economical. Separation of REE after extraction is also a concern due to presence of iron, titanium, zirconium etc., which usually gets co-extracted (Ochsenkühn-Petropulu et al., 1996; Zhou et al., 2008; Wang et al., 2013).

This article elicits a comprehensive review on the presence of REE's in red mud, their mineralogical characterization and its association. Also would be presented the recent first of its kind results on extraction of these rare earth elements from red mud.

Keywords: red mud; rare earths; leaching; selective precipitation; La-Ce-Sc.

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Waste Disposal Management in Aluminium Industry

Lu Yi, Jingjin Environmental Protection Inc.
And
V. Subramonian, Director,
Unitop Multitech India Private Limited

ABSTRACT

Traditionally the Waste from Aluminium Industry has either been stored in contained Dykes. With passage of time and the tightening of Environmental Regulations Worldwide the Industry had to comply with the newly imposed Regulations and started to initiate a number of measures like Lining of the Waste Disposal Sites with improved techniques of Disposal. In additional, failure of some disposal Sites across the World, causing spills of waste to nearby Settlements and resulting in damage to Environment has forced the Industry to look for improved methods of managing the Waste. This paper intends to cover the Current Practices and the effort of Jingjin to assist the Industry in managing the Wastes and thereby minimising or practically avoiding the possibilities of Storage Site failures besides reducing the requirement of Land for disposal.

Production Practice of Fe Concentrate Recovery Out of the Red Mud in Alumina Produced from Pingguo Bauxite

Peng Xueqing
Changsha Engineering & Research Institute Ltd. of Nonferrous Metallurgy, Changsha, 410011
A Chalieco Company

ABSTRACT

The engineering design and production practice of Fe concentrate recovery out of the red mud in alumina produced from Pingguo bauxite has demonstrated that the application of magnetic separation process flowsheet by 1-stage roughening and 1-stage cleaning for Fe concentrate extraction can ensure automatic control of various operations , simple circuits , simple operation and maintenance , good product quality as well as effective reduction of tailing discharge and resource comprehensive utilization to offer good economic benefit for the enterprises .

Keywords: alumina; red mud, magnetic separation; Fe concentrate

Issues and Opportunities related to Bauxite Residue Disposal and Reuse

S. Sankaranarayanan
VP & Head: HIC-Alumina
Hindalco Industries Limited
Belgaum – 590 010

ABSTRACT

Bauxite Residue (also called as Red Mud commonly) is generated as a waste material when alumina hydrate is extracted out of bauxite ore using the Bayer Process. The quality of bauxite ore and the process conditions adopted by a particular alumina refinery decide the quantum of Bauxite Residue generated per tonne of alumina produced. This is generally in the range of 0.8 – 1.5 t/t. Though many attempts have been made to utilise bauxite residue for various application, only a very small quantity is being actually used and a major portion of the generation in India and the World is being disposed-off and stored in specially constructed ponds.

There are many technical and logistical issues related to utilisation of bauxite residue or recovery of valuables from it on a commercial scale. The overall quantum of bauxite residue generation, running into millions of tonnes per annum is of course one major issue. This paper places these issues in perspective and tries to identify opportunities for the effective utilisation of bauxite residue and attempts to provide a sense of direction to the researchers and entrepreneurs on this important aspect.

Keywords: Bauxite residue, Red mud, Bayer process, Residue disposal, Utilisation of bauxite residue

Utilization of Fly ash in Cold Setting Geopolymer Concrete

Dr Mukesh Kumar, C.Satish Kumar, V.R.Raju, Amit Sahu and Sujit Basa
Sesa Sterlite Limited, Lanjigarh-766027, Odisha, India

ABSTRACT

Utilization of concrete as a major construction material is a worldwide phenomenon and the concrete industry is the largest user of natural resources in the world. Geopolymer concrete represent an innovative technology that is generating considerable interest in the construction industry, particularly in light of the ongoing emphasis on sustainability. Geopolymer concrete is a 'new' material that does not need the presence of Portland cement as a binder. Instead, the source of materials such as fly ash, that are rich in Silicon (Si) and Aluminium (Al), are activated by alkaline liquids to produce the binder. Hence, concrete with no cement. In contrast to port land cement, most geopolymer systems rely on minimally processed natural materials or industrial by products to provide the binding agents. Since portland cement is responsible for upward of 85% of the energy and 90% of the carbon dioxide attributed to a typical ready-mixed concrete, the potential energy and carbon dioxide savings through the use of geopolymers can be considerable. Geopolymer cements offer an intriguing combination of higher mechanical strength, excellent chemical durability, variety of environmental benefits, and strong potential for commercial implementation. Consequently, there is growing interest in geopolymer applications in transportation infrastructure. This technology is rapidly advancing in Europe and

Australia. Various studies had been done which contributed the development of new energy efficient green technology for high volume utilisation of fly ash in manufacture of Green Concrete.

Keywords: Geopolymer, fly ash, cement replacement & Green Concrete

Strategic Rare Earth Metals in Industrial Wastes -Future recovery Prospects from Red Mud

Upendra Singh, P. A. Mohamed Najar & S.P. Puttewar

Analytical Research Division, Jawaharlal Nehru Aluminium Research Development & Design Centre, Amravati Road, Wadi,Nagpur-440023, India
Email: upendra1970@gmail.com

ABSTRACT

In India, significant presence of REEs is reported at various parts of states. Conversely, Odisha is known to have huge resources of metallurgical grade bauxite and largely exploited for primary aluminium production by National Aluminium Company Ltd (NALCO), Vedanta Aluminium and Hindalco. These industries are known to generate huge quantum (4.7-5 million ton) of red mud and it is logical, the red mud generated from bauxite could contain recoverable concentration of many strategic REEs. The occurrence of three most important REE such as La, Ce and Nd and others in Indian Bauxite was reported in sufficient quantities which need to be investigated and recovered as by-product during bauxite processing from bauxite residue. The research activity on REEs at various institutes as well as industry R&D laboratories in India is progressing; no activities are specifically reported in the past for the assessment and recovery of strategic REEs in Indian red mud. The rare earths are readily leachable from red mud by diluted mineral acids. After leaching, the rare earths can be recovered from the leachate by selective precipitation as oxalate, or by solvent extraction.

SECTION IV

Alumina Technology

Vietnam Bauxite-Alumina-Aluminium Industry

Dr. Tran Minh Huan
Former Director General, Vietnam's Ministry of Industry

ABSTRACT

Vietnam's bauxite reserves in 2007 totaled about 5.5 Gt. These reserves consisted of 91 Mt of diasporic bauxite in the northern regions, and about 5.41 Gt of gibbsitic bauxite in the southern region, mainly in the Central Highlands. Since 2007, the quality and quantity of Vietnam's bauxite reserves have increased as a result of improvements in exploration techniques and continued explorations in the Central Highlands regions. By 2010, Vietnam's bauxite reserves have increased to 10.8 Gt, which is equivalent to 4.6 Gt of beneficiated bauxite. The quantity of reserves identified appears to warrant the establishment of critical infrastructure for mine developments.

The Vietnamese Government is planning to develop an integrated bauxite, alumina and aluminium industry. In this respect, the 0.65 Mtpa Tan Rai Alumina Refinery was built by Chalieco in Lam Dong province. This project was put into operation in the first half of this year. A second alumina refinery in Dak Nong province, the 0.65 Mtpa Nhan Co Alumina Refinery, has also been built by Chalieco and is expected to be commissioned by the end of this year. Alumina produced by these two refineries will currently be exported. There are a number of other proposed bauxite and alumina projects in Vietnam that are currently either in the study stage or in preparation stage.

This paper discusses Vietnam bauxite deposits, the roadmap for development of the bauxite-alumina-aluminium industry, infrastructure needs, and possible environmental impacts.

The Two-Stage Precipitation Process Sandy Alumina Practice in Vietnam

Jian Wang, Yuguo Chen, Baiyong Zhang, Xianyao Ke
(Shenyang Aluminum & Magnesium Engineering & Research Institute Co.ltd, Liaoning Province of China)

ABSTRACT

The two-stage precipitation process is adopted in the first refinery plant design of Vietnam and several technology measures are designed to ensure the production of sandy alumina. Under the guidance of design measures, the various indicators of precipitation process, such as the precipitation yield, aluminum hydroxide quality, alumina quality and other indicators have reached the international advanced level. The physical and chemical properties of alumina products in full compliance with the electrolytic aluminum plant required sandy alumina requirements.

Key words： Two-stage precipitation; sandy alumina; aluminium hydroxide classification; alumina quality; precipitation yield; oxalate removal

Use of Mathematical Model as a Tool in Alumina Plant Monitoring

M.J.Chaddha, Scientist-V, JNARDDC

ABSTRACT

The Bayer Model software for determining mass and heat balance was used for alumina plant monitoring for determining parameters required to attain a production capacity of 1, 93,000 M tones/annum and based on it find the weak links and the additional equipment facility required to obtain the desired capacity. Also the plant wanted to achieve a caustic soda consumption target of 98 kg NaOH/ton. The 30 days exercise gave the weak links present in the existing plant and the mathematical model as a tool was able to give a complete picture of existing plant helping the industry to identify the capacity addition in red and white area.

Global Market Balances for Alumina – An Outlook to 2023

Puneet Paliwal
Metals Analyst
CRU
puneet.paliwal@crugroup.com

ABSTRACT

Third party alumina market represents transactions between those companies/refiners which are long in alumina and those companies/smelters that are short in alumina. Supply demand fundamentals in this market are the key drivers of alumina spot prices globally, thus are highly significant to analyze. Alumina trade flows are broadly mapped across two markets i.e. the Atlantic market and the Pacific market.

The Atlantic market has historically been short, filling in their gap in alumina demand through exports from Australia. However, this gap reduced considerably in 2013 (to approx. 696,000 tonnes) owing to capacity curtailments at some of the major smelters in the region. There lies a high probability that the Atlantic market would end the year 2014 at surplus, an indicator of this happening being a widened price differential observed between the Pacific and Atlantic markets

over the past few months. Nonetheless, the market is expected to return to its short position in 2015 while a sustainable surplus is anticipated only from 2020 onwards.
Meanwhile, the Pacific market has been in surplus over the past (a surplus of approx. 4.78 m tonnes in 2013) due primarily to alumina production in Australia and India. However, this surplus position is likely to tighten going forward on anticipation of increased alumina requirement by Middle East & China as well as closure of some of the major refinery projects, one such being the recent closure of Rio Tinto Alcan's 2.7 m tpy Gove alumina refinery. Analysis suggests the market will retain its surplus position till 2020 while it is likely to go into deficit from 2021 onwards.
In this paper, an attempt has been made to forecast alumina trade flows in the Atlantic and Pacific seaborne trade markets based on anticipated refinery & smelter capacity changes expected in these regions. The aim is to highlight an anticipated shift in trade positions of these regions going into 2023.

Keywords: Third party alumina, Seaborne trade, Market balance, Alumina supply, Alumina demand, Trade forecast

Unique Automatic Powdery Red Mud Filtration Unit

Dr Mukesh Kumar, Bimalananda Senapati, C. Satish Kumar and Tonmoy Banerjee
Sesa Sterlite Limited, Lanjigarh-766027, Odisha, India

ABSTRACT

Red mud is a waste from alumina industry and its disposal and utilisation has always been a matter of concern for environmentalists as well as alumina industry mainly due to huge land requirement as well environmental hazard involved because of alkaline slurry. Even after years of storage, the disposed off mud remain in semi fluid form and thus posed serious risks during any earth movement or leakage from earthen dyke walls. Red Mud slurry is alkaline in nature and its generation varies from 1 to 2 times of the alumina, world over millions of tonnes of red mud is lying in various red mud ponds except in some countries where it is discharged into the sea. Vedanta Lanjigarh has developed a road map for Zero Waste alumina refinery and undertaking number of projects in consultation with various scientific research institutes. As a move towards Zero Waste, it has been decided to first convert the red mud pumping into the filtration system so that wet storage of red mud can be avoided. The present practice which is being followed globally is either red mud pumping by diaphragm pumps or filtration using vacuum filters which can give solid with around 30% moisture. The new filters (plate & frame) have been developed for red mud application and this technique ensures the success to filter red mud and achieve moisture as low as 20% and make Red mud suitable for transfer by Conveyors. The resultant red mud powder is trucked to stacking area from where it is either stacked vertically or despatched for use in other industry by road

and rail. Thus it is an unique automatic system developed first time where all the risks of red mud pond has been eliminated. The unique project of producing red mud powder has been commissioned in a fully mechanised and automatic plant. This paper is an effort to share these new development and progress made which would be very useful in the context of environmental concerns for disposal and utilization of red mud.

Key words: red Mud, filter, utilization, moisture & automatic

EXTRACTION OF VANADIUM SLUDGE FROM BAYER LIQUOR, A CASE STUDY

V.Krishna kumari, Bhimsen Pradhan, Vinod Kumar Verma,

ABSTRACT

Nalco Panchpatmali bauxite is analysed to have around 0.06-0.08% of V_2O_5. During digestion of bauxite, part of the Vanadium dissolve in the caustic liquor as sodium ortho-vanadate (Na_3VO_4) and the rest goes out with the Red Mud. The dissolved vanadium gradually builds up in the circuit during its recycling. The dissolved Vanadium along with other dissolved impurities like Phosphates, Flourides, Chlorides, sulphates etc get precipitated as scales in the Concentrated and Cooler areas of the circuit causing operational problems.

Vanadium is a valuable product, which finds application in steel industry, in titanium alloys, as catalyst etc. Most of the vanadium produced globally is from the Bayer process liquor. Extraction of Vanadium as a sludge along with other impurities in the circuit also helps control scaling problems in the circuit and to maintain quality of product Alumina.

Laboratory scale studies was completed to select the source of vanadium in liquors and also to optimize the parameters for maximum extraction of vanadium containing sludge. Laboratory studies established Green Liquor as the source and 95-100% recovery of V_2O_5 was possible at 40-60oC with cooling of the liquor. Vanadium sludge recovery was about 8-12 gpl and the V_2O_5 content in sludge collected from GL was found to be about 10-12 %. Pilot trial to estimate the feasibility of the process was carried out in the plant using some non-used facilities with minor modification. About 6 MT of vanadium sludge has been produced in the pilot scale trial successfully. The average V_2O_5 content in the sludge collected was found to be 10.5 %. Action plan is prepared to produce vanadium sludge on continuous basis as it is a profitable business. Besides it will also help in reducing lime consumption and scaling problems of the Bayer plant. The paper describes the case study on the above activities that have been taken up at the Refinery.

Heavy Duty Slurry Pumps in Bauxite Processing and Alumina Production

Mr. Aleksander S. Roudnev[1], Mr. Kevin C. Buschkopf[2]and Mr. Jack Kuenen[3]

1. **Manager, R&D-Applied Hydraulics, Weir Minerals North America**
2. Chief Engineer, Weir Minerals North America
3. Product Manager -Geho® Pumps, Weir Minerals Netherlands

ABSTRACT

Rotodynamic and positive displacement pumps are commonly used in bauxite processing and alumina production. With the introduction of heavy duty centrifugal and piston diaphragm slurry pumps to this industry the cost of operation and the reliability of the processes can be optimized.

Elevated temperatures associated with the Bayer process impose certain Net Positive Suction Head (NPSH) requirements on the centrifugal pumps. The slurries in this process typically have high concentration of caustic and lime and may scale up severely in the pipelines and process equipment creating further mechanical challenges for the pumps.The ability to adapt the pumpingequipment to the application is essential to achieve reliable operation in the widely varying applications. Multiple impeller and inlet size options are examples of features that enable a user to optimize their pumping equipment to achieve reliability at the minimum cost.

The silica content of the bauxite determines the degree of slurry abrasiveness between the milling area through the final red mud disposal area. The design of the Warman® hard metal lined double cased pump, along with special pressure relief devices and thermal cut-off switches provide for extended wear life and inherent safety in these applications.

Slurry dilution is not desirable in the process, so the gland flush water (or gland seal water - GSW) consumption has to be minimized or eliminated altogether. This promotes the usage of low GSW packed glands, effective dynamic seals and mechanical seals.

Advances in the development of mechanical seals have made many options available from double seals to split seals. Standardized mounting arrangements allow seals to be purchased from various manufacturers, ensuring flexible sourcing and commodity pricing.

Crankshaft driven piston diaphragm pumps have become the industry standard pump type for bauxite slurry digester feed applications in the alumina industry since 1970s. Different digestion technologies require different pump designs. Geho® special heat barrier pumps are available for bauxite double digestion process when the pumped slurry temperature exceeds the maximum allowable working temperature of the elastomer diaphragm.

Disposal of large volume residues has been a problem for alumina plants due to environmental impact. Dry, or thickened tailings disposal system, has proven to have distinct advantages against wet system. Several design features have been introduced to piston diaphragm pumps to develop maximum pump capacity and pressure while constantly optimizing pump performance and reliability and reducing maintenance cost., This makes long distance highly concentrated red mud transportation possible and economically feasible.

To Yield or Not to Yield

Andrew Furlong, Brad Hogan, Daniel Thomas, Ron van der Kevie
WorleyParsons Services Pty Ltd., Level 3, 60 Albert Street, Brisbane 4002, Australia

ABSTRACT

For alumina technologists and plant operators alike, the quest for higher precipitation yield is seemingly never-ending. Given a sufficiently advanced precipitation design and a well-behaved bauxite, yields of 100 g/L and beyond are now achievable. Yet somewhat surprisingly, when considering greenfield alumina refinery design, the notion that "more yield is always better" does not necessarily hold. This paper explores the notion of an "optimum" precipitation yield in a greenfield refinery context, including issues such as capital cost, operating robustness, technical risks and future growth path options.

Analysis on the Mixing model of large Precipitator Tank

YANG Zhenrong,CHEN Cairong,YANG Yi,WANG You
GAMI (Guiyang Aluminum Magnesium Design and Research Institute, Guiyang 550081, China)
A Chalieco Company

ABSTRACT

It is analyzed the fluid flow motion character in large precipitator tank, by fluent code, Multiple reference frame (MRF) method and k-ε equation. It is proposed that the distributed mixing machine for large precipitator tank. This paper compared the consumed power between the single-spindle-mixing unit and the distributed mixing unit, with Inter MIG blade. It is finding that the distributed mixing unit can save power than the conventional single-spindle-mixing unit, and be suit for large or ultra-large precipitator tank.

KEY WORD: large precipitator tank, Inter MIG type blade, distributed mixing unit, energy saving

Sustainable Indian Alumina Refinery for the 2020's

H Mahadevan – ANRAK Aluminium & VK Sood – Hindalco

ABSTRACT

India, in spite of having as much as 3.1 billion tons reserve and being ranked 5th in the World, has for one reason or other not able to use its natural resource beneficially for the well-being of its population. With the expected increase in the GDP growth and the associated infrastructure, it is expected that the per capita Aluminium Consumption can be expected to grow rapidly and reach the World Average figure atleast in the next 5 – 6 years, which means by 2020 the Alumina & Aluminium production in India must be around 30 & 15 billion tons respectively.

The misplaced commotion of the environmentalists on ecological aspects of the Mining Industry in general & Bauxite mining in particular, has strangulated the growth of the Industry. Because of the above, it has almost become a night mare for the entrepreneurs to develop and implement any mineral based projects in the country. The only way to change this situation is to make sure that "Sustainable Development" of the resource industry becomes the order of the day, not only in letters but spirit also, so that the majority of the population can be taken with and be part of the development.

This paper prods in detail the Concept of Sustainable Development of Bauxite Mining & Alumina Refining, its dependence on the three important factors, namely Economic performance, Environmental performance and Social impacts of the above two, with particular reference to the new Green Field Projects being Implemented or being contemplated.

Keywords:- Bauxite, alumina, sustainable Development, Economic Performance, environmental Performance, Social Impacts etc..

SECTION V

Special Alumina and Alumina Ceramics

PROCESS AND PROSPECTS OF SPECIALTY ALUMINA HYDRATES

B.K. Satpathy
General Manger (R&D)
National Aluminium Co. Ltd., Bhubaneswar, Odisha, India.

ABSTRACT

While about 93% of world total alumina is used for production of metal, about 6-7% of the same is used in various non-metallurgical segments which are known as the specialty alumina and hydrate products or the chemical grades alumina and hydrate. Alumina tri hydrate (ATH) accounts 60-70% of these emerging as the major part of special alumina and hydrate products. As against smelter-grade alumina (SGA) production of 95.7 Mt in 2012-13, chemical-grade alumina production has remained between 6-7% of the same during last few years. The ATH accounts for about 3.8 Mt and the specialty alumina accounts about 2.6 MT. There are about 9-10 leading producers of chemical grade alumina and hydrate products who cater to the world market.

Alumina tri hydrate obtained from Bayer refining plant is generally off white, the yellowish colour originates from organic humic matter present in bauxite. Like alumina, alumina tri hydrates of fine particle size find applications as a filler material in plastics, polymers, paint, PVC, synthetic marble etc. Alumina tri hydrate decomposes beyond 200° C. to release water vapour. The polymer, using alumina hydrate as filler, decomposes endothermally, acts as a heat sink and shows the rate of rise in temperature. These results in reducing the rate of decomposition of polymer and as an additional effect, the released water vapour served to dilute any combustible gases evolved during decomposition. This is how hydrate is growing as popular flame retardant filler. Similarly due to its mild abrasive nature (hardness being 2.5 mhos), it is extensively used in synthetic marble to the extent of 60-70% by weight. White hydrates of different particle size are generally used in synthetic marble, paper etc. Ground hydrate of 5 to 10 micron is also used as filler in tooth paste, PVC etc.

The present paper describes the market situation of specialty hydrates vis-a-vis their applications and processes of achieving desired properties.

Almatis – Premium Alumina Based Raw Materials

[1]Henning Stams, [2]Sarbapi Mukherjee, [2]Animesh Bose, [2]Shankha Chatterjee*
1 Almatis GmbH 2Almatis Alumina Pvt Ltd, India

ABSTRACT

ALMATIS offers a wide range of alumina based products for use in refractory, ceramic and polishing applications.Alumina (Aluminum oxide) is most widely known and used as the starting material for the production of aluminum. However, there is a wide range of specialty aluminas for non-metallic applications. Alumina is highly refractory material (fusion point 2050°C) and is an excellent thermal and electrical insulator. Aluminum oxide adds great mechanical strength and has excellent resistance to corrosion &wear. All these characteristics make alumina suitable for various applications in refractory, ceramic and polishing applications. Almatis is committed to provide high quality specialty alumina products and leading edge services. Being the world's leading producer of aluminabased materials for refractory, ceramic and polishing applications, Almatis concentrates fully on its role as producer and secure supplier of premium alumina. With its high quality alumina materialsincluding tabular alumina, sintered magnesium aluminate spinels, calcium aluminate cements and calcined&reactive alumina, dispersing aluminas as well as dense and lightweight aggregates based on CA6, Almatis offers the broadest product portfolio in the global market. In the present paper, Almatis's different raw materials and their major properties with regard to various refractory, ceramic and polishing applications are briefly discussed.

An Alternative Advanced Alumina for Advanced Refractory Ceramics

Elodie Chabas*, Jérôme Kiennemann, Carol Ulrich

* Refractory Business Developper, ALTEO, Gardanne, France

ABSTRACT

The effect of the particle size distribution of alumina has been investigated for silica-free tabular alumina Low Cement Castables (LCC) in a previous internal study. This compared different bimodal reactive aluminas from Alteo with bimodal aluminas available commercially in the market. The aim of this article is to present a new, lower cost, alternative alumina, FLO-2, which can also be compared to bimodal commercially available aluminas. Two different combinations of castables have been investigated in this study: A1, in which we included only reactive alumina in the matrix formulation of the castables and; A2 in which we included a mix of ground calcined alumina from Alteo and reactive alumina. In both combinations, we compare two different aluminas; FLO-2 from Alteo and a bimodal commercially

available reactive alumina named C. A1 and A2 combinations are composed of different fine/coarse particle ratios. Optimization of particle size packing has been performed for the four different formulations using the Dinger and Funk model. This study shows that we can reach similar performances in all formulations with FLO-2 (flowability, density, open porosity and cold mechanical properties).

The special production route for FLO-2 ensures a highly consistent product, available in large quantities. Strict control of the particle size distribution, especially fine particle content, shows that FLO-2 can exhibit properties similar to or even better than some bimodal reactive aluminas. FLO-2 has the potential to become as a reference solution on the market for refractory customers.

Effect of Precipitation Temperature on Soda Content of Hydrate and Liquor Productivity

S.Rai[1], M. T. Nimje[2], K. J. Kulkarni[3], M. Panchal[4], S. Bagade[5], A. Agnihotri[6]

1. Scientist III, JNARDDC, Nagpur
2. Scientist V, JNARDDC, Nagpur
3. Scientific Officer, JNARDDC, Nagpur
4. Scientific Assistant III, JNARDDC, Nagpur
5. Research Fellow, JNARDDC, Nagpur
6. Director, JNARDDC, Nagpur

Corresponding author: Dr. (Mrs) Suchita Rai

Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC)
Opposite Wadi Police Station, Wadi, Amaravati Road, Nagpur
Maharashtra – 440 023
e-mail: suchitarai1968@gmail.com

ABSTRACT

The leachable soda from the hydrate can be removed by washing but the residual soda is picked up during precipitation process and cannot be removed after several washings. Hence precipitation conditions such as temperature and supersaturation needs to be controlled for low soda pick up in the hydrate. Low soda hydrates are the precursor materials for low soda alumina and low soda activated aluminas. Precipitation tests have been carried out at elevated temperatures. Lowering caustic soda in the hydrate has been studied by controlling the temperature during precipitation. Effect of precipitation temperature on soda content of hydrate and liquor productivity has been studied in the paper. The studies have been carried out for the development of low soda hydrates to be used for special purposes in Bayer cycle.

Keywords: precipitation, low soda hydrate, temperature, liquor productivity

Alumina and Bauxite Based Wear Resistant Ceramics

Dr. L N Satapathy
Sr. Dy. General Manager
Ceramic Technological Institute
Corporate Research and development
Bharat Heavy Electricals Limited
Malleswaram Complex, Bangalore-560012, INDIA
Cell : 09449857965, E mail : lsatapathy@gmail.com

ABSTRACT

Alumina is a well-known industrial wear resistant ceramic material which finds wide applications in power sectors as liners in coal carrying ducts. The wear resistant property of alumina is dependent on the initial particle size of the material; lower the better. However, with decreasing particle size and decreasing impurity content, the cost of the raw material goes up leading to un-viability of the product for many industrial applications. Therefore, other potential raw materials like bauxite, which is a rich source of alumina can be used to produce relatively mild wear resistant ceramics which can be a cost effective option for many wear resistance applications replacing alumina based ceramics. However, the metallurgical grade bauxite is mined from earth and always contains varied amount of impurities which drastically affect the wear resistance. Further, the coarse bauxite needs to be crushed to fine powders prior to use as a structural ceramics adding to the cost of the product. Therefore, an optimization approach needs to be followed by using a relatively impure grade bauxite material and with suitable additives to develop a cost effective wear resistant material which can replace alumina ceramics in many applications.

This talk will discuss the alumina based wear resistant ceramics for power sector applications and an approach for developing an alternative Bauxite based wear resistant material. The optimization of parameters like impurity content, additives, sintering temperature etc. will be highlighted for developing such materials for wear resistance applications. This talk will also briefly describe the wear resistance measurement techniques including the state of the art high temperature wear resistance method for measuring mass loss at high temperatures exceeding 1000 deg C.

Keywords: Wear Resistance, Alumina, Bauxite, structural Ceramics, Liners

Special Grade Value Added Alumina Product and Co Products to Improve the Competiveness of Alumina Refining Business

Harish Chandwani
Consultant: Bauxite, Alumina & Chemical Processing.
Address: T-2 A Block Heera Panna Apartment, Vastrapur Ahmedabad 380015
Email: hkch2@rediffmail.com

ABSTRACT

With substantial rise to alumina extraction costs in alumina refinery producing metallurgical grade alumina need a great shift for easy survival to produce alumina hydrates, special alumina products, co products and higher value added new products in alumina processing in Bayer cycle as well as in separate line. The significant bye products are presently vanadium, gallium while co products are alumina hydrate products, special alumina, Flame retardants, activated alumina are being produced and marketed. In the new range of alumina chemicals significance of Synthetic Zeolite as ion exchange application as detergent builder and Zeolite molecular sieves having requirement in drying and purification of gases has high adsorption efficiency shall be leading the product ranges in future. The estimated quantity of alumina chemicals which is nearly 10% of alumina market has to go to 15% is the next decade to come. Chemical grade fine alumina is used as a raw material for several industrial products such as polish, paints, abrasive products, refractory, toothpaste, building materials, ceramics and lighting. Purest alumina is also used to make electronic materials such as LED glass materials and IC packaging.

The paper deals with the recent avenues and opportunities in different sectors of applications and value addition of alumina hydrate chemicals shall be improving the competitiveness of business and economics of alumina production which is right now dependent on the metallurgical grade alumina only.

SECTION VI

Aluminium Smelting Technology

IMPROVEMENT IN OXIDATION BEHAVIOUR OF PREBAKED ANODES USED IN NALCO SMELTER PLANT

By Binuta Patra1 and R.K.Barik2
1. Asst General Manager(Chem),Smelter Plant,NALCO
2. Senior Manager (Elect) ,Smelter Plant, NALCO

ABSTRACT

In view of the importance of the anode carbon consumption on the economics of the Aluminium production process & CO_2 emission, great efforts have been made in recent years to study the problem.

A detail study has been carried out at NALCO to understand the problem of **excess anode carbon consumption** during the electrolysis process .Experiments carried out in laboratory scale, bench scale and plant scale to improve **the oxidation behaviour** of **prebaked anodes** has been presented in this paper.

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Simulation of best process condition of aluminium electrolysis pot

Chen Cairong
GAMI (Guiyang Aluminum Magnesium Design and Research Institute Co., Ltd., Guiyang 550081, China)
A Chalieco Company

ABSTRACT

The best process condition that aluminium electrolysis pot seeks for is the important task for the smelter to get the best operation indices, which is normally achieved by test pot in China and abroad. The complicated bath system formed by alumina with multi-impurities produced by Chinese bauxite with inherence characteristics decreases not only the crystallization temperature greatly, but also the solubility of alumina. Due to the uncertainty of material sources, the bath compositions of potlines have big differences which results in difficulty in experience reference among the aluminium enterprises and the smelters have to grope for long time which seriously affects the technical efficiency. After research for several years, the author thinks that the pot requires setting up health alumina dissolution process condition, which is the technical key to ensure sustainable, high efficient and stable operation of pot. Thus, the author digitally defines the alumina quality coefficient, corrects the calculation model for crystallization temperature & alumina solubility and puts forward health alumina dissolution process model and finally is able to precisely simulate various parameters matching the characteristics of the best process condition of pot, showing good practicability and process implementation guidance after comparison verification of more than 50 potlines in China and abroad.

Keywords: alumina quality coefficient, solubility, crystallization temperature, alumina concentration, health, process condition, model

OUTOTEC Rodding Shop Solutions

Manfred Beilstein
Outotec GmbH & Co. KG, Albin Köbis Str. 8, D-51147 Cologne, Germany

Tom Evans
Outotec Canada Ltd., 1551 Corporate Drive, Burlington, Ontario, Canada L7L 6M3

ABSTRACT

Outotec is a global leader in minerals and metals processing technologies, and has developed many breakthrough technologies over the decades. Outotec's aluminium processing and production offering combines proven, innovative technologies with unrivalled minerals processing and metallurgical expertise. Outotec provides complete solutions for paste plants, rodding shops, carbon recycling, bath treatment, and cast houses, as well as plant upgrades.

For the "anode rodding shop", the company offers the full range of process equipment, and the ancillary shops for carbon scrap ("butt") crushing and bath processing.

The state-of-the-art equipment and systems, as supplied by Outotec for the rodding shop area, are described, covering the entire range of 2-, 4-, 6- and 8-stub anode assemblies as used in the industry, with focus on equipment and plant automation, and automatic tracking of rod assemblies.

Keywords: rodding shop, carbon anode blocks, anode rods, bath removal

LEVERAGING TECHNOLOGY FOR GREEN ALUMINIUM INDUSTRY

PRADIP RANJAN CHOUDHURY
(Former Executive Director, NALCO)
Director, Arkitechno Consultants (I) Pvt.Ltd, Bhubaneswar

ABSTRACT

Climate change and environment issues are significant for the primary aluminium production as the process is highly energy intensive and generates huge quantity of solid wastes starting from refining of ore to electrolysis of alumina. Considering saving of energy during usage of the metal and 100 per cent recyclability of the metal, the life cycle impact of the primary metal produced can be seen as sustainable for the industry.

Primary aluminium production process evolved through consistent R&D efforts and contemporary technology has ensured cleaner environment and energy efficient production process. The energy consumption and environmental effects associated with product manufacturing and use are important measures of the product's impact on society. It is true that in near future, manufactured products will compete not only on price and performance, but also on their impact on society. While analyzing trends in aluminium technology in this paper we will review the important developments taken place addressing environmental issues in the primary metal manufacturing industry.

Carbothermic Processes to Replace the Hall-Heroult Process

Yaghoub Sayad-Yaghoubi
Calsmelt ptd ltd, Australia

ABSTRACT

For aluminium production, conventional carbothermic reduction of alumina has inherent problems such as: generation of aluminous fumes, float of the produced aluminium on the top of the slags, high content of carbon in the product and excessive consumption of graphite electrode and refractory. These problems are rooted in the behaviour of the feed material during heating and of the alumina rich molten slag that the process is based on. Other proposals to replace Hall-Haroult process are carbothermic reduction of alumina or bauxite in vacuum or inert gas. Analyses of the results obtained from these recent works indicate that an application for aluminum production based on these approaches could not be practical. The problems with these approaches are very low reaction rates, low yield, very high actual heat and work requirements (above 24 kWh/kg Al), very high amount of inert gas usage (500-1200 M3/kg Al). Separation of aluminium from carbide and ferroalloy phase produced in the reactor, or from deposits produced from fume condensation are additional issues. In contrast, Thermical process is not based on liquid slag and doesn't use vacuum or inert gas to operate. The feasibility of the Thermical process is based on its ability to rapidly heat charge and, thereafter to rapidly cool the metal product, together with a lower temperature requirement.

Keywords: Carbothermic, Aluminium, Smelting, Reduction, Energy, Slag, Vacuum, Inert Gas, Replace.

Study of Energy Saving for Large Reduction Cell

Yan Feiya
GAMI (Guiyang Aluminum Magnesium Design and Research institute Co., Ltd, Guiyang 550081, China
A Chalieco Company)

ABSTRACT

As the market downturn and the increase of energy prices, the energy consumption in reduction cells in China has accounted for 50% of the total production cost. In this paper, measures and precautions for energy saving are stated from a few aspects, and further study conception, as well as development direction of energy saving for reduction cell are also proposed, based on the design characteristics of large reduction cell and much actual application practice.

Key Words: reduction cell, energy-saving, stability, low energy consumption

Analysis of Economic Plan for Reduction Cell Overhaul

Yang Chaohong
GAMI (Guiyang Aluminum Magnesium Design and Research Institute , Guiyang 550081, China)
A Chalieco Company

ABSTRACT

In this paper, a more economic plan for reduction cell overhaul is proposed based on the analysis of various reduction cell overhaul plans, and comparison in view of various aspects with reference to the actual conditions of grid power supply.

Key Words: reduction cell, cell overhaul, power fare, cell baking for startup

SAMI High Capacity Energy Saving Aluminum Reduction Cell Technology Development and Application

Zhou Dongfang[1], Yang Xiaodong[1], Liu Yafeng[1], Liu Ming[1], Liu Wei[1]

[1]SAMI (Shenyang Aluminium & Magnesium Engineering & Research Institute Co. Ltd.); 184 Hepingbei Street Shenyang, LN 110001 P.R.CHINA

ABSTRACT

Since 1993, SAMI has developed the SY series aluminum reduction cell technologies (SY160, SY190/200, SY230/240, SY280, SY300, SY350, SY400). All these cell technologies have been largely used in China, which covers over 60% aluminum capacity of China. From 2009, according to the power price increasing and the national policy for the aluminum industry, SAMI is starting to develop the energy saving technologies and based on these technologies the current SY series cell technologies are upgraded. The new generation SY500 (current intensity 500kA) low energy consumption cell technology is developed by SAMI which using low ACD energy-saving cell technologies and its industrial experiments, through numerical simulation modeling and operation knowledge. The new design criterion is established for high capacity low energy cell technology. In this article presents the development and application of

energy saving technologies including horizontal reduction technology, new conceptual busbar technology, lining and low voltage heat balance design, and the main technical characteristics of SY500 cell technology and its application is also described in this paper.

Keywords: Aluminum reduction cell, Low energy consumption, Horizontal current, MHD

SECTION VII

Aluminium Downstream

Wrought Aluminium Alloys Produced in Indian Industries for Defence Applications

A.K.Mukhopadhyay
Defence Metallurgical Research Laboratory, Kanchanbagh, Hyderabad-500 058

ABSTRACT

There has been a consistent requirement of a variety of wrought aluminium alloys in different semi-product forms and heat treatment tempers for manufacturing components in both primary and secondary structures of aerospace and defence applications. These requirements, till date, were being met through import from multiple sources resulting in issues involving quality, time, cost overruns and impediments of country's technological growth.

This talk discusses the technical challenges met by DMRL while successfully indigenizing and developing eight varieties of wrought aluminium alloys in eight different semi-product forms in seven medium to large scale aluminium industries in the country.

Aluminium Roll Products at BALCO

Ajay Kumar Sharma
Bharat Aluminium Comapany Ltd., Korba
(Unit of Vedanta Aluminum Resources)
Balconagar, Korba Pin 495-684 (CG), INDIA

ABSTRACT

BALCO is an integrated aluminium complex comprises several production units likebauxite mines, alumina refinery, aluminium smelter, cast houses, foundry and rolling mills along with captive power plants, situated at east-central part of India inChhattisgarh state.

Bharat Aluminium Company limited with support of ISRO installed additional Units having equipments for producing various hard alloy Rolled Products of aerospace and defence grade.

The use of aluminium alloys is increasingly oriented towards high quality end products, where aluminium enters into competition with other materials on a property/quality/cost basis. The aluminium industry has developed several technologies to provide the required quality of the aluminium alloys as function of the end application. BALCO with its excellent casting and rolling facilities is committed to produce material for such stringent applications.

Different types of Aerospace and Defence alloys in the form of Plates and sheets have been successfully developed and supplied to the end users by BALCO, making us a proud associate with various Defence and Aerospace initiatives like PSLV, GSLV, Brahmos apart from applications of Indian Army and Indian Navy.

Apart from such hard alloys BALCO also supplies all the different grades of commercial Al Alloys to different customers in industrial segments like Indian Railways, Road Transportation, Heavy machineries, Electrical segment, Packaging, Consumer durables, Utensils etc.

This talk provides an overview of the Rolled Product business of BALCO and its significance to Indian Aerospace, Defence and other industries.

Key words: Aluminium Rolled products, Defence and Aerospace Grade Aluminium Rolled Products, Research and Development of Specialized Aluminium Alloys.

Development of High Performance Refractories for Aluminum Industries – A Recent Trend

J. P. Nayak, B. Ghosh*, A. K. Samanta, S. Adak, P. B. Panda & A. K. Chattopadhyay
TRL Krosaki Refractories Limited, Belpahar – 768218, Odisha (INDIA)
*Corresponding Author: bghosh@trlkrosaki.com (Mobile: +91-8455868281)

ABSTRACT

Aluminium is an important primary metal in our daily life. The usage of Al and its alloys are getting importance in both domestic and commercial sectors like electrical and electronics devices, architecture and construction fields, biological and dietary applications, transportation and aviation purposes, packaging industries etc. With the advent of different modern technology and due to the continuously changing characteristics of the raw materials, the Aluminum metallurgy has undergone severe technological modification over the years. Refractories play an important role in every stages of the primary and secondary metal production equipment like anode baking furnace, pot furnace, melting and holding furnace, crucible etc. TRL Krosaki have developed a comprehensive range of next generation refractories for Aluminium industries to achieve higher productivity, less downtime, uninterrupted operation and cost-effective solutions.

The present paper deals with the development of high performance Refractories (both bricks and monolithic) to meet the challenging demand of Aluminium industries. High creep resistant flue wall and head wall bricks for Anode Baking Furnace (ABF), high alkali resistant fire clay bricks for Pot Furnace, non-wetting phosphate bonded high alumina bricks and plastics for Melting and Holding Furnace and various castables for Aluminium sectors have been developed. Combination of different high purity raw materials and modern process equipment like high-intensity inclined mixer machines, high capacity fully automatic SACMI press, high temperature tunnel kilns etc. have been used for bulk production of these products to meet excellent physical attributes and other physico-chemical and thermo-mechanical properties. The key features of the products like thermo-mechanical properties (RUL, Creep, HMOR etc.) and non-wetting property towards molten metal were evaluated using different characterization techniques like XRD, HMOR, corrosion resistance, creep, microscopy etc. TRL Krosaki is equipped with a

complete package of Refractories with dedicated design and application teams to serve Aluminium industries.

Keywords: Aluminium, High Alumina Bricks, Castables, Thermo-Mechanical Properties, Anode Baking Furnace, Alkali Resistance

Emerging Role of Secondary Smelting and Products thereof in the Asia-Pacific Markets

B.S.Pani, Industrial Consultant
Span Resources management services: Bhubaneswar, India
bhavani.pani2@gmail.com

ABSTRACT

Recycling Aluminium saves more than 90 percent of the energy that would be needed to smelt a comparable amount of the metal from its raw materials. It is estimated that recycling of every Kg of Aluminium saves earth 5Kg of Bauxite, 4 Kgs of Chemical products and nearly 14 units of electrical energy. This saving in inputs plus near 'zero' generation of green house gasses in the operation of secondary smelters, more than covers the addition operational expense of scarp collection, sorting, re-melting for casting to provide over 20-25% cost advantage in products produced from recycled aluminium.

Of the current global aluminium consumption levels of around 80-85 million TPA, over 30% or 30-35 million tons comes from recycled aluminium. While primary aluminium, which is produced in just about 30 odd countries on the globe, aluminium is used in some form or the other in virtually every small and big nations on earth. The countries that show significantly higher per capita consumption rate of aluminium over and above the global average of 8 Kg/head per annum do so on the basis of products they produce and export to other countries. Thus in every other country, Aluminium scrap is generated and re-used after the product goes through its economic life cycle of use. Therefore, unlike primary aluminium, aluminium scrap generation, availability and re-melting for re-cycling is global industrial activity.

In terms of secondary aluminium smelting capacity China which now produces over 40 % of Primary Aluminium of the world also covers 45% of global secondary smelting capacity. In the Asia Pacific region, Japan, Thailand, Hong Kong, Taiwan, South Korea and Malaysia, none of which are primary Aluminium producing countries, contribute to the global secondary aluminium smelting capacity by 42%. These countries, apart from using their indigenously generated aluminium scrap, are major scarp importers from the west. Significantly, of the total volume of scrap aluminium supplied to the global recycling industry by north America, the largest scrap generating region on earth, China alone accounts for over 45% of its overall raw and processed scrap exports.

The secondary aluminium sector being heavily fragmented across the globe, information and statistics on availability of different types and categories of scrap, recycling capacities and technology status etc have never been available in an adequately authenticated manner. This obviously created enormous problems scenario in building making projecting on future market supply and demand trends. The growing economic prosperity and consumerism in Asia- Pacific region in recent years has further added to the complexities.

Many new questions have been thrown up in recent times regarding the industry and its future growth pattern. Would Indian sub-continent which today consumed less than 1.5 Kg per head per annum become a major global primary and secondary Aluminium producer and consumer as it approaches the 50% mark 4 Kg/per head/per annum of global average? Would Gulf region which is emerging as the fastest growing primary and downstream product producing region on earth become a major playground for the global scarp handling, processing and utilising region in coming years? Would the growing prosperity in the Asia- pacific region make it also a significant generator and supplier scarp to the global secondary Aluminium industry? And of course, the pattern of technological up- gradations that would be needed to accommodate the significant changes that are likely to emerge with changing quantitative and qualitative pattern scrap availability across the globe.
The above are some of the issues that the paper would attempt to analyse and present with qualitative and quantitative analysis and projections.

Study of R&D Characteristic and Application in Aluminum Processing Industry of Domestic Two-stand Tandem Cold Mill

CHEN Chun-can, ZHAO Jing-shen, LOU Jian-ting
(China Nonferrous Metals Processing Technology Co., Ltd., Luoyang 471039, China)

ABSTRACT

The paper presented the characteristics of tandem cold mill; it described the application and configuration of two-stand irreversible tandem cold mill in aluminum processing industry at home and abroad; it highlighted R&D characteristics of 1700mm two-stand 4-hi irreversible tandem cold mill developed independently by China; it illustrated the equipment composition, main technical parameters and performance, as well as application effects; and it pointed out the lessons learned during R&D of the two-stand tandem cold mill.

Keywords: domestic; two-stand; tandem cold mill; aluminum processing; equipment research and development

Effect of Heat Treatment on The Paint-Bake Performance and Formability of 6xxx Automotive Sheet Alloys

Hao Zhong
Suzhou Nonferrous Metals Research Institute, Suzhou 215026, China

ABSTRACT

6xxx alloys have been considered as the most promising candidates for aluminium automotive body panel applications due to their good combination of formability and strength. In this study, the influence of heat treatment (including natural ageing and pre-ageing) on the paint-bake performance and formability of three 6xxx alloys with different Si and Cu contents were studied. The results show that

although pre-ageing can improve the paint-bake performance, it could deteriorate the formability of the materials. Furthermore, the work hardening and strain-rate hardening behaviours of the alloys were analysed to understand the formability results.

Key words: 6xxx alloys; automotive body panel; paint-bake performance; formability

CEL – A "One-Stop Solution" For Extrusions, Defence, Engineering and Industrial Applications

J. K. Malpani
Century Extrusions Ltd., Kolkata, India
president@centuryextrusions.com

ABSTRACT

Century Extrusions Ltd., a company promoted by Mr. M P Jhunjhunwala, a first generation entrepreneur commenced its operations in the year 1991. The plant is located at Kharagpur about 140 KM from Kolkata.

When the company commenced its operations, it was engaged in the manufacture of extrusions mainly for Architectural and Transport Applications in Aluminium Alloys of **6xxx** series. Over a period of time, the company has evolved itself, set up the requisite infrastructure and has been successfully producing extrusions for Defence, Engineering & Industrial Applications in Soft, Medium and High Strength Aluminium Alloys of **1xxx** to **7xxx** series in simple to intricate shapes from the three extrusion presses of different capacities.

The presentation talks about the company's capacity and capabilities to cater to the requirements of the Defence, Engineering & Industrial Sectors.

Indigenization of Aluminium Alloys for Space Applications: Challenges, Current Status and Visions

K**oshi M. George**
VSSC, ISRO, Trivandrum

ABSTRACT

ISRO had made initial attempts to indigenize Aluminium alloys prior to the year 2000 and success was very much limited. The challenges faced during earlier efforts were mainly due to non-availability of melting, refining & casting facilities, lack of powerful ring rolling mill & heat treatment/finishing line for realizing sheets/plates in the country and also non-availability of technology for aerospace grade Aluminium alloys. Another big challenge was lack of requirement which can encourage Indian industries

to take up establishment of required facilities. At the same time, ISRO faced a severe shortage of supplies of Aluminium alloys from overseas sources due to embargo. The cost of Aluminium alloys available through import route was exorbitant. In this background, ISRO has taken up an ambitious task of indigenizing Aluminium alloys for space applications during the beginning of the last decade.

This paper briefs the journey over the last one and a half decade detailing the efforts of ISRO team towards facility establishment, technology development and product development. To start with, ISRO has narrowed down to just 4 alloys namely, AA2014, AA2219, AA6061 & AA7175 based on the recommendations of a National Committee. Team ISRO has also identified minimum facility establishment required in the country for indigenization like cast house for realizing billets/slabs of aerospace grade alloys, 630T/315T capacity ring rolling mill capable of rolling seamless rings up to OD of 5.5m, heat treatment & finishing line for achieving the desired temper for Al. alloys sheets / plates etc. The challenges faced during the last decade during indigenization and how the same has been overcome is dealt in this paper. Today, indigenization of Aluminium alloys as for as technology and capabilities are concerned is more or less completed resulting in self-reliance and also enhanced National capability. ISRO has already made its future vision also very clearly. In the short run, near net shaped forgings & rings will be realized resulting in huge material cost savings, lesser machining cost and also improved properties. In the long run, ISRO has set its sights on indigenous development of Al-Li alloys like AA2195/AA2050. Our initial lab level trials are very much successful and we are sure of replicating the success story for industrial level Al-Li alloys also.

Applications of Aluminium Extrusions

Kshemendra Nath
Sapa Extrusions India

ABSTRACT

Aluminium extrusions find wide range of applications across varied segments. Globally Building & construction segment accounts for about 50% of aluminium extrusion segment followed by Industrial, Automotive & Transportation and Electrical & Electronics.

The demand for quality extrusions is growing in building system applications. The Fenestration Industry is coming of age and has become one of the most important aspects of the construction industry and an important challenge for the architects' fraternity. Therefore, there is a very demand for quality extrusions in building & construction segment. The emerging applications such as formwork and scaffolding are forecast to drive the demand for quality extrusions further.

Precision machined extrusions have a greater demand in Industrial and Electrical & Electronics application. Machine Building, Hydraulic / Pneumatic devices, Heat sinks & Bus bars drive the demand for machined extrusions.

Aluminium extrusions have been used in automotive and Transportation sector mainly because of the light weight future of aluminium. The usage of extrusions in automotive sector mandates stringent quality requirements and extruders should be capable of meeting such specifics. In India, the usage of extrusions in automotive is still at a nascent stage.

Extrusions have been largely used in renewable energy segment, especially solar. The frames for solar panels are largely aluminium and the usage of aluminium mounting structures has been growing. Light weight, Corrosion resistance are the major reasons for the usage of extrusions in solar segment

This presentation discusses the applications of aluminium extrusions and the reason why extrusions are preferred in such applications.

Aluminium – The Future Metal

Lovkesh Bhatia
General Manager – Strategic Marketing
Hindalco Industries Limited

ABSTRACT

Aluminium has been one of the fastest growing metals globally and in India for the past few decades. Global Aluminium consumption has grown at a CAGR of 6% since 2001 and has reached 50 million tons in 2013. During the same period, Indian aluminium consumption has grown at a CAGR of 15%, making it along with China, one of the fastest growing markets for the metal.

India's per capita aluminium consumption, which is significantly lower than most other nations, has increased from 1.1 kgs in FY06 to 2.2 kgs in FY14. This translates into an average annual growth rate of 9%. However still there is tremendous potential in India to catch up with the global average of about 9 kgs and average of 12 kgs of China. The penetration of Aluminium is increasing in India, and its pace of growth is ahead of the general economic growth rate. The changing trend of consumption in favour of the Automotive, Packaging and Construction segments due to favourable demographics, with a rising middle class, increasing working age population and rapid urbanization, will further aid the rapid 'Aluminisation' in India.

Hindalco has recognized the changing trends in the market and is focusing its efforts on growing the new future potential segments. Over the last decade, Hindalco has pioneered various new products and championed the cause of "Applications Development" in India under its various "Market Driving Initiatives". The Primary Producers doubling their capacities in India, will give a further impetus to grow the Indian Aluminium downstream Industry, giving a further boost to the new segments in India. Hindalco has already invested in a new rolling mill complex at Hirakud, larger dia extrusion presses at Renukoot, a new foil complex in Mouda and HAAL, a billet and slab unit for Aerospace and high end applications.

The abundant upstream and downstream future capacities in India, coupled with its various unique advantages and growing consumption, is expected to guarantee Aluminium's bright future in India, and maintain its status as the "" Future Metal".

Growing Applications of Aluminium in Transportation and the Implications for the Indian Downstream Sector

Shanker Gopalkrishnan, President, Madras Consultancy Group

ABSTRACT

Of the total global usage of some 64 million tonnes of primary and secondary aluminium in 2013, the transportation sector accounted for about 17million tonnes. The usage of aluminium in the transport sector has witnessed steady growth over the last few decades and is now poised to expand further with the automotive industry taking a keen interest in increasing the usage of aluminium in order to reduce the kerb weight and improve fuel efficiency of automobiles. In USA, an automobile uses, on an average, around 155 kg of aluminium while the number is closer to 130 kg in Europe. Vehicle manufacturers on both sides of the Atlantic are working hard to increase the usage of aluminium. Growing environmental concerns and need for light weighting of various transport vehicles without compromising the structural and functional integrity of these systems will drive the global demand for aluminium in transportation sector through the next decade.Apart from automobiles, the demand for aluminium in the form of flat rolled sheet, extrusions, casting and forgings will also be driven by other transport applications such as high-speed rail coaches, bus & trailer bodies, aircrafts and marine applications. India's usage of aluminium in the transport sector is estimated at around 700,000 tonnes and the demand for downstream products is forecast to grow rapidly. This paper explores what the transportation sector has in store for the Indian aluminium downstream sector and what the industry needs to do to meet the challenges arising from the demand for additional capacity, new products and alloys.

Upgrade and Optimization of Oil-Mist Recovery System for Aluminum Plate, Strip and Foil Rolling Mill

Wei Dongfeng ; Wang Bo ; Pan Bo
(China Nonferrous Metals Processing Technology Co., Ltd., Luoyang 471039, China
A Chalieco Company)

ABSTRACT

This paper discusses the upgrade and optimization of oil-mist recovery system for aluminum plate, strip and foil rolling mill through the structure of three towers in one, the waste-heat utilization and the development of multiple absorption towers and multiple spray process, so as to make the oil-mist

recovery system for aluminum plate, strip and foil rolling mill in more reasonable design, more stable running, more energy saving, less investment and more extensive application.

Keywords: Oil-mist recovery system; Energy saving; Emission reduction; Three towers in one; Waste-heat utilization; Multiple absorption tower and multiple spray

SECTION VIII

Environment Management & Sustainable Developments

Impacts of Mining on Ecological Sustainability: Case study of Baphlimali Bauxite Mines of M/s Utkal Alumina International ltd

B R K Padhi
Sr. General Manager
Baphlimali Bauxite Mines of M/s Utkal Alumina International ltd.
Aditya Birla Group
biswaranjan.padhi@adityabirla.com

ABSTRACT

Mining companies need to move beyond viewing sustainability as a "Social license to operate". Leading mining companies globally, view sustainability as a source of competitive advantage- as a source for newer greener businesses, opportunity for efficiency improvements and a pool of intangible benefits. If sustainability initiatives have to evolve and gain further prominence within the mining industry, the companies need to think differently and give it due importance on their management agendas. This is only possible if companies are able to perceive direct benefits of sustainability, beyond the "Social license to operate".

Sustainability is not a constraint to mining growth. Mining can become more environmentally sustainable by developing and integrating practices that reduce the environmental impact of mining operations. These practices include measures such as reducing water and energy consumption, minimizing land disturbance and waste production, preventing soil, water, and air pollution at mine sites, and conducting successful mine closure and reclamation activities.

Finally, Environment has not been inherited-Treat it as a loan to be returned-To the future generation. An attempt has been made in this paper to represent the advanced techniques used for mining purpose at Baphlimali Bauxite Mine of Utkal Alumina International Limited to minimize the impact of mining on ecological sustainability.

Keywords: Baphlimali, Bauxite, Mining, Sustainability, Ecology, Environment.

Environmentally Sustainable Development of Aluminium Industry: Status and Future Challenges

S.K.Goyal[1], Harshvardhan Singh[2] and S.R.Wate[3]

[1.] Senior Principal Scientist and Head, EIRA Division, CSIR-NEERI, Nagpur
[2.] Senior Scientist, EIRA Division, CSIR-NEERI, Nagpur
[3.] Director, CSIR-NEERI, Nagpur
Email address: sk_goyal@neeri.res.in;hv_singh@neeri.res.in;sr_wate@neeri.res.in

ABSTRACT

Aluminium is the third most abundant element after oxygen and silicon in the Earth's crust. It makes about 8% (by weight) of the Earth's solid surface. Aluminium metal is highly chemically reactive and mostly found combined in over 270 different metals. The main ore of aluminium is bauxite. India has the fifth largest bauxite reserves with deposits of about 3 billion tons, constituting 5% of the world's deposits. Production of 1 ton aluminium requires 2 tons alumina, while production of 1 ton of alumina requires 2 to 3 tons of bauxite, and in the process, 2-4 tons of red mud or bauxite residues is generated. Present level of aluminium production in India is about 1.8 million tons and it is expected to reach 5 million tons by 2020.Aluminium industry is known for its high-energy consumption, and also for serious environmental problems, particularly posed by smelters, and red mud disposal.

Normally Aluminium Industry comprises major activities like Mining of Bauxite, Refining of bauxite to produce alumina, Reduction & Smelting to produce Primary Aluminum and Fabrication to produce fabricated products. There are various environmental issues associated with different activities/processes. Major environmental problems associated with bauxite mining are related to the rehabilitation of mined-out areas and the disposal of tailings. In alumina production, the disposal of bauxite residue saturated with caustic soda ("red mud") is the major problem, besides gaseous and particulate emissions from boilers, calcination furnaces and bauxite dryers. In aluminum smelting, emission of fluorides from reduction cells and off-gases, smoke and steam resulting from pitch distillation are considered most important, whereas in aluminum fabrication, emissions of gases and particles from smelting and re-heating furnaces pose severe environmental threats.

Red mud is highly alkaline thick suspension of water-insoluble silicates, aluminum silicates and metal oxides, and hence needs special precaution while disposing to avoid pollution of surface as well as ground water& soil resources, and subsurface environment.Aluminum smelters and serious fluoride poisoning go hand in hand. Various toxic compounds are released from smelters in both gaseous and solid forms. 'Scrubbers' are usually used to remove the majority of fluorides from smelters. Disposal of any fluoride rich liquid/solid waste on land may adversely affect soil quality. Fluorides are phytotoxic (toxic to plants) and actually accumulate in vegetation, making long living trees particularly susceptible to fluoride poisoning. When animals or humans eat fluoride polluted plants or meat, or drink fluoride rich water, they can develop 'fluorosis' which weakens bones and teeth and can, in extreme cases, lead to bone deformation and birth defects. Fluoride can also build up in soft tissue in the body causing a range of serious health effects. A large amount of carbon is also used, resulting in significant amount of greenhouse gas emissions.

The paper reviews status and environmental challenges of aluminum industry along with its various upstream and downstream processes/activities/industries to ensure environmentally sustainable development of aluminum industry sector.

Keywords: Aluminium Sector, Smelter, Red mud, Fluorides, Sustainable Development

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Century NF Castings, Faridabad & Hodal (Haryana)	Secondary Aluminium Alloys	60000
	Zinc Alloys	6000
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	Zinc Alloys	600
	Secondary Aluminium Alloys	600

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•**Extruded Rods to vendors who manufacture forged and machined components for Defence; Round Tubes for Ordnance Factories and of late, about 100MT of Rods in very high strength aluminium alloys for forging and machining to M/s. BrahMos Aerospace Pvt. Ltd. for their Missile Indigenization Program**.

•Die library has 4500+ Dies to manufacture 3000+ different profiles

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• Accredited with **ISO 9001:2008**, **ISO 14001:2004** and **OHSAS 18001:2007** by DNV, the Netherlands

• Market presence all over India: North, South, East and Western regions

Forward Integration

The company has planned to put up facilities for:

Powder Coating, Anodizing, Profiles with Thermal Break and Fabrication

creating happiness

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Aluminium - A Green Metal

Keeping the Mining & Metal Industry strong including Aluminium - a green metal makes Chhattisgarh most prosperous & strong state. Aluminium which is known as a green metal being produced in very environment friendly process as substitute of wood in construction, is a major contributor to economic growth of Chhattisgarh. BALCO is operating currently with 2.45 lakh tonne aluminium smelter and 810 MW captive power plant with one lakh tonne downstream facility. It has already increased aluminium producing capacity to 5.70 lakh tonnes and Power Plant to 2010 MW with an investment of Rs. 9,000 crores.

State Exchequer & Investment :

- During last one decade, BALCO contributed approx. Rs. 1000 Crore to State Ex- Chequer. During this period approx Rs. 2800 Crore business was generated within the state.
- BALCO invested approx Rs.12000 Crores and almost entire profit of BALCO was reinvested in the state for industriadevelopment.

Employment :

- Employment was generated for nearly 1 lac people directly and indirectly.

Cancer Hospital Project :

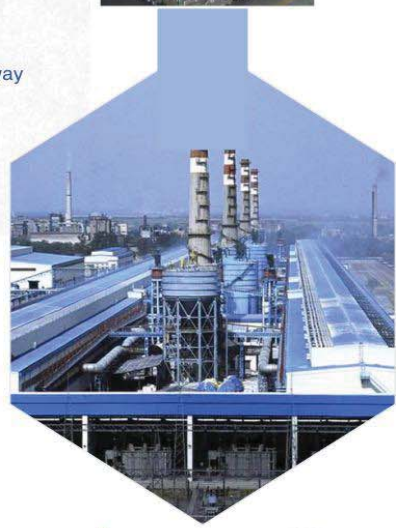
- A state of art 350 bed Cancer Hospital is being setup by BALCO at Raipur with an investment of Rs. 350 Crores under the aegis of Vedanta Medical Research Foundation for the people of Chhattisgarh and the nation.

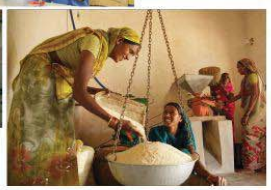
Bringing Prosperity to People :

- Over 25000 families in Chhattisgarh are dependent on BALCO for their livelihood.
- Key social initiatives include imparting vocational training to tribal youth through training centre set up with IL&FS, Mother & Child Care Projects (Aaganbadi - Mamta) and development and support to agriculture growth through Project Watershed and Wadi development.

With the overwhelming support of the people of Chhattisgarh and Government BALCO is on the way to becoming million ton integrated aluminium smelter with this:

1. Employment opportunity will grow 2 times.
2. Business generation through BALCO within Chhattisgarh will grow 3 times & Revenue contribution to state Exchequer will grow 3 times.
3. Downstream Aluminium Industry will grow 4 times.





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BHARAT ALUMINIUM COMPANY LIMITED

Korba, Chhattisgarh

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