# International Symposium
## Bauxite, Alumina and Aluminium Industry of Asia

# IBAAS 2012

# VISION 2020

**December 3-5, 2012**
**NAGPUR, INDIA**

**SOUVENIR**

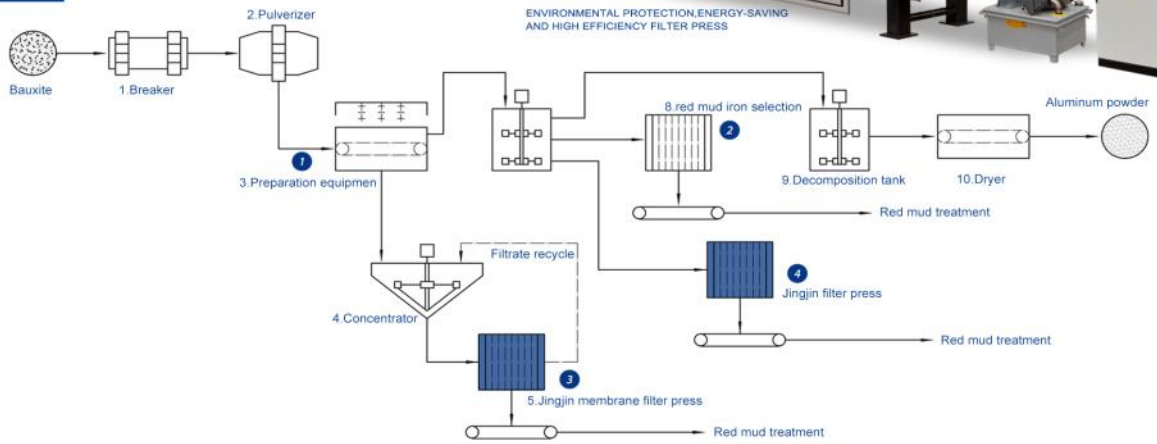
# JINGJIN FILTER PRESS

## A LUMINA INDUSTRY (RED MUD)

Jingjin will provide the best filtration scheme to optimize production environment, reduce labor intensity and save production cost. The red mud water content after filtration is about 23%,It's about 4-6 cycles per hour.

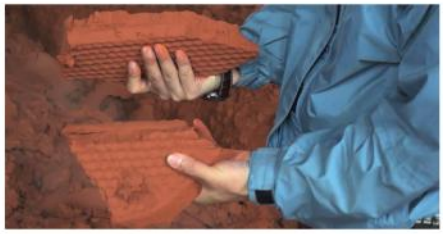
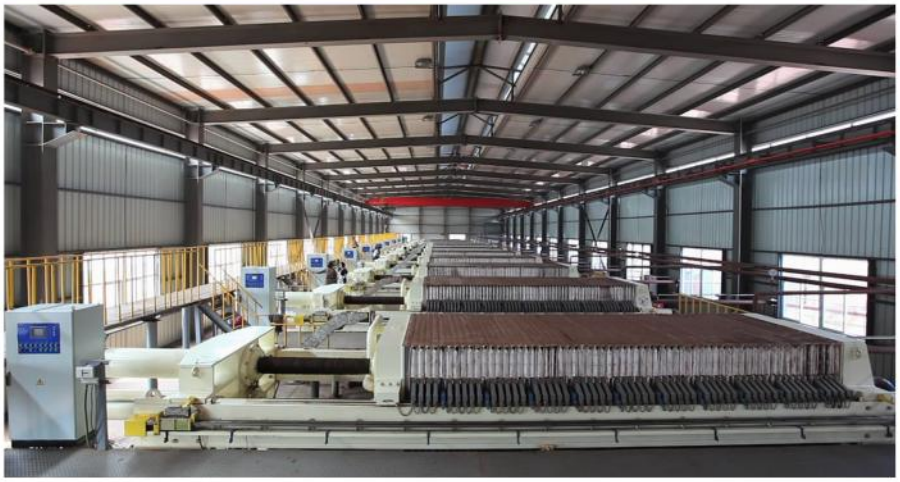
ENVIRONMENTAL PROTECTION,ENERGY-SAVING AND HIGH EFFICIENCY FILTER PRESS

## PROCESS




## RED MUD DEWATERING AND WASHING



**SHANDONG JINGJIN ENVIRONMENTAL PROTECTION EQUIPMENT CO.,LTD**
ADD:JINGHUA ROAD,DEZHOU ECON.DEVELOP.ZONE,DEZHOU,SHANDONG,CHINA.
POSTCODE:253034 MOBILEPHONE:0086-13792208600 TEL:0086-534-2556198
FAX:0086-534-2753695 WEBSITE:www.jjylj.com E-MAIL:dmxs-com@263.net

# International Symposium

Focus on key topics and issues in the Bauxite, Alumina and Aluminum Industry of Asia

# Vision 2020

**About 60 technical papers to be presented during 3 days of conference on various aspects of bauxite, alumina and aluminium industry.**

## Special Sessions

- Non-metallurgical bauxites and alumina products
- Processing Innovation in Alumina Ceramics
- New Emerging applications of Alumina Ceramics

## Organizers

International Bauxite, Alumina & Aluminium Society

Jawaharlal Nehru Aluminium Research Development & Design Centre (JNARDDC)

**More than 70 participating organizations from all over the world.**

## Major Event Sponsors

## Co-Sponsors

## Media Partners


景津
JTP


BRIGHT
贝莱特


RAMK
GROUP
Towards sustainable growth


Al Circle


Refractories Window
www.refwin.com


Minerals & Metals Review


ECVV.com
Challenge Your Trading


INDIAN INSTITUTE OF TECHNOLOGY BOMBAY


al
AUSTRALIAN
ALUMINIUM
COUNCIL LTD


ALMATIS
PREMIUM ALUMINA


JYOTI
CERAMIC


TATA
Leadership with trust


RioTinto


RBITE


WorleyParsons
resources & energy


CGCRI
CECRI
कर्मणैव हि संसिद्धिम्


vedanta


नालको NALCO
National Aluminium Company Limited


Metrohm
India Limited


BHEL


ALUFER


CUMI


CERAMIC
INDIAN
SOCIETY


ORIENT ABRASIVES LTD


HALLMARK
Minerals (I) Pvt. Ltd.


BEROA


FLSmidth


PCRA


PANalytical


AOPL


HINDALCO


BIRLA GROUP


barriquand
technologies thermiques


Outotec


calderys
REFRACTORY SOLUTIONS


NFTDC


VIROTEC
Global Solutions


नीरी
NEERI


Excellent
Minerals
Solutions
WEIR
MINERALS


CYTEC


ANRAK
ALUMINIUM LIMITED


ASL


SKG
Refractories
Ltd.


TREIBACHER
SCHLEIFMITTEL

# IBAAS 2012

## Participating Organizations

Ace Calderys Ltd

Aditya Birla Science & Technology

Company Ltd.

ACC Ltd

AlCircle

Allied Strips Ltd.

Almatis Premium Alumina, Germany

Aluchem India Ltd.

Alufer Mining Ltd.

Amber Developments, France

Anark Aluminium Ltd

Ashapura Minechem

Australian Aluminium Council Ltd.

Avian Overseas

Barriquand

Bharat Heavy Electrical Limited (BHEL)

Beroa-Uniseven Refractory Services

Bhuvaneshwari Mineral Consultancy

Bombay Minerals

Carborundum Universal Limited

Credo Mineral Industries Limited

CSIR-Central Glass & Ceramic

Research Institute

Feluwa Pumpen GMBH, Germany

FLSmidth Alumina Technology

GBConsult

GEA Process Eng

GVS Envicon Technologies

Hallmark Minerals (India) Pvt. Ltd.

Hencon Group

IFGL Bioceramics Ltd

IFGL Bioceramics Ltd

IIT Bombay Powai, Mumbai

Indian Bureau of Mines

Indian Institute of Technology

Kharagpur

Indira Gandhi Centre for Atomic Research

IOT Anwesha Eng. & Construction Ltd.

Jawaharlal Nehru Aluminium Research Development and Design Centre

Jyoti Ceramics

Koncepts Global

Kunash Instruments

Magnum Minerals

Meena Agency

Meenal Ceramics

Metrohm India Ltd

Minerals & Metals Review (MMR)

Mineral Information & Development Centre

Multitrator Pty Ltd, Australia

NALCO Chemicals

National Aluminium Company Limited(NALCO)

National Environmental Engineering Research Institute (NEERI)

National Institute for Interdisciplinary Science and Technology (NIIST)

Nikkam Chemicals

Non Ferrous Materials Technology Development Centre (NFTDC),

Orbit Alumine, Canada

Orient Abrasives Ltd.

Outotec

Panalytical

Petroleum Conservation Research Center

Primary Aluminium Consultants

Ramky Enviro. Eng.

Rio Tinto

Saint Gobain, Grindwell Norton Limited,

Saurashtra Calcine

Shandong Jingjin Environmental Protection Equipment Co., Ltd

Shri Natraj Ceramics and chemical industries Limited

SKG Refractories Ltd.

SNC Lavalin

Tangshan Zhonglian Refractory E-Business Co., Ltd.(Refractory Window)

Tata Reasearch Devlopment and

Design Center

The Indian Ceramic Society

The Indian Mining & Engineering Journal

Treibacher Schleifmittel GmbH, Austria

TRL Krosaki Refractories

Tyco Valves & Controls

VEDANTA Aluminium Limited

Venus Eng. Works

Virotec Global Solutions

Weir Minerals India Pvt. Ltd

Windsor Peterochmical

Worley Parson

Zhongda Bright Filter Press Co. Ltd

Zibal Exim

# TABLE OF CONTENTS

## IBAAS 2012

**Inside this issue:**



### Company Profiles – Sponsors & Co-Sponsors



### Abstracts

# IBAAS

## Company Profile

International Bauxite, Alumina & Aluminium Society (IBAAS) is set up and registered in India by professionals active in various fields of the aluminium industry.

The aluminium industry structure is rapidly changing and production centres are shifting to developing, high growth potential countries of the world. Keeping the present development pace and growing importance of Asian countries, International Bauxite, Alumina & Aluminium Society (IBAAS) is set up in this part of the world by professionals active in various fields of aluminium industry.

The initial activities will be focused in the Asian region with special attention to India, China, Vietnam, Indonesia, Saudi Arabia and UAE. The founders of this society have vast experience in organizing similar conferences on bauxite, alumina and aluminium in India and China.

The objectives of IBAAS are as follows:

- Provide platform for aluminium industry professionals to interact and work together for the common goal and development of the industry
- Organise annual and bi-annual workshop, seminar and conferences in association with primary aluminium producers and/or R&D centres
- Represent primary aluminium industry as an independent organisation
- Promote latest technology and advertise products and equipment.
- Publish, papers, monographs and books to highlight latest achievements in the field
- Facilitate technology transfer and compile a list of experts available in the field.

The development in non-metallurgical applications and uses of bauxite and alumina are also rapidly changing and in the recent past several small to medium sized independent industries have come up in India and China to produce value added items. IBAAS will actively address various issues associated with the development of this industry and disseminate latest R&D activities in this field.

# JNARDDC

## Company Profile

Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur a "Centre of Excellence" was set up in 1989 by Ministry of Mines, Government of India with assistance from United Nations Development Program (UNDP) to provide major R & D support system for the emerging modern aluminium industry in India for undertaking research in the areas of bauxite, alumina and aluminium. The Centre is also recognized as a Scientific & Industrial Research organization by the Dept. of Scientific & Industrial Research, Ministry of S&T, Govt. of India. It is the only institute of its kind in India.

Vision

***"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"***

Mission

***"Provide modern technological inputs to aluminium industries and other sectors for value addition, reduction in energy / material consumption and environmental pollution based on optimum utilisation of existing facilities and further development of technical capabilities".***

Centre has endeavoured to assimilate and adapt the technologies available in India for the production of alumina and aluminium and to develop indigenous know-how and basic engineering packages for future alumina and aluminium plants to be set up in the country. Research programmes specifically in the areas of reduction in material and energy consumption have been undertaken and databanks have been setup in the areas of bauxite for the benefit of the aluminium industries. Centre is offering regular training programs to personnel employed in the Indian aluminium industries.

JNARDDC has set up facilities in the areas of bauxite, alumina and aluminium and developed expertise in areas of characterization & technological evaluation of bauxite, alumina technology, smelter technology, cell monitoring & modeling of smelting process, carbon research & physical testing, modeling activities in downstream processing, alloy development, metallography and materials testing, instrumental and wet chemical analysis including quantification of trace elements. The Centre also offers analytical and testing facilities to other non-ferrous industries, steel plants, small-scale industries, R&D organisations and academic institutions

Since 2004, Centre has also diversified its activities to secondary aluminium industries especially in the areas of downstream processing, waste recycling and providing a technological support to industries in the area of energy and environment. The Centre's research work is of utmost importance to the nation, particularly to the primary and secondary aluminium industries.

Contact Address: JNARDDC, Opposite Wadi PS, Amravati Road, Wadi, Nagpur -440023

# IBAAS 2012

# SPONSOR PROFILES

# ZHONGDA BRIGHT FILTER PRESS CO., LTD.

## Company Profile

Zhongda Bright Filter Press Co., Ltd. is one of the most professional and the largest filter press manufacturers as well as solid liquid separation systems (filtration) solution providers in the world.

Zhongda Bright is a famous brand as well as a Top 500 Machinery Manufacturer in China; Zhongda Bright Industrial Park covers a total area of 8.6 million square meters, its workshop covers an area of 2 million square meters; it has a staff consisting of more than 1500 specialists and engineers. Zhongda Bright has an annual output of 4000 sets of filter presses, its annual sales in 2011 is USD 0.4 billion.

Zhongda Bright Filter Presses are widely used in many fields such as mining, chemical industry, waste water treatment, food industry, biodiesel, metallurgy, etc. Zhongda Bright has profound experiences in Red Mud Disposal in alumina refinery. It is a membership company of CHINALCO (The Largest Alumina Plant in china) as an expert of red mud dewatering. Till now, it has more than 500 sets of filter presses working in different alumina refineries all over the world.

Zhongda Bright has a worldwide marketing network covering the UK, Germany, the USA, Brazil, India, Bangladesh, Thailand, Malaysia, Japan, Russia, Egypt, South Africa and many other countries and regions.

Zhongda Bright Filter Press Co., Ltd. has obtained ISO9001:2000 certificate of quality management system and ISO14001:2004 certificate of environment management system.

# RAMKY ENVIRO ENGINEERS LIMITED

## Company Profile

Ramky Enviro Engineers Limited, a part of the Rs.7000 crores Ramky Group of Companies, is Asia's leading provider of comprehensive environment management services. We offer a whole slew of best-in-class services under various categories including Waste Management - hazardous, municipal, solid, biomedical & e-waste; Recycling - waste water, paper, plastic and integrated waste. Apart from these we also offer renewable energy, consultancy and integrated environment services.

Our ISO 9001, ISO 14001, ISO 17025 and OHSAS 18001 certifications and state-of-the-art R&D facilities have set the platform for excellence in environmental and waste management. Constant upgradation fuels our future plan of action in exploring newer options in environmental sustainability.

In line with our mission of Sustainable Development, we have built key competencies in environment services which include Waste Management, Water Management Recycling, Renewables and Integrated Environmental Services. The Company has 26 subsidiaries and 85 facilities in nearly 50 locations across India, Singapore, Middle East and Africa.

Under "Integrated Environment Services" all services for environmental services and waste management are provided on a one-stop-shop basis for industries and Industrial estates. This concept enables organizations to concentrate on their core competencies and entrust to Ramky Enviro Engineers Limited, all issues connected with environment infrastructure services and compliances.

Taking dedication to our cause a step ahead, we have established state-of-the-art Research & Development facilities to provide Analytical Services, Treatability Studies and to carry out Environment Performance Studies.

**Services Spectrum:**

Waste Management Solutions: Municipal Solid waste, Industrial Hazardous waste, Bio Medical waste, Electronic waste and Remediation of Contaminated Sites.

Recycling : Oil , Metal , Plastic , Paper , Solvents, Battery , Wood , Glass , e- Waste, Construction & Demolition.

Environment Services: Integrated Environmental Solutions, Air Pollution Control, Water & Waste Water Management, Water benchmarking & Water security and Lakes Remediation.

Renewable Energy: Solar Energy, Wind Energy, Municipal Waste to Power, Bio-diesel and Plastic Waste to Fuel.

**Key Highlights:**

27 Municipal Solid Waste facilities handling more than 11,000 Tons per Day.

13 Hazardous Waste Management facilities with capacity of than One million tons per annum.

15 Bio-medical Waste Disposal facilities catering to over 12,000 health care establishments and more than 200,000 hospital beds.

# ABSTRACTS

## SECTION I

## KEYNOTE ADDRESSES

# Cost and Green Technology to extract alumina from a variety of aluminous ores without producing red mud

**Yves Noel**
Orbite aluminae Inc., 505 route Transcanadienne,
St_Laurent, Quebec H4T 1S3

## Abstract

Orbite Aluminae Inc. is a Canadian cleantech company whose innovative technologies are setting the new standard for alumina production. Orbite's technologies enable environmentally-neutral extraction of smelter-grade alumina (SGA), high-purity alumina (HPA) and high-value elements, including rare earths and rare metals, from a variety of sources such as aluminous clay and bauxite, without generating the toxic red mud residue that the traditional Bayer process produces.

The Company owns ten different families of intellectual property rights (and patents pending) filed across the world for the extraction of alumina at the highest standards of sustainability. Orbite also owns exclusive mining rights over a total of 60,984 hectares, including the 6,665-hectare Grande-Vallée property, the site of an aluminous clay deposit in Quebec, Canada. An NI 43-101 compliant report identified over 1 billion tonnes of aluminous clay in part of this deposit. Orbite is currently converting its 2,600 $m^2$ pilot plant in Cap-Chat, Quebec, Canada, into a full-scale high-purity alumina production facility, and expects this plant to be fully operational in early 2013. The Company also anticipates the launch of construction of its first SGA plant towards the end of 2013. Orbite plans to offer SGA and HPA products and to license its low processing cost technologies to well-qualified producers who want to reduce their environmental footprint. Orbite has recently entered into partnerships with the world's largest aluminum producer, UC Rusal, and Asia's largest aluminum complex, National Aluminium Company Limited.

The truly ground breaking factor in this story is Orbite's unique and low-cost patented technology, which enables the clean and particularly efficient extraction of alumina and other valuable and marketable by-products from a variety of sources, including aluminous clay, bauxite, kaolin, nepheline, fly ash from coal combustion, and other aluminum-containing ores. What's more, the company's continuous process does not generate the infamous and caustic "red mud" associated with

the long-established Bayer process for extracting alumina from bauxite. This red mud typically requires longterm storage to protect the environment and human life. By contrast, Orbite's process separates the individual components of the clay sequentially and recycles the acid used to leach out the metals.

Not only does Orbite's process not generate red mud, but it has been successfully demonstrated toremediate the toxic waste produced by Bayer processing, rendering it environmentally neutral while recuperating previously trapped and wasted alumina, hematite, and even rare earths and rare metals, thus transforming the economic and environmental liability of red mud ponds into a source of revenue for the alumina industry. Orbite has also demonstrated the ability to extract alumina and other elements using fly ash from coal combustion as feedstock.

**Keywords:** alumina, low-cost, eco-friendly, cleantech, patented technology, hydrometallurgy, red mud, fly ash

## Sustainability in Aluminium - Mines-to-Market: Issues and Opportunities

**Sadguru Kulkarni,**
Joint President, Hindalco Technology, Mumbai

### Abstract

Production of aluminium by the Bayer and Hall-Herault processes has often been a subject of serious concern in both aluminium meetings and in sustainability forums. The industry poses many issues such as (i) high impact environmental issues such as deforestation often required for bauxite mining, (ii) high power requirement of aluminium smelters and associated high water consumption and (iii) waste water generation of alumina plants, (iv) creation of vast prices of waste lands for dumping of alkaline red mud and fly ash, (v) liabilities of hazardous spent pot-lining & black dross, (vi) fluoride emissions with suspect health risks, (vii) high GHG emission intensity when associated with thermal power plants, (vii) generation of VOCs through oil vapours in rolling and solvent vapours in conversion operations, (viii) Coal tar pitch emissions in anode plants and (ix) large scale displacement of locals often caused by setting up alumina or aluminium complexes with large footprint. On the other

hand, aluminium metal offers unique opportunities for improved sustainability of its end users due to its unique combination of properties. These include- light weighting of building exteriors, barrier-safe packaging, and opportunities for infinite recycle potential of aluminium. From the beginning of the production of aluminium metal over a century and quarter ago, aluminium industry has been sensitive to the sustainability needs and has in fact taken enormous efforts to overcome the negatives through technology & innovation. The presentation will put forth the magnitude of the sustainability footprint of aluminium industry, from mines to market, track developments in technology options, addressing the sustainability barriers and efforts to resolve the issues. It is imperative that a technology that is over a century old will start showing the appearance of new S-curves of evolution, as will be seen in some of the recent examples of budding alternative technologies to Bayer and Hall-Herault processes.

Key words: Aluminium, sustainability, GHG emission, energy intensity, alternative technology, life cycle assessment

# Research and Development Activities of Nalco at a Glance

**B.K.Satpathy**
General Manager (R&D),
National Aluminium Company Ltd., Bhubaneswar, Odisha 751061

## ABSTRACT

National Aluminium Company Ltd. (NALCO) a navaratna public sector company has been engaged in the business of alumina and aluminium since more than 25 years. The company with state of the art technology for both alumina refining and aluminium smelting has been operating with continuous augmentations to its capacity and all fronts. While the company has been provided with necessary technical services from Aluminium Pechiney (now Rio Tinto Alcan), off late it has been felt necessary by the company to strengthen its research and technological facilities. This would enable NALCO to sustain its continuous growth in capacity and also aim for technological improvements in different fields such as: process and product development, higher productivity, reduction in cost of production, waste management etc. pertaining to its core areas of operations.

NALCO R&D team has been engaged in working with various in-house as well as collaborative projects with the existing facilities. Various in-house projects are being taken up pertaining to day to day plant performance. To name a few; development of a resin for recovery of hot condensate, study on impurities built up in refinery and recovery of vanadium sludge, development of low soda alumina, improvement of anode performance, study on the oxidation behaviour of anodes etc. Similarly, a number of collaborative research projects have been taken up by NALCO with other institutes such as: JNARDDC, Nagpur, IMMT, Bhubaneswar, IIT, Kharagpur, NIT, Rourkela etc. 'Some of the important collaborative projects are: development of a process for production of building materials from red mud, process for production of ceramic tiles from low carbon fly ash, utilisation of low grade dross for making alum, destruction of cyanide from spent pot lining material for its subsequent utilisation, development of techniques and tools for per-fluorocarbons (PFC) measurement, process for production of light weight aggregate and ceramic glass tile from red mud etc. The products developed have been characterised for different physical and chemical properties and compared with both BS specification

as well as with the branded products available in the market. Projects which are of commercial potential have been scaled up to pilot scale level for generating technological data and building confidence towards the viability of the process. All the projects are aimed for establishing either substantial or incremental process improvement or solving process related problems directly or indirectly. The projects for waste utilisation have been taken up with an objective to establish processes for bulk utilisation of the waste materials which could be viable. Some of the processes developed have been patented and are in the stage of commercialisation either in-house or through expression of interest from other agencies.

The current paper provides some of the above R&D activities taken up by NALCO at a glance with future plan of the company in strengthening its R&D facilities.

# ABSTRACTS

## SECTION II

## BAUXITE: GEOLOGY, MINING AND SPECIAL PRODUCTS

## Bauxite and its use – with special emphasis as a Refractory raw material.

**P. Sengupta**
SKG Refractories Ltd., Nagpur

**ABSTRACT**

Bauxite is one of the most widely used naturally occurring raw material, used for varied applications in different industries, spread over a broad spectrum. It finds its use in different industries like Metallurgical, Refractory, Abrasive, Oil exploration, Chemical etc. This paper has focused mainly on the application of Bauxite in Refractory industry. It has discussed about the properties required of the Bauxite, for its application as a Refractory raw material. The thermal processing of Bauxites, to make it suitable for Refractory application, has also been discussed. Bauxite can also be used for the synthesis of other Refractory raw materials. Finally, application of Bauxite and Bauxite derived, synthetic raw material based Refractories are discussed.

## Value addition to inferior grade Indian Bauxite for Refractory application by innovative route

**A. Ghosh and H. S. Tripathi**
CSIR-Central Glass & Ceramic Research Institute
196, Raja S. C. Mullick Road, Kolkata - 700 032, India.

**ABSTRACT**

Bauxite is one of the high alumina sources used as refractory. In India, it is mainly available in Gujarat, M.P. and Bihar region. The huge reserves of low grade Indian bauxite are not suitable for refractory applications due to the presence of high level of impurities. This material is associated with $Fe_2O_3$, $TiO_2$ and CaO in considerable amount. The low melting phases developed from bauxite degrade refractory properties. The high alumina aggregates developed from these bauxites contain high amount of vitreous phase along with low melting $FeAlTiO_5$. In this area significant beneficiation studies were carried out by different agencies. Though impurity can be brought

down by different techniques, all of these processes are not techno economically viable. CSIR-CGCRI in the recent times is developing value added aggregates from Indian bauxite by a route which transforms the impurities into high melting phases. High alumina refractories developed from these aggregates exhibits excellent hot properties. When high alumina refractories are developed from Indian bauxite the refractoriness under load (RUL) ranges between 1400-1450$^{o}$C. Whereas, if the same refractory is developed by the present process the RUL increases from 1600-1625$^{o}$C.

## The Bauxites Reserves of Maharashtra.
## Why do these stay in the ground ?

**Jan Kotte**
AluChem India Limited
Kolhapur Area, Kolhapur-416 003

### ABSTRACT

This presentation highlights the vast amount of bauxite deposits available in Maharashtra. It will show there is enough bauxite for 3 alumina refineries and a vast number of added value bauxite based projects. It will discuss the clear and simple mining laws and regulations of India as well as the impossibly difficult practices employed by the government authorities.

It will end with posing questions and solicit the audience tor suggestions and discussion on how to change the situation and how to give back the right of the people of Maharashtra to use and benefit from these god given bauxite reserves.

# Blast Free Mining in Indian Bauxite Mines - An Overview

**G.K.Pradhan**
Addl. Director & Chief Regional Coordinator, PCRA-Kolkata,

## ABSTRACT

Bauxite deposits in India are all located on hill tops which are normally in very rough terrain, surrounded by thick vegetation and inhabited by tribal population. Blasting continued to be the cheapest and easiest mode of rock fragmentation of the waste and bauxite in most mines which are currently under production. Except for few deposits having softer bauxite, in most mines blasting is the rock breaking system. Use of explosives, its handling, storage and transportation not only involves lot of follow up and detailed planning but also involve risk from its getting stolen by unlawful activists.

In view of growing menace of unlawful activities in most bauxite deposits, plans were made to adopt blast-free mining. Although soft bauxite has been removed by high power dozer with ripper attachment of varying capacities. When it comes to excavating harder strata conditions, blasting is preferred. An attempt has been made in last few years to select a state-of-the-art system of mechanical breaking of the material by engaging surface miners. Surface Miners are very popular in Indian coal mines and in few limestone mines of Gujarat & Tamilnadu, to excavate material in desired size, by eliminating drilling, blasting and crushing systems. Based on detailed study of globally operational surface miners in soft, hard and very hard rock formations, right type of unit was selected to excavate hard waste and bauxite material in some Indian bauxite mines. Apart from being a safe mode of excavation, it has been proved to be highly energy efficient.

An attempt has been made in this paper to present the blast-free mining techniques, involving ripping and excavation by surface miners, together with various geotechnical Parameters etc.

# INDIAN CALCINED BAUXITE - STATUS AND FUTURE PROSPECTS

**P G Bhukte, M J Chaddha, S P Puttewar, M Najar**
Jawaharlal Nehru Aluminium Research Development and Design Centre, Nagpur 440 023
And

**A K Nandi**
Director, Mineral Information and Development Centre, , Nagpur-440033

## ABSTRACT

The vast resource of laterite and bauxite occurs in various parts of the Country and India occupies 5th position in the World bauxite map. Despite availability of large bauxite resources there are limited occurrences of high grade bauxite deposits. Gujarat occupies the top position in resources and production of high alumina bauxite suitable for valued added refractory, abrasive industry. However, this bauxite has significant calcium content, which deteriorates its value for refractory industry. Some high alumina and high titania deposits are found in Maharashtra and Central India (Chhattisgarh, Jharkhand & Madhya Pradesh) region and small scattered deposits are also exploited in various parts of the country. In many cases the non-metallurgical grades are specially selected high quality bauxite from metal grade deposits for which normally higher prices can be obtained. With the fast depletion of good quality bauxite resources, it has become necessary to use suitable beneficiation process, mainly to bring down iron and titania content in Indian bauxite. R&D efforts are being made to develop high temperature iron-titania phases and also produce illmenite, which can be eliminated by magnetic separation.

In the current scenario, China is the leading country to supply of refractory bauxite in the World after Russia, India and Guyana. Guyana is the main competitor to China in the International market and further new production from UC Rusal due on stream in 2012. After the China, Russia, India and Guyana, other producers of refractory grade bauxite in the world are Brazil, Greece, Malaysia, and Australia. Brazil has small refractory grade production for the domestic market and also for proppant production. In the present paper, the high grade bauxite deposits of India are highlighted and the Indian calcined bauxite is compared with world producers.

# Scope for Value-added Bauxite Items in Gujarat, India

**J V Bhatt**
Mineral Consultant, Bhuvaneshwari Mineral Consultancy
212, Sur-Sarthi Business Management Centre, Opp. Central Bank of India, Ambawadi Circle
Ambawadi, AHMEDABAD 380 006

## ABSTRACT

Gujarat Bauxite is well known for its superior quality in the mineral market. It is assessed as 184 million tones by "Commissioner of Geology & Mining, Govt. of Gujarat".

The Kachch Bauxite is reserved for Gujarat Mineral Development Corporation vide 31-12-1963 notification. All bauxite bearing areas in the state are further reserved for GMDC in public interest except areas already granted for PL/ML vide resolution No. MCR-102008-1868-CHH 19/11/2009. as per resolution GMDC will supply bauxite to users for value-added projects on long term arrangements as per project need.

"Gujarat State Mineral Policy 2003" has emphasized to encourage value-added projects. GMDC has invited expression of interest value-addition bauxite items like Refractories, Castables, Brown-fused alumina, High grade alumina cement, Alumina, Speciality Chemicals, Zeolite, Proppants or any other products by which substantial value-addition take place for non-plant grade as well as plant grade Bauxite except calcinations and benefication of Bauxite.

Industrial mineral housed have come forward during Vibrant Gujarat 2009 and 2001 summit and signed MOU for some of items. ***"iNDEXTb"*** (Govt. of Gujarat organization) nodal agency to encourage the mineral based industries in the state has compiled the "Prospect of value added bauxite projects in Gujarat" publication for entrepreneurs. GMDC is encouraging joint venture for maximum value of output per unit of bauxite within time-frame.

For value-added item manufacturing, entrepreneurs have to identify commercial technology sources to implement the project in joint venture within time frame.

# SINTERED BAUXITE (PROPPANT) PRODUCTION IN INDIA & FUTURE PROSPECTS

**A. K. Dasgupta**
Hallmark Minerals (I) Private Limited,
Pune, India
and

**A.K. Nandi**
Mineral Information & Development Centre, Nagpur, India

## ABSTRACT

A small sintered bauxite (proppant) plant was set up in 2004 in Pune, India and started the pilot plant production in 2005. To produce different qualities of Ceramic Proppant, raw bauxite are sourced from three different mines in central India and blend to get the desired raw mix proportion. As a first step defined quality of raw bauxite feed is calcined near the bauxite sources in central India, their physical and chemical properties are thoroughly checked and after quality certification same is considered as raw material for proppant plant unit at Ranjangaon near Pune. Calcined bauxite is micronized, palletized, screened and sintered in this unit. The quality of sintered bauxite is checked in the on-site laboratory based on the recommended practices of API RP60 Procedures.

The small quantity of sintered bauxite produced in Pune plant is well comparable to high strength proppants of Saint Gobain, Carbo-ceramic of US and also Curimbaba, Brazil. This pilot plant has also produced Intermediate strength proppants by changing the raw mix and product was found acceptable in the world market. Efforts are being made to set up a large sintered bauxite plant in India for commercial production of proppants for hydro-fracturing of non-productive oil and gas wells.

# ABSTRACTS

## SECTION III

## ALUMINA TECHNOLOGY

# Alumina by Gas Suspension Calcination – 25 Years Development and Experience

**Benny E. Raahauge**
Non-Ferrous Division, FLSmidth Alumina Technology,
Copenhagen, Denmark

## ABSTRACT

The first Gas Suspension Calciner (GSC) for Alumina was commissioned in 1986 at the Hindalco Alumina Refinery at Renukoot, and since then more than 24 GSC units has been commissioned covering capacities ranging from 150 – 4500 tpd of Alumina.

This paper review the major new developments introduced, and report the operational results and experience gathered since commissioning of the 850 tpd GSC Unit at Hindalco up till today.

The commissioning experience from starting above Gas Suspension Calciners confirms that the GSC technology is easy, flexible and cost effective to operate, and produces Smelter Grade Alumina (SGA) quality meeting specifications regardless of capacity.

The latest GSC flow sheet at Utkal and AnRak, include new furnace inlet design and a fluidized holding vessel, resulting in a lower operating temperature and fuel consumption. Experience with improved environmental performance obtained, when selecting Fabric Filters or Bag House, instead of Electrostatic Precipitators, as for AnRak, is reported.

# HPGR Grinding Technology and its Application to the Bauxite Industry

**Frank P. van der Meer**
KHD Humboldt Wedag GmbH, Cologne, Germany
Minerals Processing and HPGR Technology
Colonia-Allee 3, 51067 Cologne, Germany

**Dr. C.H.M. Nagaraj**
WEIR Minerals India Pvt Ltd
Sr. Manager – Business Development
#2, Block A, Platinum City, HMT Factory Road
Off Yeshwanthpur, Peenya, Bangalore – 560022, India

## ABSTRACT

High Pressure Grinding Roll ("HPGR") technology is applied is a broadening range of applications. In the last few years, increasing numbers of HPGR units have been or are being installed in minerals processing projects such as gold, diamonds, copper, iron, and iron ore pellet feed, and further installations will start in nickel, lead and zinc operations this year.

HPGR application is also being considered for bauxites or alumina, given the potential benefits of a high unit capacity (up to 2500 TPH per unit), high availability (92-97%) and high size reduction efficiency.

Bauxite ores have been tested from various deposits. This publication summarizes some of the results achieved and observations made during this test work, including relationships of specific throughput, energy and size reduction in relation to operating parameters of press force, roll speed and moisture content. Given anticipated operating conditions, performance aspects and operating costs of HPGR for bauxite applications are presented.

Keywords: HPGR, bauxite, Humboldt Wedag, pre-grinding, size reduction, moisture
.

# Alumina hydrate suspension in the draft tube agitated precipitator design

**T. Kumaresan and Shirish Thakre**
Aditya Birla Science & Technology Company Ltd.
Plot No. 1 & 1- A/1, MIDC Taloja
Tal. Panvel, Dist. Raigad 410208, India

## ABSTRACT

Industry scale draft tube precipitators (Agglomerators and Growth tanks) in alumina Bayer process have the task to uniformly suspend the alumina hydrate particles with minimum power consumption. The batch precipitator design exhibits a non-swirl flow pattern and the same design in the continuous design reveal a swirl flow pattern. The present work emphasis the importance of prevailing hydrodynamics on the hydrate solid suspension/settling from the batch to continuous stage. In order to analyze and investigate the variation in flow, computational fluid dynamics (CFD) modeling study has been used to investigate the flow and suspension behavior.

Keywords: Alumina precipitation, solid settling, CFD, Swirl flow

# Effect of Mineralogy of Bauxite on Double Digestion process for Extraction of Alumina

**M. J. Chaddha, Suchita Rai, P. G. Bhukte**
Jawaharlal Nehru Aluminium Research Development and Design Centre
Nagpur, Maharashtra, 440 023, INDIA.
and
**Y.V. Rammana, Sateesh Kumar**
Vedanta Aluminium Ltd, Lanjigarh, Dist: Kalahandi, Odisha, INDIA.

## ABSTRACT

The digestion of predominantly boehmitic bauxite is carried out at an elevated temperature ranging from 220°C to 250°C, thus total thermal energy requirement for processing boehmitic bauxite is very high. The Double digestion technology coupled with Pressure decantation system is a proven and established technology and many alumina refineries have adopted it. In double digestion process, the bauxite (gibbsitic and boehmitic mix) is first digested at 145°C and the resultant mud (containing undigested boehmite) is digested at 220-250° C. The mineralogy of bauxite plays a very

important role especially in the 2nd stage digestion. The paper investigates into this issue by citing case studies (with 5, 10 and 15% Monohydrate alumina or MHA containing bauxites) related to how the mineralogy play an important role in processing of the bauxite. The paper shows how the mineralogy of the bauxite affects the mud charges for 2nd stage digestion in a typical double digestion process.

The paper discusses the charge required for 2nd stage digestion process based on equilibrium boehmite solubility (A/C) determined from literature. The charge has been calculated for a target A/C of 0.03 to 0.05 units less than the equilibrium boehmite A/C for different caustic concentration ranging from 169 to 187 g/L as $Na_2O$. A comparative plots show the effect of caustic concentration and temperature of digestion on the mud charge for the 2nd digestion stage with 1st stage digested mud generated from bauxites with different mineralogy. It also gives an information about the Indian bauxite deposits which have a higher boehmite content and are ideally suitable for double digestion process. The paper indicates that higher the boehmite content (MHA%) of the bauxite more economical and technically feasible will be the double digestion process.

## Applications of Hydrocyclones in Alumina Refinery

**C.H.M. Nagaraj and Binesh Gopalakrishnan**

*WEIR Minerals India Pvt Ltd*

#2, Block A, Platinum City, HMT Factory Road
Off Yeshwanthpur, Peenya, Bangalore – 560022, India

### ABSTRACT

Hydrocyclones are ubiquitous equipment for a wide range of classification and thickening/ dewatering applications in mineral processing industry. Hydrocyclones separate finer particles from feed slurry containing a wide size range of particles in centrifugal field. Hydrocyclones are preferred over conventional mechanical classifiers because of their advantages such as sharper separation, low footprint, simple operation and minimum maintenance requirements.

Cavex cyclone features unique laminar spiral inlet geometry, which minimises the turbulence at the inlet and achieves sharper classification efficiency compared to conventional tangential / involute inlet cyclones. Applications involved in alumina refinery offers challenges in designing cyclone circuit because of viscous slurry, alkaline nature and high temperature. Weir Minerals offers hydrocyclones made of polyurethane and high chrome alloy cyclones and Cavex cyclone can be very useful to improve the efficiencies of classification and thickening.

Hydrocyclones are successfully deployed in Alumina refinery for applications such as closed circuit grinding, red mud de-sanding, hydrate classification and spent liquor recovery. Weir Minerals work very closely with the industry globally to provide the solutions for the above referred applications. To design the cyclone circuit for any application, Weir considers computer simulation studies to select suitable size of hydrocyclone followed by on site plant trials to re-confirm the predicted performance and also to establish consistency over the feed fluctuations. In this paper case studies of closed circuiting of mill, hydrate classification and spent liquor recovery applications are discussed.

**Keywords:** CAVEX, Hydrocyclone, Classification, Thickening, closed circuit grinding,
laminar spiral inlet geomerty

# Angle Valves For Alumina Industry- "NEXT PRACTICES"

**Anay Mashruwala**
Marketing & Quality Control
M/s. Venus Engineering Works,
104, GIDC IndustriaL Estate, Odhak Road, Ahmedabad

## ABSTRACT

INTRODUCTION:
Valves are a very important component for any piping system in any process plant. Valves are used for a Variety of purposes in process plants including for controlling important process parameters, for isolating certain equipments etc.

Out of all the applications where Valves are used, Alumina Plants as an application are considered to be one of the most demanding applications. This is because in Alumina Plants, Valves need to be designed to combat a totally erosion along with pressure, temperature, corrosion etc. and need to perform satisfactorily in such a in such demanding environment.
There are very few applications where in multiphase fluids are to be controlled, and even lesser applications where in such fluids contain suspended particles of such high hardness with high pressure and temperature along with caustic corrosive environment. This application that I am referring to is the Alumina Industry application for Industrial Valves.

We have endeavoured since last 17 years in understanding this application and coming out with some path breaking solutions which can increase the life of Valves in this applications with marginal increment in costs. We cannot say that we have reached our goals, but we can surely say that we have made much progress in the right directions and we are still working hard to come up with newer better solutions in this field.

PROBLEMS IDENTIFIED:
Any major Valve failure practically have a tendency to cause shutdown in the plant, and such shut down means down time in production which would eventually mean loss of money much higher than the cost of the Valves. Even small leakages in Valves result into large efficiency losses in the entire plants.

We have identified four major chronic problems that these Valves face namely

⇒ Passing Of Valves.

⇒ Erosion in the Body.

⇒ Spindle Breakage Due To Erosion.

⇒ Leakage from the Gland Packing Area.

SOLUTIONS:

We have come out with solutions to eliminate these problems by bringing about innovation in the fields of Designing, Manufacturing, Inspecting, Installing, Operating and Maintaining Valves used in Alumina Plants.

We will be sharing the same in this paper both the “BEST PRACTICES” and “NEXT PRACTICES” in our paper.

BENEFITS:

This paper will benefit the Alumina Industry by sharing with the audience the methods of improving the efficiency of plants by reducing down times created by the failures of Valves and also discuss preventive measures to give long life these Valves.

# Safety, Health and Environmental Sustainability Management Practices in Alumina Refining from bauxite

**Harish Chandwani,** Associated Vice President & **D.B.V.S.N. Raju,** General Manager (HSE),
Anrak Aluminium Limited ,G- Koduru, Makvarapalem site,
District: Visakhapatnam 531 113 (India)

## ABSTRACT

With increasing alumina refining capacities and workforce, the rising importance of industrial safety, occupational health and environmental sustainability has become an integral part. As India establishes itself as an economic superpower, the country is catching up with the rest of the world in terms of improving the working conditions of millions of its workers. Rising incomes and exposure to international work standards is bringing in a change in the way Indian companies look at workplace safety, opening up opportunity for those specializing in providing holistic approach to safety, occupational health and environmental sustainability management. Compared to more developed countries, the industrial safety, health and environment management in India is still in its infancy, mainly due to enforcement issues.

The European Union (EU) for example, has a far better track record of enforcing safety laws than India. Though India has no dearth of laws like The Indian Factories Act, The Indian Explosives Act and The Building and other Construction Workers Safety and Welfare Act of 1996, very little of it is put to implementation. Above all the SHE (safety, health and environment) concept need to align with the key elements of ISO 14001 and to certified OHSAS 18001 standards since 2005. However, when it comes to proper implementation, many companies fail to adhere to them. It is also observed that most of companies that have implemented a comprehensive safety, health and environmental sustainability program for their workers but to speed up the project activities also lesser pressure from regulatory is responsible for the lapses on this front.

Ironically in which safety, health and environment (SHE) implies for alumina refinery which include the landowners, workforce, government, community groups, local resident ecosystem and the general environment as well as state, national and international stakeholder. In latest context, the nation's environmental issues are also of key importance to the alumina /bauxite/ mining/ and its constituents—the public, government and regulatory agencies, research and academic communities.

# A Community-Based, Regulatory Framework for the Sustainable Management, Beneficiation and Safe Reuse of Alumina Refinery Residue: A Long-Term Global Example of Socially Responsible Industrial Behaviour

**Lee Fergusson**
Virotec Global Solutions Pty Ltd
Level 1, Building D, 19 Harbour Village Parade, Coomera Waters 4209, Queensland
P.O. Box 1092, Oxenford 4210, Queensland, Australia; +61-7-5573-3353; www.virotec.com

## ABSTRACT

After fly ash, alumina refinery waste residues constitute one of the largest industrial solid waste streams in the world. With production levels at over 150 million tonnes per year and 2.5 billion tonnes in global stockpiles, these hazardous residues pose a significant threat to human and environmental health. Australia alone generates more than 30 million tonnes of these residues each year, and estimates suggest that more than 300 million tonnes are stockpiled in Queensland, Northern Territory, Western Australian and Tasmania. India's ten refineries generate approximately 20 million tonnes of residues per year, with many millions more in stockpiles. The main, although not the only, problem associated with this waste is its high alkalinity and extreme causticity; contact with alumina refinery residues can result in burning and even death. The recent 2010 Hungary example is a case in point.

In October 2010, large dam in the town of Ajka, Hungary containing alumina refinery waste breached its northern wall and spilled approximately 1,000,000 tonnes of caustic tailings over a 40 $km^2$, much of it two meters deep, killing ten people and hospitalizing another 130. Given the tailings had a pH >13.0 at the time of the spill and were of a type that had extremely high levels of insoluble alkalinity, the tailings not only burnt its victims on contact but continued burning, and sometimes even increased damage to skin, many weeks after initial contact; many people died instantly, but one man died from his burns more than a month after the accident and clean-up workers suffered ongoing deep dermal damage many months after contact with the tailings. Environmental risks from the spill included the possibility of the tailings reaching and polluting the Danube River, one of Europe's most important waterways.

# ABSTRACTS

## SECTION IV

## SPECIAL ALUMINA & ALUMINA CERAMICS

# Specialty Alumina Producers
# A Distinct Class away from Smelters!

**Henning Stams*,**
Almatis GmbH, Frankfurt, Germany

**Robert Marra,**
Almatis Inc, Leetsdale, USA

and
**Sarbapi Mukherjee and Animesh Bose,**
Almatis Alumina Pvt Ltd., Kolkata, India

## ABSTRACT

Almatis is the leading global producer of Specialty Alumina with over 100 years of experience in this business. This presentation explains how a specialty alumina company differentiates from mainstream standard grade Alumina consumers thereby creating a distinct class and competitive structure – shifting the value chain away from smelters into other niche industry segments, like Refractories, Ceramics and Polishing. The Alumina market is analysed in terms of volume and how and where a Specialty producer fits in. Taking the example of Almatis, the presentation revolves around the key parameters factors like technological edge, brand equity, customer and technical service, and innovations, which are the essential ingredients for such a niche, specialty segment. The market dynamics, industry-wide and regionally market demand are discussed, as they generate various opportunities for the business to differentiate, innovate and maintain the leadership position. Accordingly, products are engineered and quality, consistency and on time logistics are ensured through best practices, lean management systems and technology support. A Specialty Alumina player, like Almatis, thus needs to invest in material science and research to a greater degree to remain competitive and profitable in the segment. The talk concludes with emphasis on the feedstock requirements for the specialty value chain, impressing upon the close cooperation on process and supply controls needed by the producer and feedstock supplier to culminate into a win-win, value added, long term business relationship. The overall conclusion is that Specialty Alumina producers constitute a separate, distinct sourcing market which currently is under-developed.

# Emerging Trends in Applications of Alumina Based Wear Resistant Materials

**Dr Shyam S Rao**
Carborundum Universal Ltd. India

## ABSTRACT

Various industrial processes require the use of high wear/corrosion-resistant materials to prevent wear loss in industrial equipment which are subjected to harsh abrasive/erosive/corrosive environment. Use of quality wear/corrosion resistant materials increases the efficiency of the process, and also improves the quality of manufactured products by reduction in contamination that may develop during wear/corrosion. In particular, hard particle-laden fluid flowing though either enclosed or an open system at high velocities quickly erode the equipment and damages the equipment significantly in the presence of corrosive environment such as acids, alkali, salts, reactive gases. Again, the wear/corrosion effect would multiply with every 10 degree rise in temperature. Maintaining and improving the up-time of equipment is critical to remain competitive in the market. Traditionally, hard irons & steels (such as Ni-hard etc), some grade of polymers such as polyurethanes, cast-basalt and some polymers are used for wear-resistant part of equipments, as these are relatively in-expensive, easy to fabricate and to install. However, they only provide a moderate wear protection, prone to chemical attack or cannot resist high temperature and therefore not a value for money as far as cost to performance ratio is concerned.

High alumina (>90% Alumina) sintered structural-grade of ceramics manifests a superior wear resistance due to high hardness value because of hexagonal close-packed crystal structure. It also possesses a high mechanical strength, moderately good fracture toughness, high temperature resistance and exceptional impact resistance properties. Sintered alumina ceramics also have a very good corrosion resistance in most of the acidic and alkaline environment because of its chemical inertness & are amphoteric in nature. Therefore, sintered high alumina (alumina content > 90%) ceramic-based components are the most used materials for different wear/corrosion resistance components due to the excellent mechanical properties, wear and corrosion resistance and good manufacturing ability of even complex and large shapes and therefore a value-for-money for the customer as far as cost to performance is concerned.

This paper describes the emerging trends in applications of alumina based ceramics in wear, impact and corrosion resistant applications in coal, cement, thermal power generation and steel industries.

# Recent Innovations at CSIR-CGCRI on the Development of Alumina based Ceramic Components for Advanced Structural Applications.

**Swapan Kumar Das and Indranil Manna***

CSIR-Central Glass and Ceramic Research Institute

196, Raja S.C. Mullick Road, Kolkata-700032, India

* Presently Director, IIT, Kanpur

## ABSTRACT

Aluminium Oxide ($Al_2O_3$) is an extremely versatile engineering material with wide range of application as structural ceramics components and several other high temperature and specialized use. CSIR-CGCRI has been serving this country as one of the premier Institutes engaged in R&D on glass and ceramics. Research on alumina based advanced structural ceramic components including refractory is one of the thirst areas of R&D activities at CSIR-CGCRI. The paper discusses the recent innovations made in this area at this Institute. To name a few, densed and micro finished alumina components (acetabular cup) developed by CSIR-CGCRI have been introduced in the human system recently for hip implants. The conventional prosthesis made of metal or polymer has limited life span and is not suitable for younger patients. The CSIR-CGCRI developed alumina ceramic implants is expected to extend the life of hip joints by more than 30 years.

Recent innovation in ceramic membrane technology at CSIR-CGCRI, development of high alumina based ceramic tube with controlled pore size and its distribution in the matrix is another success story. Several pilot scale demonstration of ceramic membrane based iron and arsenic removal plants have been established in different parts of the country particularly in the north eastern region. Development of clay- alumina hollow fiber based membrane for natural gas purification is one of the very recent work undertaken at this institute. In the area of refractory science and technology development, CSIR-CGCRI is contributing significantly to cater the need of refractory industries in India. Different kinds of alumina (tabular, reactive, fused and sintered) is one of the main ingredient in many refractory products. The paper will present some of the interesting development being carried out in the area of alumina containing refractory castable, corrosion resistant refractory shapes for different kinds of glass melting, newer alumina based spinels, calcium aluminate binders etc. The paper also briefly touches upon some of the world research undertaken in this field.

## The future role of Alumina Chemicals
## From a refractory manufacturer's perspective

**A.K. Chattopadhyay**

TRL Krosaki Refractories Limited, Belpahar, Odisha

**ABSTRACT**

Alumina in its various forms find wide range of application in the field of ceramics and refractory materials for its well balanced physical and chemical characteristics. Last few decades, alumina manufacturers have extended their R&D and market development programmes and created new materials through the production of high purity fine aluminas, controlling their particle size and shape and producing at a relatively low cost. Alumina in its special form have found now huge market in ceramic and refractory industry. Let us thus understand –

1) What then is the future of alumina che ?

2) What strategies and business approach now is required by the suppliers for serving their future business?

## Porous ceramics : Alumina membranes for filtration and separation

**G Swaminathan**

NFTDC, Hyderabad

**ABSTRACT**

Ceramics are seldom completely dense. Extensive efforts are made in ceramics manufacturing and application to investigate the mechanism of the pore generation in ceramic material and to improve the processing routes that can produce ceramics with zero porosity. The occurring pores are one of the main defeats . The pores matching critical flaw size for ceramics which is of the order of a few microns affect the life term of the most conventional ceramic products.

In the recent past technologies have evolved to arrange the porosity of ceramic material in a well-

defined and homogeneous manner or heterogeneously , resulting in special characteristics which in turn make it possible to find new applications in a broad range of industries such as biotechnology and pharmaceutical, dairy, food and beverage, as well as chemical and petrochemical, microelectronics, metal finishing, and power generation. Each industry presents specific needs and opportunities..

Demand for advanced ceramics in the US is forecast to $14.2 billion in 2015.. The major growth will come in environmental markets, where new regulations will dramatically increase demand for pollution control systems that use porous ceramic filters and membranes

The advantages are that the alumina membranes in particular can withstand elevated temperatures, extremes of pH (0 to 14), and high operating pressures up to 10 bar (145 psi) without concern for membrane compaction, delamination or swelling. This makes these membranes suitable for many applications where polymeric and other inorganic membranes cannot be used. Additionally, ceramic membranes are ideal for in-place chemical cleaning at high temperatures, while using caustic, chlorine, hydrogen peroxide, ozone and strong inorganic acids, and/or by using steam sterilization.

The talk will highlight filtration and treatment using porous alumina ceramic membrane ranging from micro to nano filtration and in separation processes in various industries and also out line system configuration. Performance of a ceramic membrane based effluent treatment system for process reuse will be presented.

# Microwave – A new flame for heating alumina components

**L N Satapathy**
Ceramic Technological Institute, Corporate R &D
Bharat Heavy Electrical Limited ( BHEL)
Malleswaram complex, Bangalore-560012, INDIA

## ABSTRACT

Sintering or heat treatment of ceramics is an important processing step. Conventionally, ceramics are either fired in an electrical furnace or in oil/ gas fired kiln. Alumina ceramics is a versatile ceramic material and finds wide applications. Products for variety of engineering applications are manufactured using this material by varying the alumina content in the range of 80- 100 %. With the decrease in alumina content, liquid phase sintering becomes the main driving force for the bonding of particles at high temperature. The conventional processing of such components at high temperature utilizes long cycle time and long soaking hours at peak temperature resulting in high energy cost. The microwave assisted processing of such components have been shown to be very promising on faster heat treatment of complicated components of such materials resulting in significant energy savings. However, very few organizations in the world are practicing such technique in a larger scale due to the high capital cost involved in establishing such technology.

The Corporate R &D unit of BHEL is in the forefront of microwave technology for processing ceramic materials in an industrial scale. This activity was kick started with the indigenous development of a laboratory microwave furnace in 2003 and experimenting the sintering of host of ceramic materials including alumina, zirconia, cordierite, ferrites etc.. The encouraging results obtained in these studies lead to the establishment of a 6 kW microwave furnace. This system was used to scale up the sintering of actual alumina components upto 10 kilogram batch. Significant savings can be made on the sintering of such advanced ceramic components in large scale. The alumina components which are not susceptible to microwaves at room temperature could be heat treated in a 6 kW microwave furnace and the results indicated that 30 -40% cycle time reduction is possible as experimented in a 10 Kg. batch.

These industrial research on Microwave processing lead to the conceptualization and development of 30 kW microwave sintering system for demonstration of sintering of alumina components. This facility was indigenously developed and established in Bangalore, India for pilot level production at BHEL for processing upto 60 Kgs. of advanced ceramic components such as alumina for high temperature treatment in the range of 1600 – 1650 deg C. Using this unique facility, it has been demonstrated that the cycle time in sintering can be reduced in the range of 25 to 35 % compared to the existing conventional process of these commercial ceramic products. The talk will focus on our developmental activities on alumina components in pilot scale.

## Forming of alumina shapes and structures and their applications

**Parag Bhargava**
Metallurgical Engineering and Materials Science
Indian Institute of Technology, Bombay

### ABSTRACT

Alumina is one of the most versatile ceramic among the ones known today. It has been used in a wide variety of applications based on its physical properties such as high hardness, wear resistance, chemical resistance, thermal conductivity, high electrical breakdown strength, ability to withstand high temperatures, moderate strength and fracture toughness. Its use in applications such as textile thread guides, high pressure water jet nozzles, low temperature co-fired ceramic packages (LTCC) for electronic applications, electrical insulators, high performance thermal insulation, dental prostheses etc. is enabled by processes that are capable of fabricating various shapes, macro and microstructures. The presentation will cover various applications of alumina and the shapes and structures that are needed to enable the applications. Further the presentation will cover various processing techniques to achieve the desired shapes, structures and some examples from author's group on shape forming and microstructural engineering of alumina based ceramics.

# Synthesis and processing of nanostructured alumina ceramics - Role of particle morphology and microstructure for developing new applications

**Sukumar Roy**
Ceramic Technological Institute, Corporate Research & Development,
Bharat Heavy Electricals Limited, BHEL
Malleswaram Complex, Bangalore 560 012, India

## ABSTRACT

Alumina, being one of the most industrially important materials in ceramic family, always poses renewed challenges to manufacture the same material with versatile morphology and microstructure, crystalline phases, besides the chemical purity and particle size. Though the synthesis of alumina or aluminous materials is pretty matured, alumina with its amphoteric nature associated with the existence of numerous crystalline modifications makes the synthesis chemistry very interesting and still offers opportunity to synthesize tailor-made alumina raw materials with interesting particle morphology, microstructure and chemistry that could be exploited in realizing new applications in several interdisciplinary areas.

The present talk entitled, Synthesis and processing of nanostructured alumina ceramics - role of particle morphology and microstructure for developing new applications" would address specific experience for synthesizing certain forms of alumina raw materials and also fabricated structures thereof. The talk would also highlight the scope of future research and the counter challenges to exploit alumina raw materials and fabricated products in new applications.

# Laser / Flame Assisted Spray Pyrolytic Synthesis of Alumina Thin Films and Applications

**Baban P. Dhonge[1], T. Mathews[2] and A. K. Tyagi[3]**

Surface and Nano science Division, Materials Science Group

Indira Gandhi Center for Atomic Research, Kalpakkam, 603102, India

[1]bpdhonge@gmail.com, [2]tom@igcar.gov.in, [3]akt@igcar.gov.in

## ABSTRACT

Development of open atmosphere large surface area coating techniques and synthesis of high temperature oxides like Alumina ($Al_2O_3$) coatings and/or thin films are important for thermal barrier, high temperature oxidation, corrosion and wear resistant coatings. The coating method and the chemistry of the oxide to be coated are interrelated, as under the ambient conditions, precursors to be used and energy needed for coating play a vital role in coating formation and adhesion. For the production of large surface area alumina coatings at industrial level an open atmospheric coating process is the most economically viable one since oxide films are easily formed and impurities, like carbon which is commonly found in Chemical Vapour Deposition (CVD) grown films, can easily be eliminated by oxidation in open atmospheres. With this in mind we have modified the open atmosphere spray pyrolysis technique; it is an open atmosphere process in which a coating is synthesized by spraying a precursor solution as fine mist on to a substrate maintained at an appropriate temperature. To enable large surface area coating synthesis, this technique was upgraded to Flame Assisted Spray Pyrolysis (FASP) and/or Combustion Chemical Vapour Deposition (CCVD) and Laser Assisted Spray Pyrolysis(LASP).

In this paper we present the synthesis of $Al_2O_3$ coating using CCVD. Aluminum acetylacetonate (0.005 M) dissolved in ethanol was used as the precursor solution. A custom made premixed-diffusion type burner with an extra coaxial oxygen inlet close to the burner mouth enabled variation of deposition temperature from 600 to 1100 °C in steps of 100 (±10) °C. The presence of γ- and θ- $Al_2O_3$ phases were observed in the deposition temperature range of 600 to 800 °C, whereas at 900 and 1000 °C single phase θ- $Al_2O_3$ and at 1100 °C α- $Al_2O_3$. Adherent

coatings were obtained at temperatures ≥700 °C and critical failure observed at ~ 10N. The coefficient of friction of alumina coated Si samples, measured using a tribometer. It was observed that the tribological properties shows response to surface roughness of the films and are not affected significantly by the crystal structure and crystallite size. Oxidation resistance of alumina-coated Ni–20Cr specimens were studied using a thermogravimetric analyzer by exposing them to isothermal heating at 1000 °C in 20% O2–Ar gas mixture.

On other hand LASP has been developed to synthesis dense optical alumina films. In this technique ultrasonically generated aerosols of aluminum acetylacetonate dissolved in ethanol and a laser beam (Nd:YAG, CW, 1064 nm) were fed coaxially and concurrently through a quartz tube on to a hot substrate mounted on an x-y raster stage. The substrate is rastered to get large surface area coating. The surface morphology revealed coalescence of particles with increase in laser power. Refractive index of the films synthesized increased from 1.56 to 1.62 as the laser power increased from 0 to 50 W. The stoichiometry of films was studied using XPS and the increase in interfacial layer thickness with laser power was observed from dynamic SIMS depth profiling and ellipsometry.

## An Innovative Spinel –Calcium Acuminate Refractories for Aluminium Industries

**R.P. Rana, B. Ghosh, S. Adak, P.B. Panda and A.K Chattopadhyay**
TRL Refractories Limited, Belpahar-768218, Odisha (India)

### ABSTRACT

The demand of aluminum metal is increasing day-by-day; which leads to increase the casting of aluminum in cast house. The alumino-silicate based Refractories are widely used in cast house application, though it is easily affected by aluminium metal in the reduced atmosphere. The silicate based Refractories are thermodynamically unstable towards aluminum. The silicate phase in the brick gets reduced to silicon metal and diffused into the metal deteriorating the quality of aluminum metal. However, the aluminum attack depends on the physico-chemical as well as mineralogical properties of the brick used for the lining. This problem can be avoided by using high quality alumina brick with $A1_2 O_3$ content more than 85% (with minimum possible $SiO_2$). The increase in $A1_2O_3$ content

again leads to increase in thermal conductivity of the brick which is undesirable. As per the thermodynamic stability from the Ellingham Diagram, any metallic oxides above Al can easily be reduced to corresponding metal by Al and it is difficult to reduce by Al metal below this.

The present work describes the development of a new innovative spinel –calcium aluminate based Refractories as an alternative to overcome such problems. The developed material has been characterized and different properties like AP, BD, CCS, HMOR, Thermal Conductivity, pore size distribution etc. are evaluated using different equipment. The detailed phase analysis has been characterized using XRD and Microscopy. The Al resistances of the alumino-silicate and spinel-calcium aluminate bricks were tested against pure Al (A-7 grade) and its alloy (Grade- 7075) under similar condition. The developed bricks showed non-wetting characteristics and no impurity pick up from the brick to the Aluminum metal after the test. The phase analysis and pore size distribution of the metal treated surface and the outer surface were also compared to ensure the metal penetration.

## Alumina nanofluids based on car engine coolant with enhanced thermophysical properties

**Tapas Kumar Dey**
Cryogenic Engineering Centre
Indian institute of Technology, Kharagpur
Kharagpur 721302 (WB)

Cooling is indispensable for maintaining the desired performance and reliability of a wide variety of products, such as computers, power electronics, car engines, and high-powered lasers or x-rays etc. With the unprecedented increase in heat loads caused by more power and / or smaller feature sizes for these products, cooling is one of the top technical challenges facing many high-tech industries. Conventional way to enhance heat transfer in thermal systems is to increase the heat transfer surface area of cooling devices or to disperse solid particles (usually micrometer-sized) in heat transfer fluids. The dispersion technique however has not been successful due to problems such as sedimentation, clogging, erosion, fouling and increased pressure drop etc. Recent advances in materials technology have made it possible to produce nanometer-sized particles which can be dispersed in conventional heat transfer fluids. Nanofluids are a new kind of novel heat transfer fluid containing nanometric-sized solid particles that are uniformly and stably suspended in a liquid, like ethylene

glycol, water, etc. The term "nanofluid" was coined by Choi (1995), who demonstrated that the uniform dispersion of small quantity of nanoparticles in a traditional liquid such as water, oil, and ethylene glycol (EG), could noticeably improve its thermal performance. However, application of nanofluids as efficient coolant in advanced industrial processes depends not only having high thermal conductivity, but also on its viscosity and heat transfer characteristics etc. It may be noted that in heat exchangers that use conventional fluids, the pumping power must be increased by a factor of ten in order to improve the heat transfer by a factor of two. Whereas, for a nanofluid with thermal conductivity three times that of a conventional fluid, the rate of heat transfer can be doubled without any increase in pumping power. So nanofluids are considered as the *"next generation coolants"*. Apart from applications in thermal management systems of various engineering devices, nanofluids are useful for micro-heat exchangers. Magnetic nanoparticles in bio-fluids are important as drug delivery vehicles, providing a new direction in cancer treatment. Thus, nanofluids offer an effective alternative for various advanced thermal and medical applications.

In this presentation, we shall share with you our results on highly stable Alumina nanofluids based on car engine coolant (HP KOOLGARD) and their thermophysical properties (viz., thermal conductivity and viscosity) as a function of $Al_2O_3$ concentration and temperature between 10 and 80 $^oC$. Prepared nanofluids are examined using Fourier transform infrared spectroscopy, Dynamic Light scattering and TEM. The enhancement in thermal conductivity of the nanofluid linearly varies with $Al_2O_3$ loading and reaches a maximum of ~11.25% at 80 $^oC$ for nanofluid with 3.5 vol% of $Al_2O_3$ nanoparticles. Thermal conductivity enhancement displayed in $Al_2O_3$ – engine coolant nanofluids are discussed in light of translational Brownian motion, interparticle potential and micro-convection arising from Brownian movement of nanoparticles. Viscosity of $Al_2O_3$ – engine coolant nanofluids increases with increasing $Al_2O_3$ content and decreases with temperature rise. Newtonian behavior is preserved in nanofluids with low $Al_2O_3$ loading, while, nanofluids with higher $Al_2O_3$ content display non-Newtonian features and shear thinning. We confirm that the viscosity of $Al_2O_3$–engine coolant nanofluids is predicted well in light of a recent theoretical model based on Brownian motion of nanoparticles in nanofluid. In addition to the above, a brief review of the results on pool boiling heat transfer with alumina based nanofluids will also be presented.

# Alumina based orthopedic implants developed by CSIR-CGCRI, Kolkata

**Someswar Datta**

Bioceramic & Coating Division

CSIR-CGCRI, Jadavpur, Kolkata-700 032.

## ABSTRACT

Alumina (medical grade) is a highly inert material and resistant to most corrosive environments, including the highly dynamic environment that is the human body. Under physiological conditions, it is also extremely non-reactive and is classed as nearly inert, eliciting little if any response from surrounding tissues and remaining essentially unchanged after many years of service. The high hardness, low friction coefficient and excellent corrosion resistance of alumina offers a very low wear rate at the articulating surfaces in orthopedic applications.

CSIR-CGCRI developed suitable alumina precursor and its processing techniques to fabricate different articulating systems including total hip implant for use in different load bearing orthopedic applications. The present paper describes development of alumina components of total hip implant system starting from suitable commercially available raw material. The material was initially studied and after developing some processing methods to convert it to an internationally acceptable material and then suitable fabrication technique is developed to produce commercially acceptable alumina femoral head and alumina acetabular cups. The detailed study is reported along with some available clinical results.

# ABSTRACTS

## SECTION V

## SMELTER TECHNOLOGY AND RELATED AREAS

# HERALDING IN NEW ERA IN INDIAN ALUMINIUM INDUSTRY

**Umakant B. Agrawal [1], Deepak Dash [2], Krishan K. Agrawal [3]**
Sr. Vice President – Hindalco Industries Ltd
Asst. Manager – Hindalco Industries Ltd
Sr. Engineer – Hindalco Industries Ltd

## ABSTRACT

Aluminium reduction technology has made steady progress over the years. With automation and mechanization focus is on increasing amperage. Increasing labour costs have also forced to increase the production per man hour. Hindalco Industries Ltd – an industry leader is aluminium and copper is embarking on major expansion drive. Two Greenfield projects (in the state of MP and Odisha each) based on AP 36S technology are in advance stage and due for commissioning in last quarter of FY 2013. This paper outlines the challenges of Greenfield mega projects, with thrust on CSR and R&R in line with philosophy of Aditya Birla Group. The paper also outlines the salient features of the technology. Other factors of technology like environmental friendliness, operational efficiency, safety, reliability & robustness etc. have been also discussed. An attempt is made to compare the technology with other modern technology which evolved in recent past.

# Process Concept of Green Anode Plant : Today and Tomorrow

**Manfred Beilstein and Preetam Routry**
Outotec India Pvt Ltd.
South City, Pinnnacle Building
Level:12, Salt Lake Sector-5, Block EP, Kolkata-700091

## ABSTRACT

This presentation describes the trends in capacity rating of new Green Anode plants. The process principles of a new high capapcity Grenn Anode Plant are described. A similar plant of such kind has recently been constructed by Outotec and successfully put into operation at EMAL-Emirates Aluminium PJSC, a strategic joint venture company PJSC, Abu Dhabi, UAE. This

was first time , that a 100 tph capacity green anode plant was built in one step, utilising continuous mixing and vibro-compacting technologies.
Focus areas for further technological development of green anode manufacturing are addressed and challenges in such technological development are highlighted.

## Energy Reduction Initiatives by Vedanta Aluminum Limited

**G G Pal and Harsha Ruchandani**
Vedanta Aluminium Limited, Jharsuguda, PMO Office, Bhurkahamunda
PO-Sripura, Dist- Jharsuguda,
Orissa, Pin-768202

### ABSTRACT

Primary production of aluminium is highly energy intensive which accounts for nearly 40% of the total production cost. This energy is being used in a) electrolysis of alumina to produce aluminium metal b) to maintain a thermal balance in pot.
Vedanta works on 360 degree approach for continuous improvement in all aspects of Smelter i.e. electrolytic cell design, process, operation strategies, equipment& employee satisfaction that has led to substantially improved technical results.

We are continuously working on various initiatives to reduce energy consumption and to improve work environment for maintaining competitiveness. These initiatives include: Strict work schedule compliance &100% SOP Compliance, improvement in carbon quality (increase in CRR), Optimization of process parameter.

Serious efforts have been taken to reduce energy consumption on the basis of Voltage break up analysis like reduction in Clamp Drop & Stub to Carbon Drop which has helped us to reduce energy consumption by 100kWh/MT-Al. Recent trial on Slotted Anodes in one section with few process improvement initiatives has given us the potential to further reduce energy consumption by 100kWh/MT-Al. Other major initiatives for technology development & sustaining performance like graphitized cathode and advanced pot controller are in pipeline which will help to sustain a competitive edge in Aluminium Business.

# Impact of pot design, process control and pot operation on anode effect frequency of aluminium smelters

**Manoj Chulliparambil , Sankar Namboothiri, Satheesh Mani and Amit Gupta**
Aditya Birtla Science & technology company ltd.
Plot no. 1 & 1-A/1 MIDC Taluja
Taluka- Panvel, Dist. Raigad

and

**Niraj Kumar, Ajoy Palit, Jinil Janardhanan and Debasish Gosh**
HINDALCO Industries, Renukoot

## ABSTRACT

Anode effects (AE) are the primary cause of green house gases generated during aluminium smelter operation. AE occur when alumina depletion in cryolite bath causes insufficient alumina availability in the electrolytic reaction zone under the anode. This leads to undesirable electro chemical reaction of carbon anodes with the electrolyte, producing harmful green house gases - $CF_4$ and $C_2F_6$, which are 6500 times more potent than $CO_2$.

Though alumina feed control is critical, it alone cannot guarantee consistent low AE pot operation. Modern smelters have realized that consistent operation at low anode effect frequency requires a combination strategy of optimizing design, operation and process control. In this paper, some of the important considerations of the anode effect reduction strategy are discussed through literature review and results from controlled experiments in a smelter.

## ELECTROWINNING OF PRIMARY ALUMINUM INERT ANODE TECHNOLOGY

**S.D Chouharia**
Former Executive Director, NALCO
Consultant primary Aluminium, Nagpur

**ABSTRACT**

Electrolytic production of aluminium by Hall-Herault cell emits large quantities of $CO_2$ and perfluorocarbon gases ($CF_4$ & $C_2F_6$) due to use of consumable carbon anode. These are earth warming gases. Inert anode technology is a promising break through to replace the carbon anode with a non consumable inert anode. This change will eliminate emission of earth warming gases from primary aluminium industry and reduce the cost of production by nearly 15%. . Efforts to develop a viable electrolytic cell are going on across the world by major aluminum producers and specialized technology developers.

## Reverse Osmosis for Treatment of Fluoride in Aluminium Smelters Effluent

**Abhijit Pati , D.K. Singh, D.N Behera & Dr. A.S.P. Mishra**
Vedanta Aluminium Limited, Jharsuguda, PMO Office, Bhurkahamunda
PO-Sripura, Dist- Jharsuguda, Orissa, Pin-768202

**ABSTRACT**

Inorganic fluoride is the major pollutant in any Aluminium Smelter and has posed a threat to air, water, soil and vegetation. Though Aluminium smelting is a dry process, it uses water for various cooling purposes. The waste water from Aluminium Smelters along with the washings contaminated with fluoride has been increasingly become an issue particularly in Indian Smelters. Though conventional treatment with lime and alum, essentially Nalgonda technology and Ion Exchange has been used to treat fluoride in Aluminium Smelter effluent, a combination of precipitation of higher level fluoride by calcium ion followed with Reverse Osmosis (RO) has been a more efficient solution of the day for treatment of fluoride in Aluminium Smelter effluent. Vedanta Aluminium Limited has upgraded its ETP at Smelter -1 ,with PLC based chemical dosing system followed with Ultrafiltration and Reverse Osmosis with a improvised Solar Pond for R.O. reject management. This will be a trend setting example for Aluminium Smelter effluent treatment and recycling.

# Perfluorocarbon (PFC) Emissions from Aluminium Smelters

**Anupam Agnihotri*, V K Jha* and T R Ramachandran****
*Jawaharlal Nehru Aluminium Research Development and Design Centre, Nagpur
**NonFerrous Materials Technology Development Centre, Hyderabad

## ABSTRACT

Primary aluminium production process has been identified as one of the as the largest anthropogenic source of emission of the two perfluorocarbons (PFCs), tetrafluoromethane ($CF_4$) and hexafluoroethane ($C_2F_6$), according to information available in the open literature. Along with $CO_2$, these gases constitute major green house gas emission in the aluminium industry. The two to three higher order of magnitude of the life of PFC in relation to $CO_2$ poses a great challenge to environmental control. Significant amount of PFC emission occurs during the onset of anode effect in the electrolysis cells – the abrupt increase in cell voltage due to depletion of alumina in the electrolytic bath leading to reaction between carbon in the anode and fluorine component of the bath. The frequency and duration of anode effects depend primarily on the pot technology and operating procedures. Therefore the emissions of PFC vary significantly from one aluminium smelter to another.

Prediction of emission estimates are highly uncertain until and unless actual emission measurements are carried out at the smelter. However with proper tools and techniques it is possible to develop smelter-specific emission factors. The most common PFC estimation methods as per IPCC guidelines are the Tier 3 methods - Tabereaux Method (Modified Faraday's Law Method), the Pechiney Over-voltage Method, and the Slope Method. The principles of these methods are explained briefly in this paper; the relative advantages and disadvantages are elucidated. Guide lines for PFC emission reduction in the context of sustainable development of aluminium smelting are outlined. It is recommended that smelters conduct regular measurements to correlate their operating conditions with the results obtained by the use of these methods.

# Pot operation at low current (KA) during power crisis

**D Bhattacharyya and M. Dash**
National Aluminium Company Ltd.
Smelter Plant, Nalco Nagar, Angul-759 145, Orissa

## ABSTRACT

In Nalco, 4th Potline commissioning was started in December 2008. After commissioning of 150 Pots out of 240 pots , power plant faced problem of coal supply. Then it was decided to run Potline on 160KA instead of 184KA. Start up of pots continued at 170KA. After commissioning of 240 pots , KA was reduced to 160KA . This situation occurred in July – Oct in 2009, 2010, 2011 & also in July – Sept in 2012. It is very difficult to operate pots at 160KA when the design is for 185KA. Initially by modeling studies the parameters are decided. Then actual operation is carried out. Basically, metal level is reduced and % Excess ALF3 target is reduced to achieve almost similar thermal balance as in 185KA. Also pot resistance is increased as per calculation & operation is continued at 160KA for around 2-3 months without any problem of sick pot, sludgy pot etc. Anode changing frequency is also reduced to have good thermal balance.

In this operation, pot stoppage is avoided & production is not affected due to loss of pots. Also , cost of pot restart up was saved and production loss during pot stoppage time was avoided. This low KA operation was never done in AP 18 pots in other plants except Nalco.

# Networking of PTM & ERP module using manufacturing execution system (MES).

**Jitendra Ahirwar and Zakir Ali**
Vedanta Aluminium Limited, JharsugudaPMO Office, Bhurkahamunda
PO-Sripura, Dist- Jharsuguda
Orissa, Pin-768202

## ABSTRACT

Vedanta Aluminium Ltd is an associate company of the London Stock Exchange listed, FTSE 100 diversified resources group Vedanta Resources Plc. Originally incorporated in 2001, and VAL is a leading producer of metallurgical grade alumina and other aluminium products, which cater to a wide spectrum of industries. Jharsuguda is the site for our Aluminium Smelter, Captive Power Plant and an Independent Power Plant (Sterlite Energy Ltd.). Jharsuguda is situated in the western part of Orissa on the State Highway No-10, at a distance of 335 K.M. from Bhubaneswar and 310 K.M. from Raipur. The details of these projects
are given below.

1. 1.75MTPA Aluminum Smelter.
2. 9x135 MW Captive Power Plant.
3. 4x600 MW Independent Power Plant by Sterlite Energy Ltd.
4. Rail infrastructure for Coal, Aluminum & finished product.
5. A state-of-the-art modern township

VAL-Phase 1 with a capacity of 0.5 MT of Aluminium/Annum is India's largest integrated Smelter with 16 PTM's without Gantry Support. Across the world, smelters are operating with Gantry system Pot Tending Machine (PTM) is the most critical equipment of Pot Line. All major activities like Anode Change; Beam Raising, bath & metal Tapping is dependent on it. Smelter; being a continuous process plant requires all operational activities to be completed as per schedule. Availability of PTM for operational requirement is a major constrain in the aluminium smelter operating without Gantry system.
Study about Networking of PTM to increase availability & connectivity with ERP solution for easy analysis & troubleshooting.

# BLENDING OF DIFFERENT COKES AND GRANULOMETRY TO FORM GREEN ANODES

**Rupam Dutta , Anamit Deb Gupta, Vinnakota Avinash and Raghunath Panda**
Vedanta Aluminium ltd., JharsugudaPMO Office, Bhurkahamunda
PO-Sripura, Dist- Jharsuguda,
Orissa, Pin-768202

## ABSTRACT

An Aluminium smelter consists of three main divisions: Carbon, Potline, Casthouse. Anodes act as an electrical conductor in the electrolytic production of Aluminium.Anodes are produced in Carbon unit which is again divided into three departments:

Green Anode Plant 2.Anode bake-furnace 3.Anode rodding shop.

For forming green anodes, raw materials are Calcined petroleum coke, Coal tar pitch and recycle materials are the spent anodes (butts) from potline. Calcined petroleum coke is first crushed and screened into different fractions. According to granulometric distribution, this coke is mixed with spent anodes (butts) and pre-heated, and the dry aggregate which is formed is blended with required amount of coal tar pitch. This paste is then molded in Vibro-compactor to form a block of carbon called Green Anode. The anode is then baked in bake furnace to increase electrical conductivity. It is then rodded to hung in the pot for electrolysis process.

Calcined Petroleum Coke specifications:

VBD > 0.84 g/cc

TBD > 0.80 g/cc

Size < 50 mm

Coal Tar Pitch specifications:

Toluene Insoluble 30% - 37%

Quinoline Insoluble 7% - 12%

Softening Point 104 $^{o}$C – 109 $^{o}$C

Due to scarcity of above specified coke and availability of low VBD coke, we blend two different cokes to form anodes. Proportion of the two cokes will be decided on the coke specifications, VBD, TBD of both cokes, by plotting the graphs on granulometry. There are 5 feeders which deliver coke from the silo. These feeders are rotated on hourly basis for uniform granulometry of coke.

Granulometry is a process of minimizing the porosity. It is the proportion by weight of coke of different granular sizes. The percentage of porosity in Green Anodes could be determined using the green apparent density. Higher the density better is the performance of anode. This also decreases baking loss, increases mechanical strength, decreases electrical resistivity. Granulometric distribution in anodes also decreases the pitch consumption. Increases current efficiency, decreases block drop as anode is compact with proper granulometry. Decreases carbon consumption as porosity is decreased. Thus increases the purity of Aluminium produced.

# ABSTRACTS

## SECTION VI

## ANALYTICAL : BAUXITE, ALUMINA AND ALUMINIUM

# Rapid Thermometric Titrimetric Determination of Caustic and Alumina in Bayer Process Liquors

**Thomas K. Smith**

Multitrator Pty Ltd, 6/253 Leitchs Road (PO Box 5536),
Brendale, Qld 4500, Australia

**Christian Haider**

Competence Center Titration
Metrohm International Headquarters
Ionenstrasse, CH-9100 Herisau / Switzerland

and

**V.R.Sankar Babu**

Application laboratory,Metrohm India Limited, Annai Indira nagar,

Thoraipakkam,Chennai – 600 096

## ABSTRACT

A rapid, improved method for the thermometric endpoint titrimetric (TET) determination of caustic and alumina in Bayer process liquors is presented. The time of determination is typically under three minutes, around four times faster than competing potentiometric titration procedures, leading to a major improvement in analytical productivity for this assay. Analytical precisions (expressed as one standard deviation) are <0.2 g/L $Na_2O$ and $Al_2O_3$ each. Reagents are of low toxicity, biodegradable, and readily available at reasonable cost. The procedure is amenable to full automation. The thermo Metric sensor requires no calibration or ongoing maintenance.

An aliquot of Bayer aluminate liquor is titrated with standardized stabilized potassium bicarbonate solution to a thermometrically-determined endpoint, representing the free hydroxyl ion content of the liquor. An excess of potassium sodium tartrate is then added automatically to complex aluminate ion present in the liquor, releasing one mole hydroxyl ion per mole aluminate. The liberated hydroxyl ion is then titrated with the standard bicarbonate solution. The "total caustic" and "alumina" contents of the liquor can then be computed from these two titration results. The procedure is unaffected by the presence of carbonate in the liquor. An ancillary TET method for the determination of the carbonate content alone is also presented. This procedure also serves to calibrate the bicarbonate titrant.

# XRD Quantification of Bauxite Phases using full pattern Rietveld Fitting

**Umesh Tiwari,**
PANalytical, Singapore

and
**Mandeep Singh,**
PANalytical, India

## ABSTRACT

The relative phase concentrations in Bauxite, the raw material used for alumina extraction, has important bearing on the digestion process. Not only the total alumina concentration, also the relative fractions of alumina containing phases like Gibbsite, Boehmite, and diaspore etc. define the quality of bauxite and the efficiency of the hydrothermal digestion process. This makes accurate quantification of Bauxite phases an important parameter in chain of aluminum industry processes.

Of the various techniques of quantification, XRD has its potential in being fast, environment friendly, reliable and accurate for most Bauxite phases. In the present investigations, the use of XRD has been evaluated for Bauxite quantification. Various Methods – Calibration, RIR and Rietveld have been evaluated. It is observed that high degree of preferred orientation of the main phase, the Gibbsite, makes calibration and RIR based quantification quite unreliable. Rietveld based full pattern fitting has been found to be much more reliable. However, due to the crystallographic complexity of bauxite minerals, additional restrictions are necessary to obtain reliable results from the Rietveld analysis. Two of the defining restrictions are – referencing and chemical balancing. With the use of these two restrictions, bauxite phases can be quantified very accurately.

In the present study, we show that the full pattern Rietveld fitting with additional referencing and chemical balance can be used as reliable XRD quantification of bauxite phases.

# Quantitative Assessment of Bauxite Constituents at Trace Levels by Hyphenated Chromato-Optical Methods

**P.A.Mohamed Najar*, Sonali R. Gondane, P.G.Bhukte, M. T. Nimje and K.V.Ramana Rao**

Jawaharlal Nehru Aluminium Research Development and Design Centre

Amaravati Road, Wadi, Nagpur, India - 440 023

## ABSTRACT

A rapid and simple analytical technique based on thin layer chromatography (TLC) in combination with instrumental methods to measure aluminium, iron, titanium and silicon at trace levels in bauxite samples was developed. The chromatograms representing the characteristic color of the cations was quantitatively assessed by optical scanning densitometry, digital image analysis and spectrometry. The spot colour intensities were measured from the peak area corresponding to the characteristic colour spots of the cationic species. Densitometry was performed by direct scanning of the chromatograms in reflectance mode and image analysis was carried out by importing the digital images of chromatograms into the computer for measurement of colour densities with the help of image analysis software. Simple regression was practiced on calibration between concentrations of standards and their colour densities. Subsequently the possibility of utilizing hand held spectrometer was investigated for developing a portable analytical tool for *in -situ* applications.

# Elemental Analysis of Bauxite and its products by X-ray Fluorescence Spectrometer using WROXI standards

**BN Srivastava**

Panalytical, India

## ABSTRACT

Elemental analysis of various minerals and their products by XRF technique has been well established over the years. Bauxite which is composed of one or more aluminum hydroxide minerals, plus various mixtures of silica, iron oxide, titanium oxide, aluminum silicates and other impurities in minor and trace amounts is best analyzed by XRF using the glass bead fusion technique due to the presence of various mineral phases. However, glass bead technique is not a favored technique when either trace elements are to be analyzed or when number of samples to be analyzed are more.

In the present study it has been demonstrated how a set of 19 synthetic multi-element wide-range oxide (WROXI) standards in association with the Panalytical's modified Fundamental Parameter mathematical model can be used for the determination of major, minor and trace elements in Bauxite and its associated products. The study demonstrates how glass beads as well as pressed powder samples can be analyzed using WROXI. Number of Certified Reference Material (CRM) have also been analyzed for validating the technique.

# ABSTRACTS

## SECTION VII

## RECYCLING & UTILISATION OF WASTES OF ALUMINIUM INDUSTRY

# Role of Recycling in Sustainable Development of Aluminium Production

**T.R. Ramachandran**

Nonferrous Materials Technology Development Centre

Kanchanbagh, Hyderabad 500058

## ABSTRACT

Sustainable development of any industry takes into consideration economic, social and environmental aspects with the primary objective of achieving a better quality of life for everyone for the present and for future generations. The Hall-Heroult process for the production of aluminium has been commercially exploited for over 125 years and is still going strong. Considerable efforts have been put into tackling thorny issues in this process, related to high power consumption, emission of fluorides and green house gases and disposal of spent pot lining, SPL (the waste material dug out from failed electrolysis cells). Recycling of the metal offers several advantages: reduction in utilization of valuable natural resources, considerably reduced (~ 5% of that in primary metal production) of power consumption and emissions besides avoiding the problem of dealing with spent pot lining. Consequently a lot of attention is paid to this aspect of sustainable development of aluminium production. The challenges faced in the recycling operation, including efficient collection efficiency, separation of various alloys in the scrap, improving the efficiency of melting and melt treatment, are dealt with in this presentation. Steps in closed loop recycling, which facilitates conversion of scrap into product of the same alloy or alloy family, are explained. Recent developments in methods for scrap separation and melting units with considerably improved thermal efficiency are elaborated. Mass flow analytical models, developed to gain a better understanding of the benefits of recycling and targets set for sustainable development of this sector are briefly considered. .

# Hard wear resistant ceramic tiles utilizing industrial solid wastes and calcined alumina for lining in material handling equipment

**Swapan Kumar Das**
CSIR Central Glass and Ceramic Research Institute
196 Raja S. C. Mallik Road, Jadavpur
Kolkata 700032, India

## ABSTRACT

The material handling equipment of processing industries like ferrous and non-ferrous industries, thermal power plant, coal washeries and mining industries are generally subjected to heavy wear due to transportation of erosive and abrasive media particles. Such equipment made of metals generally gets damaged after specific hours of operation. It is universally accepted that high alumina ceramic liner (85-90% $Al_2O_3$) offers a techno-economical solution for such wear problem. In India, few corporate sectors and some small scale organisation are manufacturing this product particularly for the thermal power plant in Pulverized Fuel Bend pipe lining. Presently, the high alumina material is sintered at 1550 – 1600$^{o}$C. CSIR-Central Glass and Ceramic Research Institute has established a process to manufacture such item in the temperature range of 1400 – 1500$^{o}$C with similar properties by promoting sintering of alumina with some special additives. A process has also been established to manufacture abrasion resistant tiles by blending of industrial solid wastes such as Garnet sand, Iron ore tailing, Iron and Steel slag, Red mud, Fly ash, either singly or in combination to the extent of 30-40% replacing calcined alumina from the alumina based wear resistant liner compositions. Such waste incorporated abrasion resistant tiles can be utilized as a liner in the straight portion of the pipes in the low areas of erosion and abrasion. This tile will have application scope in places where a techno-economic solution to wear problem is the prime factor. Such composition require as low as 1200$^{o}$C sintering temperature. In another study inferior grade higher iron oxide containing bauxite has been used to substitute calcined alumina in wear resistant ceramic compositions. The paper deals with such development along with structure-property-performance relationship.

# EXTRACTION OF PURITY ALUMINA POWDER FROM WASTE ALUMINUM DROSS BY ACID LEACHING AND CALCINING PROCESS

**Upendra Singh and S.P. Puttewar**

Analytical Research Division, Jawaharlal Nehru Aluminium Research Development & Design Centre,

Amravati Road, Wadi, Nagpur-440023, Fax: 07104-220942, India

## ABSTRACT

Thousands of tones of Aluminium dross produced annually during the casting or re-melting of aluminum have accumulated over the years in India. The majority of this dross is disposed off in landfill sites, causing serious pollution of the environment. Developing methods of producing useful materials from the waste dross is a very vital task for the researcher.

In this paper, a methodology was developed for extraction of pure alumina and aluminium salts (alum) from Aluminium dross using leaching-calcining process. In This process, aluminum dross was treated with calculated amount of acid to extract metallic aluminium as salt. The residue (mostly Al oxide) was mixed with soda and sintered at 1000 ±10 0C to yield soluble aluminates. Subsequently the sintered dross was leached with sulfuric acid to produce a solution containing aluminum. The impurities such as Fe3+ and Na+ were removed by washing and EDTA. The physi-cochemical characteristics of the $Al_2O_3$ powders were examined by using XRD, SEM and ICP.

Keywords: Aluminium dross, Aluminium powder, Leaching process

# Recovery of Metals from Aluminium Dross

**R. N. Chouhan, P. Mahendiran, A. Agnihotri**

Jawaharlal Nehru Aluminium Research Development and Design Centre

Amravati Road, Wadi, Nagpur – 440 023

## ABSTRACT

Aluminum dross is a process waste produced during Aluminium melting. It consists of metal, salts oxides, and other non metallic substances. The type and "quality" of dross is determined by the method of melting, the initial feed materials, temperature, and other process variables. Dross obtained from primary melting operations consists primarily of aluminum oxide with oxides of other alloying elements such as magnesium and silicon and may contain from 15 to 70% recoverable metallic aluminum. Dross from secondary smelting operations typically contains recoverable aluminum from 12 to 18%. Metal from dross is recovered through smelting in a furnace. The nonmetallic byproduct residue, which results from such dross smelting operations is frequently termed "salt cake" and contains 3 to 5% residual metallic aluminum. It is normally disposed of in a landfill. In response to increasing environmental pressures, primary aluminum smelting industry has initiated a number of efforts to both minimize dross generation and to recycle the generated dross. This paper provides insight into the melt loss due to oxidation, dross management, and metal recovery methods.

.

# A process for conversion of Spent Pot Lining (SPL) into Eco-Cements

**Beena Rai, P. Sathish, P. C. Kapur, D. Pradip**

Tata Research Development and Design Centre

54B, Hadapsar Industrial Estate, Pune - 411013, India

and

**Judy A. Stenack, Ali Unal**

Alcoa Tech Centre, Pittsburgh, USA

## ABSTRACT

SPL is an unavoidable by-product of the aluminium smelting process. Typically, 30 Kg of SPL is generated for every ton of Aluminum produced. Globally aluminum smelters produce more than 500,000 tons of SPL each year. Even though SPL has a high fuel value (8000 to 9000 BTU/lb) and contains valuable metals, it is classified as a hazardous material due to its cyanide contents and leachable fluorides. As per the report published by International Aluminum Institute in November 2011, around 43% of SPL is recycled externally mainly as a feedstock in the cement, mineral wool and steel industry. However, the economics quite often become a major bottleneck in the supply of SPL since individual smelters do not produce enough SPL to ensure a continuous supply for recycling. Thus, large quantities of SPL are still being dumped in landfills and its safe disposal/recycle/reuse still remains a challenging problem to the aluminum industry.

We have developed a process to produce hydraulic setting cements (eco-cement) containing novel fluoride rich cementitious phase, from SPL by a novel energy efficient, low temperature clinkering route. A raw mix blend of SPL, lime/limestone, calcium sulfate and tailings sands is clinkered in a two stage process to produce a soft clinker. The SPL eco-cement is made by grinding the clinker to a fineness of 5000 $cm^2/g$ Blaine. A good quality cement containing around 20% by weight of SPL in the raw mix is thus produced. The physical properties of the eco-cements are found to be comparable to the Ordinary Portland Cements (OPC). The reproducibility of the process was tested by producing few Kg of eco-cement in several batches. Once commercialized, this process has a potential of converting SPL into value-added cement products.

# Production of Glass Ceramics from Alumina Refinery Waste: Exploration of Utilization Potentials of High Iron Bauxite Residue

**[1]Manoj T. Nimje*, [1]Mohamed Najar P.A, [1]S.U.Bagde, [1]V.S.Pathak,**

**[2]B.K.Satpathy and [1]J. Mukhopadhyay**

[1]Jawaharlal Nehru Aluminium Research Development and Design Centre

Amaravati Road, Wadi, Nagpur – 440 023, India

[2]National Aluminium Company Limited, Nayapalli, Bhubaneswar – 751 061, India

## ABSTRACT

Glass-ceramics are polycrystalline materials of fine microstructure that are produced by the controlled crystallization of a glass. The major application area of these materials is associated with building and construction where glass-ceramics are largely used as decorative and architectural components. Silicate based industrial rejects such as fly ash, coal ash, slag etc. are identified as the potential industrial waste for recycling in to glass ceramics probably due the lesser proportion of iron oxide and significant presence of alumina. Bauxite residue is one of the major solid wastes generated in aluminium industry and characterized with the presence of high iron oxide content and comparatively low range of silica. The present study investigates the utilization of bauxite residue which contains more than 50 – 60 % iron oxide for the production of glass ceramics. The experimental trials were carried out after the addition of nucleating agents and glass forming materials at a temperature range 1100 – 1400$^{o}$C. The glass melt is retained for crystal generation at optimized temperature and residence time. Further it is converted in to glass ceramics by devitrification and heat treatment process in the range of 600-800 $^{o}$C. The glass-ceramic samples generated from bauxite residue show good wear and abrasion resistance. Change of surface coloration, velvetiness and aesthetic appearance of the product with respect to materials composition were also examined. The proposed method permits an optimum utilization 30-70 % red mud in raw mix. Attempts are made to commercialize glass-ceramics from bauxite residue. Furthermore, scale-up production for industrial exploitation is in progress.

Key Words: Bauxite Residue, Heat Treatment, Devitrification, Glass Ceramics, Waste Recycling

# Development of Light Weight Foamed Bricks from Red Mud

**[1]Mohamed Najar P.A*, [1]Manoj T. Nimje, [1]S.U.Bagde, [1]V.S.Pathak, [2]B.K.Satpathy and [1]J. Mukhopadhyay**

[1]Jawaharlal Nehru Aluminium Research Development and Design Centre
Amaravati Road, Wadi, Nagpur – 440 023, India
[2]National Aluminium Company Limited, Nayapalli, Bhubaneswar – 751 061, India

## ABSTRACT

The present study demonstrates the potential utilization of red mud for the production of light weight foamed bricks (LWFB) for building and construction area. A novel concept of self expanding raw material mix for the formation of LWFB has been realized. The salient features of LWFB produced by heat treatment (1000-1200°C) of admixtures containing red mud, fly ash and foaming agents were discussed. The environmental impact on the durability was also evaluated with respect to its exposure to sunlight and moisture under different climatic conditions. Various physical and chemical parameters such as compressive strength, porosity, dry and wet density, leachability and vaporization of heavy metals, soda leaching, pH variations, efflorescence, radioactivity etc. were evaluated. The possibility of product modification and area of extended applications were also discussed.

Key words: Red mud, Foamed Bricks, Building and Construction, Toxic effect of Materials, Environmental Impact.

# DISINFECTION USING SOME METAL OXIDES AND RED MUD

**Anshuman A. Khardenavis, Nitin Gedam, N. N. Rao*, H. J. Purohit**

National Environmental Engineering Research Institute

(Council of Scientific and Industrial Research), Nehru Marg, Nagpur-440020, INDIA

## ABSTRACT

Mankind and livestock have been plagued by diseases caused by many infectious microorganisms present in water, air & food. The process of destroying agents of such infectious diseases, namely bacteria, viruses, and fungi is defined as 'disinfection'. Based on the mode of action of various disinfectants, five principle mechanisms have been proposed for the disinfection including damage to cell wall leading to alteration of cell permeability, alteration of colloidal nature of the protoplasm, alteration of the organism`s DNA or RNA thereby disrupting the replication process of the organism, alteration in the chemical arrangement of enzymes. We have explored the disinfection potential of a few metal oxides with test bacterium *E. coli* and endeavoured to understand the underlying mechanism of disinfection. Of the four different metal oxides tested, only $Fe_2O_3$ and $Al_2O_3$ were effective for disinfection with higher decrease in bacterial count than in case of $SiO_2$ and $TiO_2$ where the decrease attributed to the cells reaching dormant phase. Both $Fe_2O_3$ and $Al_2O_3$ were effective at higher dilutions and could be used at very low concentration of 50 ppm and 20 ppm for disinfection of *E. coli*. As many of these oxides are generally associated with 'red mud' from aluminium refining industries, it may be expected that this waste material to exhibit disinfection properties. Results from preliminary experiments indicate that red mud does show disinfection ability.

The mechanism involved the generation of reactive oxygen species (ROS) by metal oxides in presence of water which resulted in killing of bacteria by damaging cell membrane proteins, lipids and DNA. The ROS generation was demonstrated by using dichlorodihydrofluorescein diacetate ($H_2$DCFDA) which reacted with ROS leading to formation of dichlorodihydrofluorescein. Thus the ROS was no longer available for disinfection of bacteria leading to a slower rate of disinfection than control set without the ROS quencher indicating that this compound could be used as an indicator for ROS generation. The characterisation and disinfection data obtained will be discussed during the conference.

# Intensifying Approaches for Neutralization of Red mud

**Suchita Rai, M. J. Chaddha, J Mukhopadhyay**
Jawaharlal Nehru Aluminium Research Development and Design Centre,
Amravati Road, Nagpur, Maharashtra, 440 023, INDIA.

**K. L. Wasewar**
Department of Chemical Engineering, Visvesvaraya National Institute of Technology (VNIT),
Nagpur -440010, Maharashtra, INDIA
and

**D.H. Lataye**
Department of Civil Engineering, Visvesvaraya National Institute of Technology (VNIT),
Nagpur- 440 010, Maharashtra, INDIA.

## ABSTRACT

In the Bayer process of extraction of alumina from bauxite, the insoluble product generated after bauxite digestion with sodium hydroxide at elevated temperature and pressure is known as 'red mud' or 'bauxite residue'. Bauxite residues are highly alkaline in nature with a pH of 10.5 -12.5 and are conventionally disposed of in mostly clay-lined land based impoundments. They impose severe and alarming environmental problems. The alkalinity of red mud is the main topic of concern regarding sustainable re-vegetation, soil and air pollution and embankment failure of the ponds in the course of time. The alkaline constituents in the red mud also prevent re-use of red mud and also pose problem for its storage and waste management. Hence neutralization/ treatment of red mud using different techniques is the only alternative to make it environmentally benign and for the storage and management of bauxite residue. The paper looks at the different neutralization techniques such as acid neutralization, neutralization with acidic waste, seawater neutralization, treatment of red mud with amenders, sintering of red mud and $CO_2$ neutralization in detail. A comprehensive study and research about their scope, applicability, limitations and feasibility of these methods have presented. Also reuse options of the neutralized red mud have been discussed in the paper. This paper would be extremely useful in the context of environmental concerns for residue management and utilization of red mud.

# Red mud Utilization Practices in Context of Indian East coast Bauxite Processing

**Harish Chandwani**

Anrak Aluminium Ltd,.

G- Koduru, Makvarapalem (M), Visakhapatnam- 531 113

## ABSTRACT

Red mud is essentially now regarded as hazardous waste and therefore fed to secured disposal in sealed disposal sites. This form of storage is costly and expensive since large deposition site areas and plants are required and high cost is incurred for the transport of the red mud. Despite of all the efforts for bulk utilization all over the world the very small quantity could be economically utilized. Additionally, the long-term cost incurred by the deposition can only difficultly be calculated and present an additional economical problem besides various ecological problems. It has been found that the east coast bauxite residue contains 57-60% of iron compounds in the form of Hematite ($Fe_2O_3$) and Goethite FeO(OH) minerals, depending on the quality//mineralogy of the bauxite processed, it lends itself to recovery of iron or iron ore, respectively, in particularly advantageous manner.

Therefore, the object of the present paper is to review the literature pertinent to separation of iron value from red mud and possibilities of exploiting technically realizable method for processing of waste generated from east coast bauxite. The advantageous / feasible recovery of the iron containing components of red mud shall be useful for coping with the annually arising quantum of red mud deposits. This utilization practice will be able to solve the considerable quantities of red mud disposal problem with conservation of land required for safe storage with the economics of alumina production.

Key Words: Red Mud Utilization; Iron extraction; Methods; Economics; Sustainability.

The IBAAS 2012 committee would like to extend a sincere vote of thanks to all the participating companies and organizations, the sponsors , co-sponsors and partners of the first IBAAS conference.

Thank you for making this event a grand success.

We would also like to thank the Radisson Blue Hotel for its services, the Printers , Caterers and entire IBAAS team whose dedication and commitment made the IBAAS 2012 conference possible.

Thanks a lot!

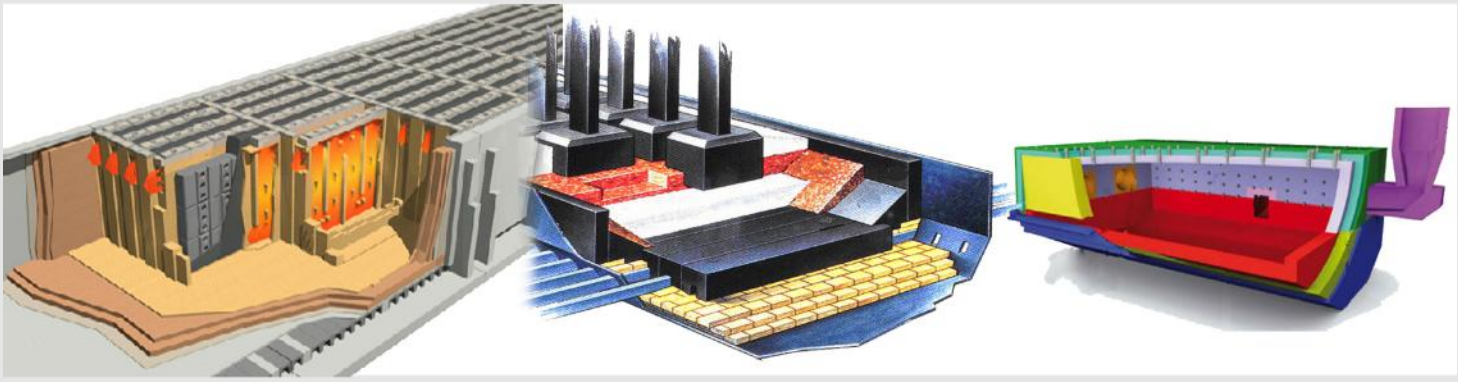
IBAAS 2012

VISION 2020

**IBAAS**
**International Bauxite, Alumina & Aluminium Society**
Email : Info@ibaas.info
Website: www.ibaas.info

TRL KROSAKI

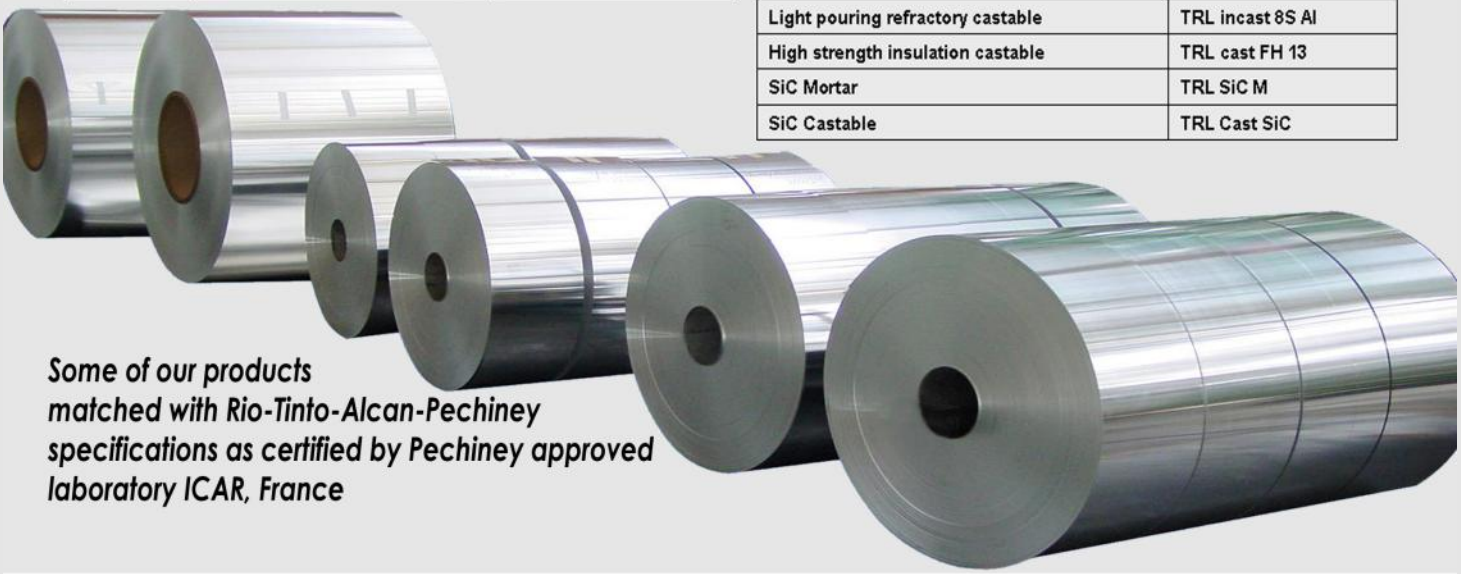
# World Class Products for Aluminium Industry



## Complete range of Refractories for Aluminium Industry from TRL Krosaki

| Area | Refractories Item | TRL Krosaki Product |
|---|---|---|
| Bake Oven | Flue & Head Wall Brick | TRL HIAL 50SPL/ TRL HIAL 59 |
| | Wedge Brick & Bottom Brick | TRL 42 D |
| | Mortar | TRL 45 M |
| | Top Block | TRL CAST LC 45 PCPF |
| Rod Shop | Ramming Mass | TRL RAM SK 165 |
| | Castable for Ladle | TRL CAST AH 60 |
| Ladle Shop | Non Wetting Castable | TRL CAST HF 85 AL |
| | Castable for Launder Relining | TRL CAST HF 85 AL |
| Cast House | Castable for Launder Patching | TRL CAST AH 60 |

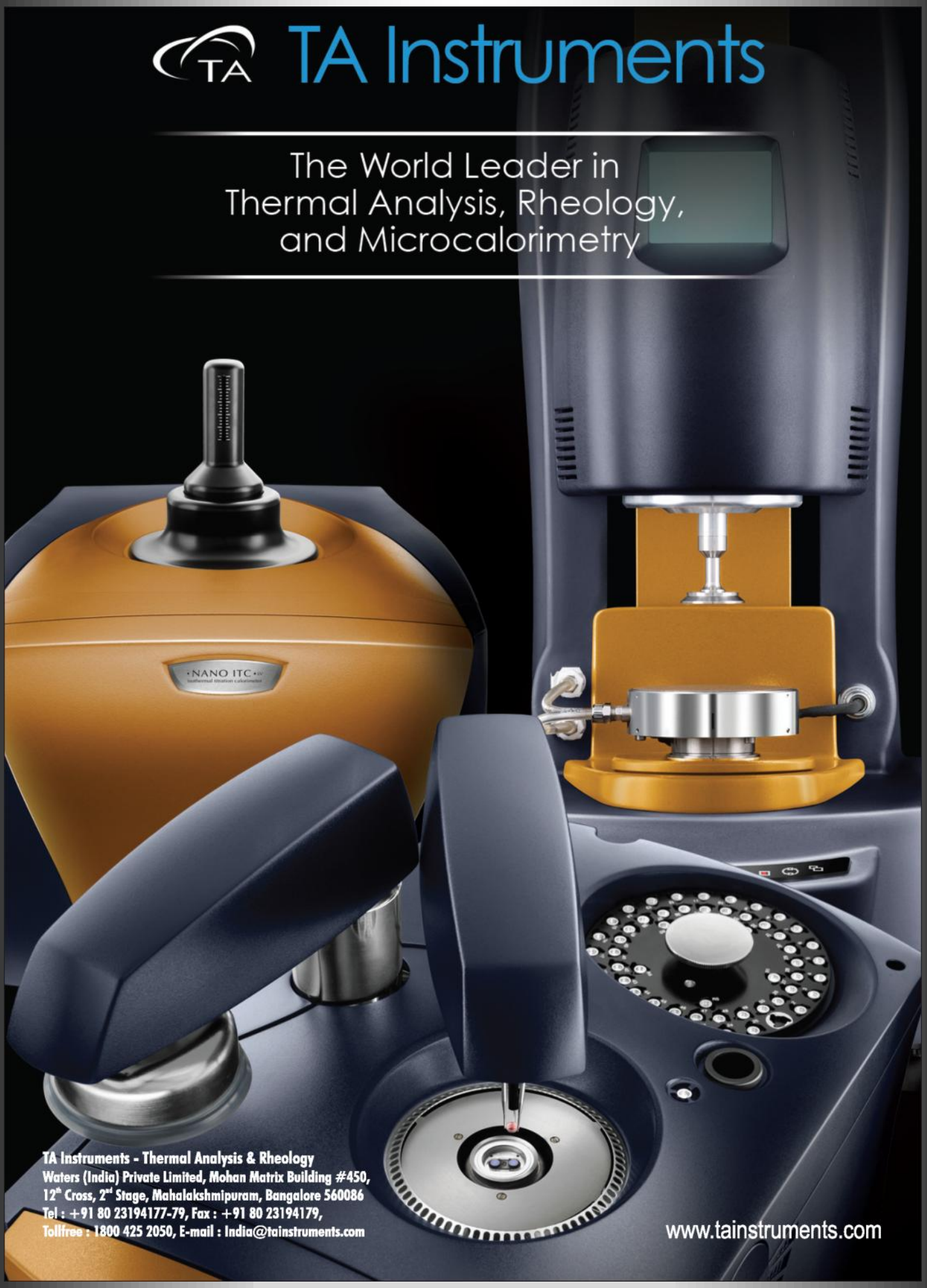
| Electrolytic POT Refractory Items | TRL Krosaki Product |
|---|---|
| High strength insulation bricks | TRL INS FC 0.7 |
| Semi-graphitic carbon cathode blocks | TRL CB-P |
| Low strength insulation brick | TRL INS FC 0.5 |
| Refractory bricks | TRL 30 |
| Silicon Nitride Bonded SiC blocks | TRL SiC-SN |
| Narrow Seam Paste (BSGH as per GAMI) | TRL-NSP |
| Corner carbon blocks | TRL CB-P |
| Side regulating block I | TRL CB-P |
| Side regulating block II | TRL CB-P |
| Light pouring refractory castable | TRL incast 8S Al |
| High strength insulation castable | TRL cast FH 13 |
| SiC Mortar | TRL SiC M |
| SiC Castable | TRL Cast SiC |



*Some of our products matched with Rio-Tinto-Alcan-Pechiney specifications as certified by Pechiney approved laboratory ICAR, France*

TRL KROSAKI REFRACTORIES LIMITED

Tata Centre, 11th Floor, 43 J L Nehru Road,
Kolkata - 700071, India
Phone: +91 33 22885051/ 22887799/ 65500473 I
Fax: +91 33 22881063/ 1065
www.trlkrosaki.com


TA Instruments
The World Leader in
Thermal Analysis, Rheology,
and Microcalorimetry
NANO ITC
TA Instruments - Thermal Analysis & Rheology
Waters (India) Private Limited, Mohan Matrix Building #450,
12th Cross, 2nd Stage, Mahalakshmipuram, Bangalore 560086
Tel : +91 80 23194177-79, Fax : +91 80 23194179,
Tollfree : 1800 425 2050, E-mail : India@tainstruments.com
www.tainstruments.com

# WITH BEST COMPLIMENTS FROM

# CASTWEL INDUSTRIES

CASTWEL

TÜV SÜD ISO 9001

## Manufacturers

Of

## Castable Refractories & PCPF Shapes

for

Aluminium
Power
Hydrocarbon
Non Ferrous
Steel
Cement

## SERVICES

Drawings / Detailing / Design
Installation and dryout

**Extensive experience in supply and installation for CFBC boilers**


C – 18/6, M.I.D.C. AREA, NAGPUR – 440028
PH. No. 07104 – 646241 to 53, Fax No. 07104 – 237666
E-Mail ID: sales@castwelindustries.com, services@castwelindustries.com

Contact: Shirish Wate: 9422111550, Mail: srw@castwelindustries.com

Pramod Deshmukh: 9422801817, Mail: pd@castwelindustries.com

FLIR®

# Thermal imaging cameras for electrical and industrial inspections


## FLIR T400-Series

### High performance at an affordable price

The new FLIR T400-Series are designed for the user looking for high performance at an affordable price. The FLIR T400-Series combine excellent ergonomics with high image quality of 320 x 240 pixels. The FLIR T400-Series come with a tiltable optical unit which makes it possible to measure and take images of objects in all angles, in a comfortable working position.

The FLIR T400-Series come in 2 versions. The top-of-the-line T440 is equipped with the innovative Multi Spectral Dynamic Imaging (MSX) feature. MSX allows producing ultra detailed and ultra crisp thermal images. It produces exceptional thermal clarity to highlight exactly where the problem is. MSX ensures easier target identification without compromising temperature data.


Overheated connection (with MSX)


Overheated connection (without MSX)

If you want to have more information about the FLIR T400-Series or any other FLIR thermal imaging camera please contact:

**FLIR Systems India Pvt. Ltd.**
1111, D-Mall, Netaji Subhash Place,
Pitampura, Delhi-110034. INDIA
Tel.: +91-11-4560 3555
Fax.: +91-11-4721 2006
e-mail: flirindia@flir.com.hk

www.flir.com

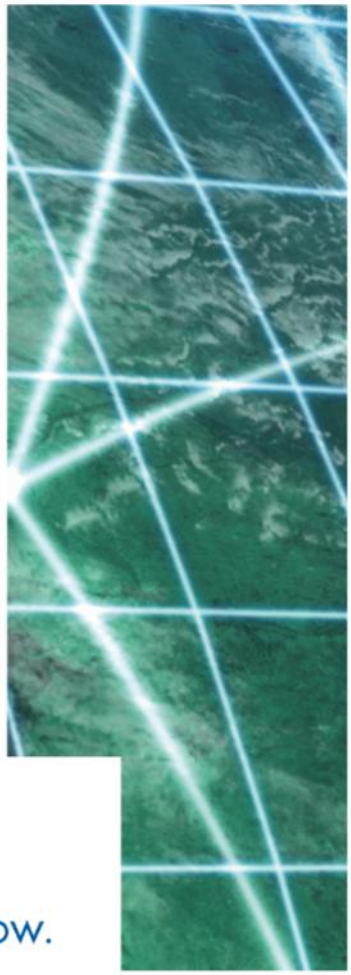
Images for illustrative purposes only.

Different users have different needs.
FLIR Systems offers you a choice!

ALMATIS

PREMIUM ALUMINA


# We are ALUMINA



With a century of alumina technology expertise, we work closely with our customers to find solutions for tomorrow.

## ZHONGDA BRIGHT FILTER PRESS CO., LTD

Zhongda Bright Filter Press Co., Ltd, a wholly owned subsidiary of Zhongda Bright Group, which ranks among Top 500 Machinery Manufacturer in China, is one of the strongest and largest filter press manufacturers in the world. Its annual turnover is more than 5000 sets of filter presses, which are widely used in environment protection areas, such as red mud dewatering, sludge dewatering, and many other tailing treatment fields. The filter presses featuring big capacity and low cake moisture have been proved successful. Zhongda Bright Filter Press Co., Ltd is trying all its best to provide best quality and excellent services to its customers.

High Efficient Quick Open Membrane Filter Press

Program Controlled Auto Filter Press With Cloth Washing System

BRIGHT ®
贝莱特

ADDRESS: NO 3379, JINGHUA ROAD, DEZHOU, SHANDONG, CHINA
TEL:+86 534 2299387
FAX: +86 534 2299282
MOBILE: +86 15863766971
FAX: +86 534 2299282
EMAIL: tengjingyi2008@gmail.com
INDIA OFFICE: G–41, Hira Arcade, Pandri. Raipur – 492004, Chhattisgarh, India
Mobile: +919755590909/9438090909
Email:brightfilterin@gmail.com

## Main Products:

- High Efficient Quick Open Filter Press
- Program Control Auto Filter Press
- Hydraulic Filter Press
- Program Control Auto Filter Press with Auto Cloth Washing System
- Manual Filter Press
- Agitating System