A biannual publication of

The International Committee for the Study Of Bauxite, Alumina and Aluminium (ICSOBA)

NEWSLETTER

Volume 3, June 2010

ICSOBA

contents.

In Memoriam.

Dr. Karoly Solymar Executive Director ICSOBA 1992-2005

We are deeply grieved to report the sad demise of Dr. Karoly Solymar in Budapest on May 31, 2010. He fought valiantly with cancer for the last few years before succumbing to it. The funeral was held on June 15, 2010.

Dr. Solymar was born in Dorog Hungary on August 26, 1934. He graduated in Chemical Engineering from the Veszprem University Hungary in 1957 and obtained his PhD in 1974 submitting his thesis on Technological Evaluation of Bauxites. He was with the Research Institute for Nonferrous Metals (FKI) Budapest from 1957 to 1975 and then with the HUNGALU ALUTERV-FKI Ltd. (Engineering and Development Centre of the Hungarian Aluminium Corporation) Budapest where he rose to the level of Principal Scientist, Bauxite and Alumina. He was very active in studies related to various aspects of the Bayer process and special alumina products and in the preparation of techno-economic and feasibility study reports on green field and modernization of alumina plants. He was a Short term consultant of UNIDO in Jamaica, Iran, Vietnam, China and India; he organized several UNIDO Group training programmes and Workshops on alumina production in Hungary and in many developing countries.

He was an active member of the Hungarian Mining and Metallurgical Society, (Head of Presidential Committee), Hungarian Geological Society, Hungarian Chemical Society, TMS AIME (from 1983) and ICSOBA (from 1963). His contributions as the Executive Director of ICSOBA from 1992 to 2005 are immense; time and again we have turned to him for his assistance in sustaining the activities. We have received invaluable help from him when the ICSOBA Secretariat was shifted from Budapest to Nagpur.

Apart from being a fountain of information on alumina technology, he was a good teacher and those who attended his marathon lecturing sessions developed a great respect for him. He was a man of charming manners and friendly disposition. The members and Presidency of ICSOBA recall with deep gratitude the services rendered by Dr. Karoly Solymar in furthering the cause of the organization and extend their sympathy and heart felt condolences to his family members, professional colleagues and friends.

May his soul rest in peace.

foreword.

Greetings from the ICSOBA Secretariat. We have great pleasure in bringing out the June 2010 issue of the ICSOBA News Letter. There are several developments since we were in touch with you in December 2009. We have enrolled many new members and made excellent progress in the organization of the XVIII International Conference in Zhengzhou China from November 25 to 27, 2010. The response to the Conference is very encouraging and we have over 90 abstracts of papers received for presentation. We have already started thinking ahead, planning for the 2012 International event and celebrating the Golden Jubilee of ICSOBA in 2013. A message from Mr Roelof Den Hond, President ICSOBA with an invitation for participation in the Zhengzhou Conference and a write-up on the outcome of the Meetings that Dr. Ashok Nandi, Executive Secretary, ICSOBA had in Brussels, Dubai and St. Petersburg are included in this issue of the News Letter.

There are two technical presentations in this issue, one dealing with the utilization red mud for the development of wood substitute composites and the other on the anode plants for future smelters. The first presentation is in a way a continuation of the one on red mud utilisation that we had in the December 2009 issue of the News Letter. We are all aware that power consumption in aluminium smelting and purity of the metal produced are influenced by the quality of anodes and we are pleased to have a presentation on anodes from the R & D Carbon group Switzerland in this issue.

Before we end, may we draw your kind attention to what we have stated in the foreword to the last two issues of the News Letter; we need your whole hearted support and cooperation in sustaining our activities. Your enrolment as member of ICSOBA, participation in various technical events organized by ICSOBA and contribution of technical articles to the News Letter would be a source of great encouragement to us. Applications for membership can be downloaded from the ICSOBA web site www.icsoba.org . Technical contributions in the areas of bauxite, alumina and aluminium production, downstream, environmental aspects and sustainable development are welcome. For the December 2010 issue of the News Letter we would be grateful to receive technical contributions before October 31, 2010.

We look forward to the pleasure of meeting with you in Zhengzhou on November 25, 2010.

ICSOBA 2010 at the door step of the Chinese aluminium industry

The growth of aluminium industry in China in the last decade is impressive. The metal smelting capacity has grown from ~ 3 Mtpy to 19 Mtpy and alumina refining capacity from ~ 4 Mtpy to ~ 32 Mtpy. While 40% of the world smelting capacity is in China, the second largest producer, the Russian Federation has 10% of the global capacity; in alumina production ~ 30% of the global capacity is installed in China with Australia coming next with ~ 20%. It is pertinent to look at the factors which have contributed to this large growth. The per capita consumption of aluminium in China has grown from ~ 3 kg to over 8 kg in the last decade. Chalco predicted that the consumption of metal in China would be 16.5 Mt in this year compared to 16.1 Mt in the last year. This represents about 40% of the total world consumption, estimated at 41.6 Mt. In view of the large population of China, the low per capita consumption compared to that in well developed countries and the projected high rate of growth in its economy, there is significant potential for further increase in aluminium consumption.

China has proven and probable bauxite reserves of 2300 Mt (8% of the world reserves), preceded by Australia, Guinea, India Jamaica and Brazil. It has the 3rd largest coal reserves in the world (120 billion t), next only to USA and Russia. The installed capacity for the production of caustic soda in 2009 was 27.93 Mt/y and the actual production was 18.91 Mt, representing 34% of the global output. The estimated Chinese aluminium fluoride production of 440 kt, in the year 2009, accounts for more than 50% of the world figure; 75% of this is consumed in the country and the rest exported. These factors are a clear indication of the adequacy of raw material for the aluminium industry. It may be noted that the alumina refining capacity does not meet with the requirements of the smelter and import of alumina is inevitable.

There has also been significant progress in development of downstream fabrication capabilities. Output of semi-fabricated products, including flat-rolled products such as sheet, plate, and foil, and extruded products has grown from 181,000 t in 1980 to nearly 11.5 Mt in 2007 with extruded sections forming a significant part. In addition, the country's production of aluminium casting and die-casting is expected to aggregate to 4.5Mt for 2007. There is increasing consolidation in the Chinese aluminum industry; Companies that have primarily been involved in the primary processing area are increasingly interested in greater vertical integration and adding downstream fabrication capability, while large aluminum fabrication companies are contemplating upstream investments. The advantages of the Chinese industry are low capex and short lead times; while Western smelters require a capital investment of $4,000/t, those in China cost $1,400–$1,600/t; it takes 12 months to build a 250kt/y plant using the 320 kA cells whereas a period of 2-3 years is needed in other countries. China has its own technology and construction resources and is developing external assets building smelters and bauxite resources in other countries.

The facts enumerated above reflect that China has rapidly grown from a minor participant to the paramount leader of the global aluminium industry. In recognition of these achievements, it was decided to have the ICSOBA 2010 conference from November 25-27, in Zhengzhou, China, in collaboration with the R&D Center Chalco. This is also in consonance with the ICSOBA practice of rotating the venue of the International Meetings in various parts of the world. The conference includes key note addresses by eminent persons, Round-Robin sessions on themes of interest, contributed presentations and field trips to a bauxite mine, an alumina refinery, an aluminium smelter and a R&D laboratory.

On behalf of ICSOBA, I have great pleasure in inviting you to Zhengzhou and joining us in making the Conference a great success.

Oegstgeest
June 2010

Roelof Den Hond
President ICSOBA

ICSOBA Presidency

Name	Designation	Address
Mr. Roelof Den Hond, Managing Director ALCOR	President	r.denhond@AlcorTechnology.com
Dr. Li Wangxing President of R&D Center of CHALCO President of Zhengzhou Research Institute, CHALCO.	Senior Vice President	WX_Li@chalco.com.cn
Mr Dimitri Contaroudas	Past President	dconta@attglobal.ne
Prof. Olga Lahodny- Sarc, Croatian Academy of Arts and Sciences	Secretary General	lahodny@hazu.hr
Dr. T.R. Ramachandran (Retd.) Director JNARDDC, Nagpur	Executive Director	trramachandran@yahoo.com
Dr. Ashok K. Nandi, Director Mineral Information and Development Centre	Executive Secretary	aknandi@sify.com
Mr. H Mahadevan President, ANRAK ALUMINIUM LIMITED, Hyderabad	Executive Secretary	hmdvan@yahoo.com
Ms Sudipta Chaudhuri	Assistant Executive	dipa.chaudhuri@icsoba.org

Prof. Dr Josip Crnko & Erik Peter van der Kuij from council members:

Council Members of ICSOBA

S.No.	Name	Address
1	Prof. Fathi Habashi Professor Emeritus of Extractive Metallurgy Department of Mining, Metallurgical, and Materials Engineering Laval University, Quebec City, Canada G1V 0A6	Fathi.Habashi@arul.ulaval.ca fathiegypt2003@yahoo.com
2	Mr. M.H. Torabi Chairman of ITOKGROUP Engineering, Technology and Contracting Company	No 154 vanak str, Tehran 19918-16883 IRAN Ttel:+982188066255 Fax:+982188066257 Mobile:+989121111862 torabi@itokgroup.com
3	Dr. Jeannette See Research Consultant, Geochemistry Bauxite & Alumina Bauxite R&D Programme Leader Rio Tinto Alcan Arvida Research and Development Centre	jeannette.see@riotinto.com T : + 1 418 699 6585, ext. 3321 F : + 1 418 699 3811,
4	Mr. Dominique Butty Director Butty Herinckx & Partners BV Website: n.a. Address: Ch. De la Croix BP 46 CH 10 70 Puidoux	E-mail: dlbutty@bluewin.ch Phone: +41 21 946 18 57 Fax: +41 21 946 22 07 Mobile: +41 79 602 05 30
5	Mr. Parris A. Lyew-Ayee Executive Director Jamaica Bauxite Institute Hope Gardens Kingston-6 Jamaica - W.I.	plyewayee@jbi.org.jm Phone: 876-927-2074 Fax: 876-927-1159
6	Mr. Anupam Agnihotri Scientist IV Head & l/c (bauxite & alumina) Jawaharlal Nehru Aluminium Research Development and Design Centre Amravati Road, Wadi, Nagpur - 440 023 (MS), India	aaagnihotri@yahoo.com
7	Dr. H Sundara Murthy FENFE METALLURGICALS NO.2,Sy.No.20-A, Uttarahalli, BANGALORE-560 061, INDIA.	fenmet@vsnl.com Telefax: +91 80 2666 1461/0603 Mobile: +91 9845011461 Email: fenmet@vsnl.com
8	Mr. R. Dhameja Corporate Technical Director Century Aluminum, Kentucky USA	rdhameja@centuryky.com rajivdhameja@yahoo.com +1 270 852 2831 Office +1 270 556 1267 Cell +1 270 852 2882 Fax

S.No.	Name	Address
9	Dr. George (György) Bánvölgyi Technical Director Bán-Völgy Limited Partnership, Budapest, Hungary	gbanvolgyi@yahoo.com gbanvolgyi@gmail.com T+F: +36 1 302 0871 Mobile: +36 30 383 2653 Skype: gbanvolgyi
10	Mr. Michael Emond Global Bauxite Resource Manager, Bauxite Alumina Technology Centre 7th Floor Bunbury Tower 61 Victoria Street Bunbury, WA 6230 PO Box 344 Collie, WA 6225.	Michael.Emond@bhpbilliton.com Tel: +61 8 97266843 Cell No. +61 416479799
11	Mrs. Rita Vaseur-Madhoeban Director Bauxite Institute Suriname	dirbis@sr.net
12	Dr. Andrey Panov Director of Alumina Engineering & Technology Center RUSAL VAMI	Andrey.Panov@rusal.com
13	Dr. Yin Zhonglin Director of Alumina Research Department, Zhengzhou Research Institute, CHALCO (Aluminium Corporation of China Limited)	zyy_yzl@rilm.com.cn.
14	Mr. Noel Marino BAUXILUM	noel.marino@bauxilum.com.ve nmarinop@gmail.com
15	Mr. Jan Kotte Vice President Operations Aluchem India Ltd	jank57@yahoo.com tel : 1 413 733 8519 mobile : +91 9763359200 fax : 1 513 733 8272
16	Mr. Ashish Jog Project Manager Alumina	Ashish_jog@dubal.ae Mobile :00971506459657 Tel:0097148021104

S.No.	Name	Address
19	Mr. Stef Sep General Manager Hencon Handling (PTY) Ltd. 78 Alumina Allee, Alton Richards Bay, South Africa	stef@hencon.co.za Tel +27 35 797 3004 Fax +27 35 797 3015
20	Mr. Leslie Leibenguth President LWL Technical Services	P O Box 363 Fernwood Ms. USA 39635 lwltech@yahoo.com
21	Mr. Alberto Fabrini Jr Senior Project Manager Hydro Aluminium ASA	Email: alberto.fabrini@hydro.com Phone: +47 95474733
22	Prof. Arthur Pinto Chaves Full Professor, Mineral Processing	2373 - Cidade Universitária "Armando de Salles Oliveira" -São Paulo - SP -Brasil 05508-900 - fone +55 11 3091-5597/5431/5321 fax +55 11 3091-5721, apchaves@usp.br

ICSOBA Corporate Members AND Scientific Organisations

Ashapura Minechem
ALCOR - The Aluminium Industry Insiders
ALUCHEM INC
Amber Development
Anrak Aluminium Limited
Bauxite Resources Ltd
BOKELA GMBH
Dubal
FL Smidth Pvt Ltd
HATCH
HINDALCO Industries Ltd
Mcnally Humboldt Wedag Minerals Ltd.
National Aluminium Company Ltd (Nalco)
RIO Tinto Alcan
RIO Tinto Alcan Exploration
STC Engineering Gmbh
Jawaharlal Nehru Aluminium Research Development and Design Centre
Rusal Vami

Technical Paper 1

UTILISATION OF BAUXITE REDMUD IN WOOD SUBSTITUTE COMPOSITES

Mohini Saxena and P. Asokan, Scientists
Advanced Materials and Processes Research Institute (AMPRI),
CSIR, Bhopal-462064, India
Email: saxenamohini@hotmail.com

Abstract

Advanced Materials and Process Research Institute (AMPRI) Bhopal has conducted several experiments and optimised process details for the development of wood substitute composite products using bauxite residues (red mud) with natural fibre and polymer for making doors, panels, tiles, partitions, furniture etc. A Technology Enabling Centre has been established at the Institute for manufacturing these products. The wood substitute products are stronger, durable, environmental friendly, cost effective and have ample scope for a variety of applications in construction sector. This paper addresses the processes and technologies developed to maximise the use of bauxite residue for sustainable production of wood substitute products.

Keywords
Bauxite residues; environmental pollution; recycling; wood substitute; mechanical properties; deforestation; resource conservation

Introduction
The Bayer process for the production of alumina involves the digestion of bauxite with caustic soda, filtering off the insoluble components and re-precipitation of the dissolved alumina. Red mud is the residue of the filtration process. It is highly alkaline in nature and contains oxides of Fe, Al, Ti, Na, Ca with trace elements such as As, Se, Cd, Co and Pb. The quantity of red mud generated varies considerably depending on the properties of bauxite, and operating conditions of the Bayer process (Yalcm and Sevinc, 2000; Li, 1996; Li, 1998; Li, 2001). The current annual bauxite consumption in India is 8.375 million tonnes and the amount of separated red mud is ~ 5.5 million tonnes. The continuously accumulating deposits of red mud and its alkaline nature require large land areas for disposal and need special attention to avoid contamination of soil, surface and ground water.

Environmental management and appropriate utilization of red mud is now a major universal concern to safe-guard the environment. Red mud has been used as a substitute for ordinary clay for producing bricks (Sglavo et al., 2000). Below 900º C, it can be considered an inert component in mixtures with carbonate-rich clays so that the mechanical strength decreases as the red mud concentration increases (Sglavo et al., 2000). In recent years, several attempts have been made to recycle red mud in ceramic products, extraction of value added elements, cement, polymer matrix composites, bricks and ceramic glazes such as porcelain, sanitary ware glazes, electroporcelain glazes, etc., (Yalcm and Sevinc, 2000, Sglavo et al., 2000, Saxena and Mishra, 2004). Up to 37% of red mud was used in achieving good quality surface finish, strength and abrasion resistance of glazes (Yalcm and Sevinc, 2000). During high temperature firing at

During high temperature firing at 1050 ºC, addition of red mud increases the density and flexural strength and formation of glassy phase. One of the studies carried out in Spain showed that red mud could be used as adsorbent for wastewater treatment especially for adsorption of Cu2+, Zn2+, Ni2+ and Cd2+ ions (Lopez et al.,1998). Lightweight aggregate is produced from red mud by adding gas-producing materials such as carbonaceous materials, sodium carbonate and talc (Lopez et al., 1998).

Red mud has good plasticity when in the form of very fine aggregate. Firing it at about 12500C produces a strong dense aggregate with which concrete of suitable strength can be obtained. Concrete made of red mud has a 28 day strength of about 32 MPa compared to 27 MPa for concrete made of standard aggregate (Gupta, 1998). A Japanese firm has patented a process for the production of lightweight material from red mud. Red mud has also been used as filler along with ceramics, rubber and in developing good quality bricks 1998 (Cruze, 1986)

The limitations in the use of traditional materials such as sand, stone, gravel, cement, brick, block, tiles, paint, timber, steel and aluminium in the construction industry are that they are all manufactured from non-renewable sources and therefore their availability for sustained periods of time is uncertain. Timber is an important material in the building and construction sector; the annual consumption being ~ 30 million cubic metre. In India, annually about 4 million cubic metre of timber is used for housing purposes and there is an additional annual demand of about 1.5 million cubic metres (Gupta, 1998). However its use is gradually getting restricted due to increasing price and non-availability at site. Architects and builders are using less and less of wood in construction due to environmental consciousness, preferring environment - friendly products. Due to rapid rate of deforestation, the Central Public Works Department (CPWD), a premier national construction agency of Govt. of India, imposed ban on use of timber with effect from April 1993 and took up the matter with various research institutes of the Council of Scientific and Industrial Research (CSIR); a brain storming session was held with the Scientists of various laboratories of CSIR to identify available technologies and products from the research institutes which could be used as a wood substitute.

Composite materials developed using synthetic resin attracted increasing interest in the last few decades because of their improved properties with simple processing technologies. Advanced composites are used as primary load carrying structural elements as they possess light weight and high stiffness. The basic approach in developing a wood substitute material is to combine the properties of fibre reinforcement with an appropriate matrix and filler, e.g. red mud to impart the desired strength and rigidity in the resultant product.

Fibre reinforced composite materials invaded the building construction area in India and got themselves established in the mid 1980's in the form of natural fibre composites. The informal sector and secondary industries in India recycle 15-20 % of solid wastes, especially in developing various building components (Asokan et al., 2009; Asokan et al., 2007; Bhattacharyya et al., 2004). Detailed investigations in the area of natural fibre composites using red mud, were initiated in the Advanced Materials and Processes Research Institute (AMPRI) Bhopal; the objective was to develop a process to make panels, doors, tiles etc. using red mud and natural fibre reinforced composites in polymer matrix. The results are very encouraging and over the years the activities have grown significantly, both in the Institute as well as in other laboratories and industries. This article deals with the AMPRI, Bhopal expertise on large scale recycling, safe disposal and effective utilization of red mud in building materials.

Wood substitute products

AMPRI has successfully developed the laboratory scale process for manufacturing R-Wood Composite materials for various applications in building industry. The specifications and testing procedures of the newly developed products were prepared in close collaboration with the Central Public Works Department (CPWD) New Delhi, according to BIS specifications. Having performed extensive tests and field trials, they finally approved in March, 1994 the use and commercial production of red mud polymer (RMP) doors in building construction. As already mentioned, the basic approach in developing a substitute material is to combine the properties of fibre reinforcement of an appropriate matrix with filler e.g. red mud to impart certain properties in the resultant product in order to give the desired strength and rigidity.

Methodology

Raw Materials : Red mud, Polymer resin, jute fibre

Red mud from some of the Indian alumina plants was used for the development of the polymer composite. The properties of red mud depend mostly upon the mineralogy of bauxite and processing techniques. Indigenously available fabric of jute fibre (woven clothe) with fibre content of about 300 g/m2 quality was used after treating with fire retardant materials for making the composite. Fire retardant grade polyester resin was used along with accelerator and hardener for making composites. The resin is of the thermoset type and is presently used for making glass-reinforced plastic composites.

In the present study, red mud was used as filler in making natural fibre- polymer composite as wood substitute products. In this process, processed red mud was thoroughly mixed with polyester resin and catalyst. After homogenous mixing of filler in the polyester resin the accelerator 2% of the resin weight was added and then hardener equal to the accelerator is added as curing catalysts and then it is stirred mechanically. This matrix is then applied on the jute fabric. According to the requirement of the thickness, the number of layers of jute cloth can be placed. In general the weight fraction of various constituents are; red mud 50%;natural fibre 15%; and polymer 35%. It is then cured at 0.5 MPa pressure in ambient conditions. After it's post curing in an oven at 800 C for 24 hours, the laminates were cut to the desired size for different applications. Various products like full size door shutters, panels etc., can be fabricated and designed according to the requirement.

Equipment & machinery

The equipment needs are modest - hydraulic press, moulds & fixtures, mixer, grinder, pulveriser, curing oven for composite curing, oven for drying raw materials, cutting machine for sizing of required dimension of the composites.

Characterisation of wood substitute composites

Physical and mechanical characterisation of the wood substitute composites was carried out as per the method prescribed by the ASTM D792-91 (Density), ASTM D571-88 (Water absorption), ASTM D790-92 (Flexural strength), ASTM D638-91 (Tensile strength) standards.

Typical characteristics of red mud used in the present study are shown in Table- 1. The main constituents are oxides of iron (31%), aluminium (18%) and titanium (19%), silicon (8%), sodium (6%) and calcium (8%). The major mineral phases in red mud are gibbsite [Al(OH3)], haematite (Fe2O3), anatase (TiO2), calcite (CaCO3), boehmite (AlO.OH), goethite [? -FeO(OH)] and acmite/ calcian [(NaCa) FeSiO2 O6]. The particle size of red mud is less than 60 µm and the shape is spherical to angular. The major constituents of the jute fibre are cellulose (82.5%), lignin (11.3%), fat and wax (0.64%), nitrogenous substances (1.5%), moisture absorption is ~ 8 % and ash content ~ 1.2%. Further details on the characteristics of red red and jute fibre were reported and discussed elsewhere (Saxena et al., 2008; Saxena and Khazanchi, 1992; Saxena, et al., 1998).

Table 1. Characteristics of the bauxite red mud

Characteristic	Value
Particle size (µm)	< 60
Bulk Density (gm/cc)	2.6
pH	>12
Fe2O3 (%)	37
ZnO (%)	< 0.5
PbO (%)	< 0.2
SiO2 (%)	16
TiO2 (%)	18
CaO (%)	1
Al2O3 (%)	20
CuO (%)	<0.2
SO2 (%)	<1
LOI (%)	9 (950 °C)

The properties of the developed composites are shown in Table 2. The red mud polymer reinforced with jute fibre showed significantly improved mechanical strength and less water absorption. The density of the composites varied from 1.60 to 1.76 gm/cc as compared to 0.50 to 0.62 gm/cc of teak wood. Further details on the various mechanical properties of the red mud polymer composites were reported and discussed elsewhere (Saxena, et al., 2008; Saxena and Asokan, 2002; Saxena and Karade, 1998).

Table 1. Characteristics of the bauxite red mud

Sr. No.	Properties	Unit	Red mud polymer composite	Teak Wood
1	Density	gm/cm^3	1.72 - 1.76	0.62 - 0.64
2	Moisture content	%	0.20-0.38	10.0 - 12.0
3	Modulus of rupture	N/mm^2	85 - 95	11.6 - 14.0
4	Tensile strength	N/mm^2	22 - 24	4.00
5	Specific tensile strength	N/mm^2	16.57	20.31
6	Flexural strength	N/mm^2	103	12.8
7	Specific Flexural strength	N/mm^2	58.86	13
8	Compressive strength parallel to surface	N/mm^2	44 - 51	2.5 - 4.0
9	Water absorption (24 hours)	%	1.10 - 1.50	10 - 20

A comparison of the typical properties of the developed composites with those of commercially available alternative products and teak wood is shown in Figures 1- 4. The details of different alternative composites are RMP- Red mud polymer composites, RHB- Rice Husk Board; PB (EG)- Particle Board-Exterior grade; EPS- Extended Polystyrene; MDF- Medium Density Fibre Board. The compressive strength of the red mud polymer composite is 95 MPa. While that of teak wood is only 4 MPa. Various other properties such as resistance to chemical Is substitute composites than that of commercially available alternative products and teak wood. Fire ignitability behaviour of red mud polymer composites showed that these are not easily ignitable. The fire propagation index showed that red mud composites were better than the medium density fibre board (MDF), expanded polystyrene (EPS) and teak wood. Mechanical properties of the developed composites in terms of modulus of rupture showed a significant improvement over the conventional products. The tensile strength of the wood substitute composites shows a substantial increase as compared to the conventional materials.

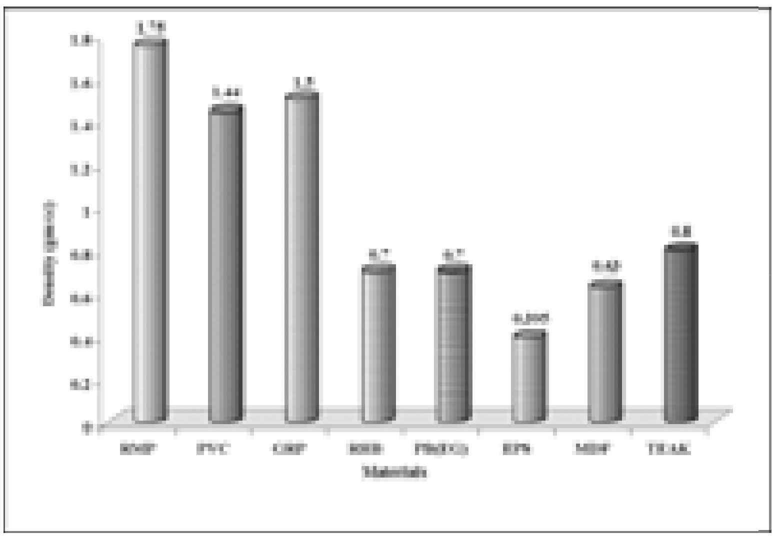


Fig. 1: Comparison of the density of Red Mud Polymer Composite over conventional materials

The salient features of the products are that they are stronger than wood, resistant to corrosion, termite, fungus, rot and rodents, fire retardant and self extingushing, cost effective, maintenance-free and durable. The technology is environmentally friendly and has potentials to recycle many more industrial wastes such as fly ash, marble waste, jarosite.waste. The industrial waste based polymer composite products are comparable to natural wood and could be used as a wood substitute for doors, windows, ceilings, flooring, partitions and furniture. In this aspects, one day programme on Institute Industry Meet (IIM 2010) on Wood Substitute Technology was organised on February 22, 2010 at AMPRI Bhopal to explore the possibility for technology transfer and commercialisation of Wood Substitutes developed by AMPRI Bhopal. The IIM has generated further confidence that the AMPRI wood substitute products would soon find the market potentials and open an avenue for the tomorrows construction industries and user agencies.

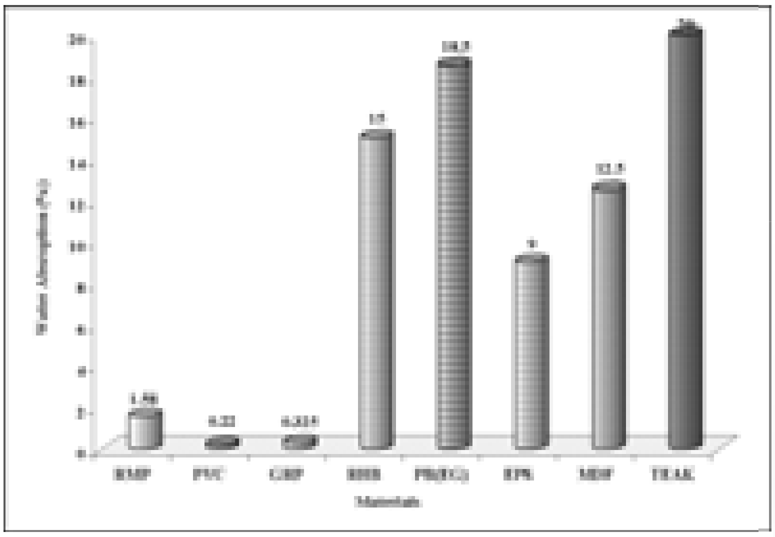


Fig. 2: Comparison of the water absorption of Red Mud Polymer Composite over conventional materials

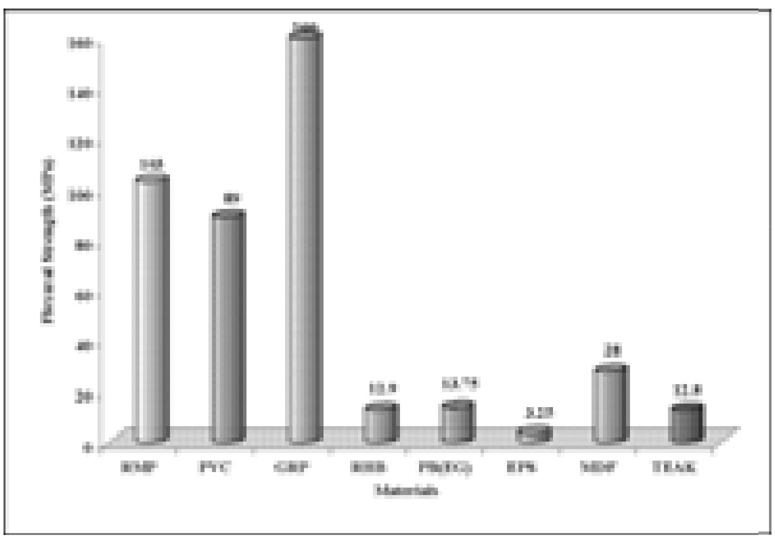


Fig. 3. Comparison of the tensile strength of Red Mud Polymer Composite over conventional materials

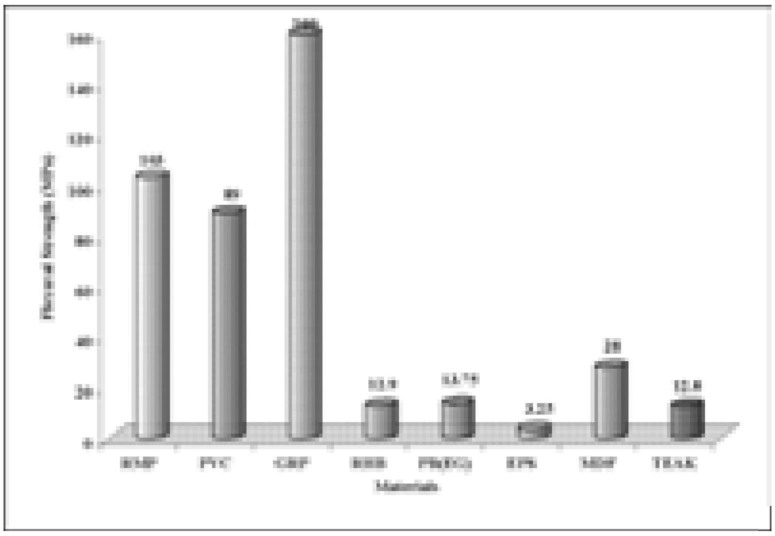


Fig. 4. Comparison of the flexural strength of Red Mud Polymer Composite over conventional materials

Table 3 Fire behavior of the red mud polymer composites vis-à-vis conventional materials/ wood

Sr. No.	Properties	MDF/EPS MDF panel	Teak Wood	Red mud polymer composite
1	Non-combustibility	Combustible	Combustible	Combustible
2	Ignitability	Not easily	Not easily	Not easily
3	Fire propagation index I	25	36	17
	II	7	10	4
4	Surface spread of flame, class	2	3 - 4	2
5	Maximum specific optical density (non-flaming), DM	736	330	470
5	Maximum specific optical density (flaming), DM	649	265	532

MDF - Medium density fibre board; EPS - Expanded polystyrene.

The fire behaviour of the red mud polymer composites over conventional materials and wood is shown in Table 3. Results revealed that the fire ignitability behaviour of red mud polymer composites is not easily ignitable. The fire propagation index shows that red mud composites are better in comparison with medium density fibre board (MDF), expanded polystyrene (EPS) and wood. The improved fibre behaviour of the developed red mud composites is due to the combined affect of fire retardant additives used in jute fabric treatment and inert properties .of red mud.

Potential Applications of Red mud polymer composites

Potential applications of the the composites have been demonstrated in the Institute by the fabrication of doors, windows, ventilators, partitions, ceiling, flooring, panels, furniture, interior decoration which can be used in the fabrication of instant houses and for electrical applications (Saxena et al., 2009; Saxena, et al., 2008). Some examples are shown in Figure 5 and 6.

Fig. 5: Red Mud Polymer Composite panels used in Partitions, Floor tiles and Instant house

Red Mud Polymer Composite Sofa   Red mud polymer composite Doors

Fig. 6: Red Mud Polymer Composites used in Furniture and Doors

Pilot plant facility for manufacturing wood substitute products from industrial wastes

AMPRI Bhopal has developed a technology for making composites (wood substitute) using industrial wastes, natural fibre and polymer. For upscaling and customization of these products, a Technology Enabling Centre (TEC) is setup at AMPRI. The Hydraulic press has been established with the facility of 10 platens, heating oil arrangements system mainly for simultaneous casting of several composites panels. The TEC facility would serve as an enabling centre for budding entrepreneurs for manufacturing wood substitute products. This center will also facilitate the development / commercialization of composites materials and products from different industrial wastes like red mud / fly ash / marble waste and natural fibre to be used in automobiles, railways, light weight composites, acoustic, insulating materials, asbestos substitute, boat and instant houses for disaster victims. The Enabling Centre has attracted a lot of attention and a large number of distinguished people. The photograph on the left shows the scientists involved in the project interacting with Dr. R. A. Mashelkar, the former Director General, CSIR, India on Wood substitute products at the TEC on March 17, 2006.

Scope for further R&D on Red mud polymer composites

Further improvement / development on red mud polymer composites can be made for the use of these materials in automobiles, railways, acoustics and noise barrier materials, light weight composites, insulating materials, boat and instant houses for disaster victims. At AMPRI Bhopal we have expertise and facilities and offers services for safe and effective recycling and utilisation of different industrial wastes like red mud, fly ash etc., to protect environment and for the socio, techno economic development.

Conclusions

As a consequence of the National Forest Policy, 1992, after the ban of "Wood" by Central Public Work Department (Government of India), a new era in producing wood substitute materials to the construction industry had begun. AMPRI, Bhopal has developed a zero wood door shutter by conditioning red mud and combining it with jute fabric as reinforcement in polymer matrix. This versatile composite possess properties comparable to those of natural wood and thus could be used as wood substitute for doors, windows ceiling, flooring, partition and furniture.

The red mud polymer composites showed better physical, chemical, mechanical, weathering and fire resistance properties than conventional materials including wood and wood substitute. Their durability and strength make them a more promising substitute to timber.

- The Wood substitute products developed from redmud are stronger than wood highly durable and cost effective.
- Technology Enabling Centre for up-scaling of laboratory processes on wood substitute products for commercialisation.
- Constructed 16 proto type houses at AMPRI Bhopal and demonstrated the use of Red mud polymer composite door as an alternative to the conventional door for the housing industry.
- This technological options leads to conservation of major natural resources like forest reserve followed by protecting the environment.

This composite is an eco friendly material as it helps the environment in two ways – firstly, by helping to prevent further deforestation and secondly, by effectively using waste product and in the process reducing pollution hazards.

The Building Materials Development Group at AMPRI Bhopal has expertise and facilities for large scale recycling bauxite red mud in building materials. The facilities have been in use for the development of technologies of direct relevance to the construction industries and waste producers.

Acknowledgements

The authors are thankful to Dr. Anil K. Gupta, Director, AMPRI Bhopal for providing guidance, encouragement and facilities. Most of the research work has been carried out with the financial support of BMTPC, MOEF, NALCO, TIFAC, DST and CSIR is thankfully acknowledged. Authors are also thankful to Dr. R.K. Morchhale, Mr. P.K. Srivastava, Mr. Dharmaraj Yadav and all other staff members of Building Materials Development Group, AMPRI Bhopal for their valued contribution for this work.

References :

1. Asokan,P., M. Saxena, Asolekar, SR., and Anusha Sharma. Cross sector waste recycling opportunities. International Seminar "Waste to Wealth" organized by BMTPC, New Delhi. pp 278-292, 2009.

2. Asokan, P., Saxena, M., and Asolekar, S. R., Solid wastes generation in India and their recycling potentials for developing building materials. Building and Environment, 42, 2311-2320, 2007.

3. Bhattacharyya, J.K., Shekdar, A.V., and Gaikwad, S.A. Recyclability of some Major Industrial Solid wastes. Jr. Indian Association for Environmental Management 2004; 31:71-75.

4. Gupta, 1998. Building Materials in India: 50 Years, A Commemorative Volume. Building materials Technology Promotion Council, govt. India, New Delhi, India.

5. Cruze, C.A., Ramosa, Clegy, D.W., and Elsevier, A.A., 1986. Natural Fibers Reinforced Thermoplastics in Mechanical properties of Thermoplastics, Applied Science, 65- 81.

6. Li, L. Y. A study of iron mineral transformation to reduce red mud tailings. Waste Management 2001; 21:525-534.

7. Li, L. and Rutherford, G. K. Effect of bauxite properties on the settling of red mud. Int. J. Mineral Processing 1996; 48:169-82.

8. Li, L. Y. Properties of red mud tailings produced under varying Bayer process conditions. J. Environ. Engg. 1998; 124(3): 254-264.

9. Lopez E., Soto B., Arias M., Nunez A., Rubinos D. and Barral M.T. Adsorbent properties of red mud and its use for waste water treatment. Wat. Res. 1998; 32(4): 1314-1322.

10. Sglavo V.M., Stefano, M., Alexia, C.,Antonio, S., Giovanni, C. and Giorgio, C. Bauxite 'red mud' in the ceramic industry. Part 2: production of clay-based ceramics. Journal of the European Ceramic Society 2000; 20: 245-252.

11. Saxena, M., Morchhale, RK., Waghmare, SS., Goel, MD., and Sakalle, P. Fly ash polymer composite-an innovative building material. International Seminar "Waste to Wealth" organized by BMTPC, New Delhi. pp 18-24, 2009.

12. Saxena, M. and Mishra, C.R. Processing of Red Mud for Development of Wood Substitutes. Book on Recycling, waste treatment and clean technology, TMS Mineral, Metals and Materials, Spain, 2004, (1): p 371-380.

13. Saxena, M., Morchhale, R.K., Asokan, P. and Prasad, P.K., Plant fibre-industrial wastes reinforced polymer composites as a potential wood substitute material. Composite Materials, 42(4), 367-384, 2008.

14. Saxena, M., Asokan, P., Ruhi, B., and Verma, A. Incorporation of industrial wastes along with natural fiber for the development of innovative building materials. In: Dr. B. Mishra, Dr. C. Ludwig, and Dr. S. Das (Eds.). Proceeding of the Global Symposium on Recycling, Waste Treatment and Clean Technology, TMS, Cancun, Mexico, pp 451-462, 2008.
15. Saxena, M., and Asokan, P. Timber Substitute Products from Industrial Solid Wastes. In: 18th National Convention of Environmental Engineers. Proc. National Seminar on Solid Waste Management. IEI, M.P.State centre, Bhopal, India, 2002. pp 192-200

16. Saxena Mohini and A.C. Khazanchi, 1992. Fibre reinforced Redmud/flyash polymer door panels/shutters as wood substitute" Proc. Nat. Semr. on New Materials in Building Industry,Organised by CPWD & NRDC, New Delhi, II: 21-34.

17. Saxena Mohini, and Karade, S.R., 1998. Mechanical Properties of Red Mud Polymer Composite", Proc. International Conference on Aluminium (INCAL'98), New Delhi, 2: 461-466.

18. Saxena, M., Mathew, M., Gupta, T.N., 1998. Utilisation of industrial wastes in the production of wood substitutes", Proc. of National seminar on new materials and technology in building indusrty, organised by CPWD, HUDCO and BMTPC, New Delhi, II:92 – 99.

19. Yalcm, N. and Sevinc, V. Utilisation of Bauxite waste in ceramic glazes. Ceramics International 2000; 26: 485-493.

Technical Paper 2

ANODE PLANTS FOR TOMORROW’S SMELTERS

Key elements for the production of quality anodes

By Werner K. Fischer, President of R&D Carbon Ltd., Sierre, Switzerland
Felix Keller, Senior Consultant of R&D Carbon Ltd. Brielle, The Netherlands
Dr. Ulrich Mannweiler, Managing Director of Mannweiler Consulting, Zürich Switzerland

Quality Anodes, a Prerequisite for Optimum Smelter Operation

Why should smelter management care about anode quality? – From all input materials required to produce primary aluminum, anodes have the highest variation in quality relevant properties. Substandard anodes have a significant impact on metal production cost and “Green House Gas” emission.

Modern smelters have annual capacities in the range of 750’000 - 800’000 tons which typically are designed to double the capacity after a certain time (typical example is the EMAL smelter in Abu Dhabi). Such smelters require anode plants with an annual output of 500‘000 tons to be doubled if the smelter is expanded to double size. Many years of steady development and design work allowed smelters to increase the amperage and number of cells and adapt rectifiers with higher voltages accordingly. Unfortunately similar developments and design for anode plants is practically not existing leading to the fact that new anode plants just are doubling small size plants with low throughputs (35 tph) and limited availabilities. Therefore, a technology for an efficient production of high quality anodes, with lowest possible production cost, dealing with inferior raw material qualities, lowest possible environmental emissions and high standard regarding workers safety and hygiene is urgently needed. Such technology must be able to handle daily large volumes of raw materials, to produce move and store big quantities of green and baked anodes and to provide in an efficient way for workers and the outside world an environment that meets the most stringent regulations. The anode plant technology supplier also has to take into account that smelters always try to increase their output by further increasing amperage and often are asking for higher and longer anodes.

This paper describes a technology approach regarding design and operation of large anode plants adapted to the needs of big smelters. This technology has been developed by R&D Carbon Ltd. in Sierre/Switzerland (RDC) in cooperation with major suppliers of green paste plants, anode bake furnaces and specific equipment suppliers. It takes the following process, operational and maintenance aspects into consideration:

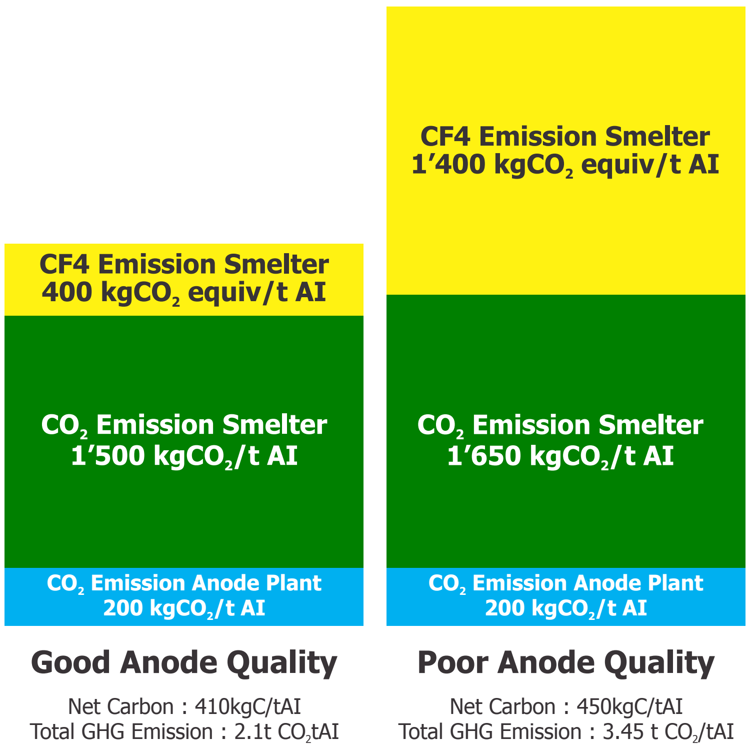
- Raw materials logistics
- Paste plant design
- Bake furnace design
- Equipment and refractory maintenance
- Emission control
- Consumption figures and cost aspects

The Cost and Environmental Impact of Substandard Anodes

Poor anodes will not only increase metal production cost by 60 USD per ton of aluminum but will also increase "Green House Gas" (GHG) emission by up to 60 %. The main portion of GHG emission is due to increased dust generation in the pots that leads to higher frequencies of anode effects.

For a smelter with an aluminum capacity of 800'000 tons per year the "GHG" emission for utilization of substandard anodes increases by 1.16 million tons of CO2 equivalent which represents a value of 30 million USD per year in CO2 emission certificates.

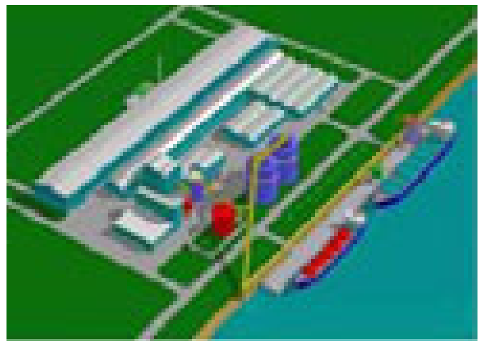
The total losses by using substandard anodes due to increased metal production cost and excess CO2 emission is up to 100 USD per ton of aluminum.

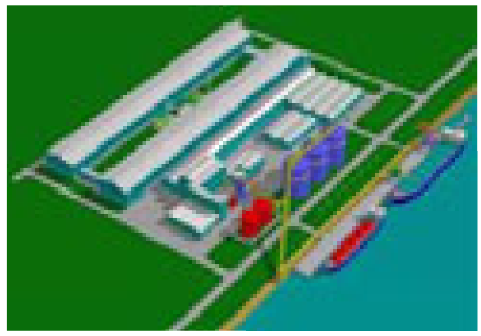


General Anode Plant Design

New smelters need sufficient storage capacities at the harbor for raw materials (petroleum coke, pitch), well designed green paste and recycled material processing plants as well as baking furnaces. RDC proposes the following concept:

Smelter Capacity	tpa	800'000	1'600'000
Anode Capacity	tpa	500'000	1'000'000
Paste Plant Capacity Throughput Shifts/week Weeks/year Availability	# tpa tph # 50 %	1 600'000 80 21 50 86	2 2x600'000 2 x 80 21 50 86
Recycled processing Throughput Shifts/week	tpa tph #	160'000 50 8	320'000 50 16
Baking Furnace Furnaces Fires Tpa per fire Fire cycle Waste gas cleaning	tpa # # t hrs Nm3/h	510'000 1 8 65'000 28 240'000	2x510'000 2 2 x 8 65'000 28 480'000
Harbor Facility Coke silos Pitch tanks	 #/t #/t	 2 x 30'000 1 x 12'000	 3 x 30'000 2 x 12'000





Raw Materials Logistics

Large anode plants have two or even more sources for petroleum coke. Today 25'000 ton vessels transport coke, and 10'000 ton tankers transport liquid pitch.

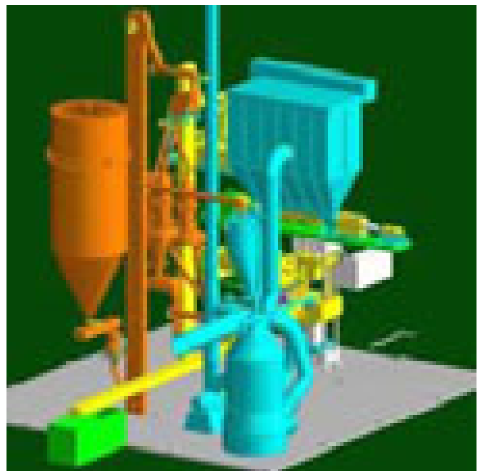
Coke is discharged by 1'000 tph vacuum unloaders in dedicated silos of 30'000 tons each. A facility allows blending of cokes with different qualities. Liquid pitch is discharged into insulated tanks. Pitch of different brands are blended in the tank farm prior to be pumped to the paste plant. Cleaned, stripped, uncrushed anode butts from the rodding shop are conveyed to the recycled material processing plant. As poorly cleaned anode butts have a significant negative impact on anode quality, great care has to be given to anode butts cleaning and processing. Baked scrap is processed together with the anode butts.

Paste Plant Design

"Simplification is the ultimate sophistication!" – (Leonardo da Vinci)

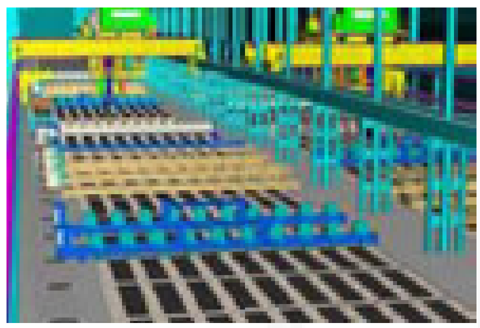
Green anode quality and consistency correlates strongly with the "Mean Time Between Failures". When the paste plant is in stable operation, green anode quality will remain stable too. Every shutdown will result in high anode property variations. The best way to reduce the number of shutdowns is to build the smallest possible number of equipment having the highest possible throughput. The simpler the design, the more efficient the plant will be. Therefore, RDC designed a paste plant technology with a capacity of 600'000 tons per year with a throughput of 80 tons per hour and a plant availability of 86 %. Five process areas are part of the paste plant:

- Storage of petroleum coke in dedicated silos and liquid pitch in tanks.
- Process plant for anode butts and scrap generated during anode production. After crushing, screening and storage a combined fraction (< 16 mm) of 85 % of anode butts, 10 % of green scrap and 5% baked scrap is transferred as "recycled fraction" to the paste plant.



- Petroleum coke is screened and added to two scales:
  - Medium fraction: 8 – 2 mm
  - Fines fraction: 2 – 0 mm
  - Overflow > 8 mm from medium fraction and fines fraction (coke only) are fed to a vertical mill with an integrated classifier. The continuously produced dust with a fineness of 4'000 Blaine is stored in the ball mill dust bin.
- One cascade for dry aggregate preheating, paste mixing, paste cooling, forming sixty to eighty anodes per hour. After cooling they are transferred to the green anode storage, where they remain at least one day prior to be sent to the bake furnace.
- Tar containing gases from pitch feeding, mixing, cooling and forming are burned in a "Regenerative Thermal Oxidation" Unit (RTO). Carbon dust is captured at the source and added to the ball mill circuit.

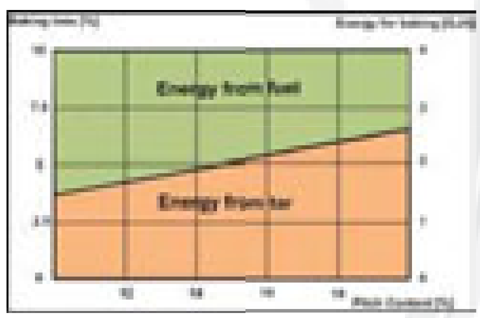
Bake Furnace Design



Open top ring type furnaces are considered "state of the art". Five main elements have to be taken into consideration:

- Conceptional and refractory design
- Energy consumption
- Mechanical and refractory maintenance
- Anode and packing material handling
- Waste gas treatment

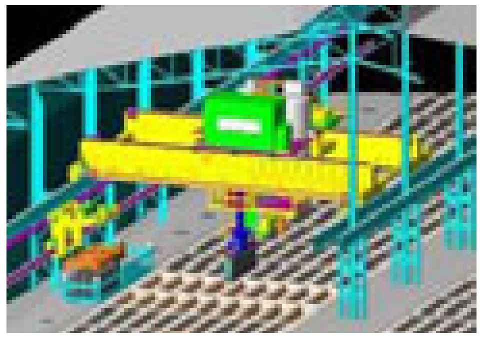
A bake furnace with a net capacity of 500'000 tons has 8 fires in one building. To produce 65'000 tons anodes per fire and year a section load of at least 200 tons with a fire cycle of 28 hours is required. The refractory design is based on "Computational Fluid Dynamics" (CFD). Refractory material is of proven quality and best brick layer practices have to be applied.



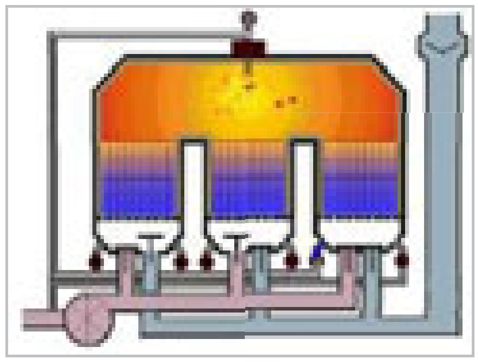
The energy consumption of such a furnace depends on refractory design, bake furnace firing and control system and mainly on the pitch content of the anodes. In a normal bake furnace operation more than 98 % of the pitch volatiles are burned. Volatiles released from pitch during baking contributes about to 50 % of the baking energy input. If the pitch content varies 2 % the natural gas consumption varies 10 %.

For energy efficiency and emission minimization, total combustion of all tar fumes is mandatory. RDC invested a lot in Research & Development regarding bake furnace design, process control and total combustion of tar and fuel. As a result of these activities RDC can predict furnace behavior regarding anode quality as well as oxygen availability and thus predicting combustion efficiency. For the first time it is possible to design furnaces scientifically and not by extrapolating and copying existing furnace designs. Also hardware has been re-designed and the process control system is upgraded to implement crane driver operation and maintenance instructions.

Overhead cranes, anode conveying equipment, process control system and waste gas treatment are designed for highest reliability. Together with a smart anode logistics system conditions are set for a regular and undisturbed furnace operation including preventive or curative maintenance.



Emission Control



In the paste plant and bake furnace, Polycyclic Aromatic Hydrocarbons (PAH-16) are the main concern regarding impact of anode plants on the environment. As PAH-16 is considered to be carcinogenic, these condensed and volatilized components are captured and destroyed completely in a "Regenerative Thermal Oxidation" unit (RTO). The RTO system is an afterburner combined with two heat exchangers. By switching the direction of the gas flow in 20 second intervals 95 % of the combustion heat can be recuperated. RTO's in paste plants and bake furnace are in successful operation for several years already.

Consumption Figures and Cost Aspects

To give a "feeling" for quantities and cost involved in anode production, the key parameters are:

		Annual Consumption	
	Specific Consumption	500'000 tpa	1'000'000 tpa
Raw Material - Petroleum coke - Coal tar pitch - Recycled material	 630 kg /t anode 160 kg/t anode 300 kg/t anode	 315'000 t 80'000 t 160'000 t	 630'000 t 160'000 t 320'000 t
Energy - El. Energy - Natural gas	 0.1 MWh/t anode 100 Nm3/t anode	 50'000 MWh 50 MM Nm3	 100'000 MWh 100 MM Nm3
Labor		150 people	250 people
Investment cost	900/700 USD/t	450 MM USD	700 MM USD

For further information contact R&D Carbon Ltd. www.rd-carbon.com or one of the authors.
Werner Fischer fischer@rd-carbon.com , Felix Keller f.keller@inter.nl.net ,
Dr, Ulrich Mannweiler ulrich@mannweiler.ch

Report on Meetings of Icsoba Executive Secretary

During May-June 2010, Dr. Ashok Nandi, Executive Secretary of ICSOBA, had series of meetings in Europe and Dubai to discuss the present status and future of the International committee. A brief summary of these meetings is given below.

1. **Meeting with President ICSOBA – On 23rd May, a meeting was held in Brussels with Roelof Den Hond and Marja Brouwer to discuss the following:**
   - Legal status of ICSOBA and Mineral Information & Development Centre (MIDC) – It is informed that MIDC is a registered body in India according to company act and ICSOBA activities are undertaken by this company. There are 3 employees and 2 consultants working for this company at present and main activities in India are organisation of conferences, publication of Newsletters, periodic updating of ICSOBA web site, checking abstracts / technical papers and coordinating with Presidency, council members and corporate and individual members of ICSOBA.
   - It is decided to re-constitute the ICSOBA Presidency and council members by introducing dynamic individuals of bauxite-alumina and aluminium industry / R&D centres and making this a world class International organisation. In this connection action has already been initiated to bring active people and it is expected that before the China ICSOBA symposium, the new Presidency and council members will start functioning.
   - Discussed the structure of presentations for China symposium – number and types of key note addresses, round robin sessions on Chinese aluminium industry, ALCOR, parallel sessions on bauxite, alumina and aluminium, poster presentations, exhibition etc. Executive secretary will prepare draft program of China ICSOBA symposium and circulate among Presidency / council members before finalisation and uploading on the website.
   - It is decided to request each paper presenter to send about 10 power point slides in advance; these will be translated into Chinese by CHALCO R&D and there would be simultaneous beaming of the slides in two languages during the symposium. The services of English-Chinese translators will be used only during the inaugural function, selected key note addresses and question/answer sessions
   - In order to sustain the activities of ICSOBA, it is necessary to generate finances by membership (corporate and individuals) campaigns, invite companies to sponsor, advertise, participate in exhibition and send delegates for the China symposium.
   - Active members of ICSOBA are selected to review the papers in the field of bauxite, alumina and aluminium for the forthcoming China symposium. A list will be circulated by Executive Secretary and ICSOBA secretariat will send China symposium papers to individual for comments before incorporating them in the TRAVAUX volume.
   - It is planned that Marja would take an anchor role to conduct ICSOBA symposium in China in consultation with Convenor, Ashok Nandi.

2. Meetings in Budapest

Dr. George Komollossy, a past president of ICSOBA, received Ashok Nandi at Budapest airport and had discussion on plans of ICSOBA and provided contacts of Hungarian and other aluminium companies. Next day a meeting was organised with Dr. George Banvolgyi, a leading alumina technologist and council member of ICSOBA to plan special red mud session during the ICSOBA China symposium. Dr. Banvolgyi facilitated ICSOBA in getting good papers on Vietnam bauxite, red mud and alumina production.

Dr. Janos Horvath, a leading aluminium smelting expert of Hungary proposed to form the Hungarian chapter of ICSOBA and periodically organise technical interactive sessions on alumina and aluminium. Dr. Horvath organised a meeting with Mr. Kovacsics Arpad, Manager, Magyar Aluminium, the only working alumina refinery of Hungary. Ashok Nandi also met Prof. Dr. Gyorgy Bardossy, Member of the Hungarian Academy of Science to discuss the updating of his book on Lateritic Bauxite by inviting leading bauxite geologists of each country and editing this under the technical activities of ICSOBA.

Meeting with Prof. Dr. Gyorgy Bardossy in Budapest

3. Meeting in Dubai

Mr. Ashish Jog, Project Manager (Alumina), DUBAL and also council member of ICSOBA provided several new ideas to make ICSOBA website and conferences interactive and useful. Some of the suggestions are as follows:

- Conduct talk show during conference, for example it is proposed to have talk show on capital and operating cost of alumina refinery in western world and China, India and Brazil.
- Provide opportunity to technology suppliers, process consultants, engineering and construction companies, equipment manufacturers and research centres to advertise on ICSOBA website.
- Organise and facilitate meetings between companies, organisations, plants and equipment suppliers during ICSOBA symposium and congresses.
- Maintain and update list of consultants, equipment manufacturers and technology suppliers of bauxite, alumina and aluminium industry under ICSOBA website

4. Meeting with VAMI, St. Petersburg

ICSOBA Meeting in VAMI, St. Petersburg

- VAMI proposed to hold the Golden Jubilee (50 years) celebrations of ICSOBA in Russia along with Light Metals of Siberia in Krasnoyarsk during September, 2013. The emphasis will be on alternate sources / alternate processes of alumina production and aluminium smelting technology and RUSAL will provide the basic support. A visit to RUSAL Nepheline Syenite plant and aluminium smelter would be organised as post conference technical activities.

- VAMI proposed to conduct 2012 ICSOBA congress in Brazil during early 2012 so there is enough gap between the two events.

- VAMI proposed to induct new council member from leading companies like ALCOA, Rio Tinto, Vale and active R&D people of NALCO, Vedanta, Hindalco, Brazilian, Gulf companies, etc

- It is proposed to start ICSOBA Hungarian, Russian and Chinese chapters.

- Publication of monographs by ICSOBA on bauxite, alumina and aluminium fields– VAMI offered to collect reports /data / information on latest alumina, smelter technology – Soderberg / pre-baked, green anodes, etc. and send these to ICSOBA secretariat. All the material will be organised, edited and formatted in India and published as monograph under ICSOBA banner and benefits would be shared.

STATUS OF ABSTRACTS as of 24th June 2010

Sr. No.	Title of the paper	Authors
	China - Bauxite, Alumina and Aluminium Industry	
1	Overview of bauxite, alumina and aluminium Industry of China	Dr. Li Wangxing, President of R&D Centre of CHALCO WX_Li@chalco.com.cn
2	"New meaning to the word 'Challenge' for an Alumina Refinery Developer"	Dr. S. Chandrashekar Dubai Aluminium Company Limited "DUBAL") chandrashekar@dubal.ae
	Special ALCOR Session on "THE FUTURE OF ALUMINA PRODUCTION"	
3	Bauxite upgrading practices in Brazil	Arthur Pinto Chaves, Professor, Mineral Processing Department of Mining and Petroleum Engineering, Escola Politécnica, University of Sao Paulo, Brazil.
4	Cross-country bauxite slurry transportation	Yueguang Che and Jay Chapman, Pipeline Systems Incorporated, Concord, California, USA
5	Bauxite, red mud and tailings dewatering by Hi-Bar filtration	Dr.-Ing. Reinhard Bott, Dr.-Ing. Thomas Langeloh, Dipl.-Ing. Jürgen Hahn Bokela, Karlsruhe, Germany.
6	Research on local flow velocities and solids concentration fluctuation in suspension vessels, using different impeller systems.	Detlef Klatt, Managing Director, STC-Engineering, Waldenburg, Germany.
7	Barriquand interstage precipitation coolers - last developments for trouble free operations.	Daniel Martin, Export Manager. Barriquand Technologies Thermiques.
8	Engineering, procurement, construction and project financing	Speakers to Be Announced.
9	CHALIECO's alumina refining technology	Speaker: to be announced
	Bauxite Geology & Mining	
10	Development of a Greenfield Bauxite mining and Alumina Project in Cameroon"	Ashish Jog and Eric Lavalou ashish_jog@dubal.ae elavalou@dubal.ae Dubai Aluminium Company Limited ("DUBAL")
11	Bauxite Resource and Reserve Modeling	Dominique Butty dlbutty@bluewin.ch
12	Review on global bauxites: Resources, origin and types	George Komolossy geokom@mail.datanet.hu
13	The joint use of imagery and topographic data for inferring bauxite deposits in a Karst landscape	Parris Lyew-Ayee Jr1 & Parris A. Lyew-Ayee2 plyewayee@jbi.org.jm
14	CHALIECO's bauxite mining technology	Speaker: To be announced
	World Bauxite Regions	
15	Status of bauxite resources and mining in Guinea and future prospects	Vladimir Mamedov, geoprospects@mail.ru General Coordinator, Geoprospects, Guinea Bachir Diallo, CBG Director

16	Vietnam's Bauxite-Alumina-Aluminium development	Trân Minh Huân huanhtqt@vnn.vn
17	Characteristic of Jajarm monohydrate bauxites and their effects for its beneficiation, North west of Northern Khurassan, Iran	Mollai, Habib hamollai@yahoo.com
18	Darling Range – The case for high grade Bauxite suitable for direct shipping operations (DSO)	Peter Senini, BSc. (Hons). Member AIG/GSA. Bauxite Resources Ltd Manager Exploration, Geological and Technical Services PSenini@bauxiteresources.com.au
19	Indian bauxite from two Geo- environments: A comparative study	B.K. Mohapatra, bk_mohapatra@yahoo.com C.R. Mishra crmishra49@yahoo.in , P.K. Mallick and A.K. Paul
20	Optimization research of accumulated bauxite ore blending in yard analyzed by Xpress-MP	Yang Shan1, Chen Jianhong1, Yang Haiyang1,2. 1. Central South University, 2. Guangxi Branch of Chalco
	Bauxite Beneficiaiton	
21	Beneficiation of Bauxite-Upgrading of recoverable Al203	Dr. Stephan Buntenbach, SBuntenbach@akwauv.com Dr. Wolfgang Rubarth WRubarth@akwauv.com Fred Donhauser FDonhauser@akwauv.com AKW Apparate+Verfahren GmbH,Germany
22	Beneficiation options for Darling Range bauxite	Mr Ben Ziegelaar, bziegelaar@bauxiteresources.com.au BSc. F Aus IMM. RACI(CC), Bauxite Resources Ltd, Manager Technical Marketing and Quality Control
23	New design and operation of the Paragominas beneficiation circuit	Fábio Araujo Mendes fabio.mendes@vale.com
24	Research status on processing low A/S bauxite by Flotation	Chen Xiangqing. zyy_cxq@rilm.com.cn Ma Junwei. Zhengzhou Research Institute
25	Effects of additives on reduction-magnetic separation of Guangxi high-iron Gibbsite-type bauxite	Zhu Zhongping. Central South University
26	Some observations on bioleaching of Indian bauxite	Sharma Deboja *, Dash RR ** dean_giet@yahoo.co.in Gandhi Institute of Engineering & Technology, Gunupur, Rayagada, Orissa & Satpathy BK*** bsatpathy@nalcoindia.co.in National Aluminium Company Ltd. Nalco Bhavan, Bhubaneswar Orissa, India
27	Characterization, Microscopy and Beneficiation Studies of Bauxite Ore	P K Pandey*, M M Kulkarni, Pranjali Joshi and Chetan Shah Knowledge and Innovation Centre, Ashapura Minechem Ltd, Jeevan Udyog Building, Fort, Mumbai – 400001, INDIA *Corresponding Author: prashantp@ashapura.com

Status of Abstracts as of 24th June 2010		
28	Sustainable Bauxite Mining Survey	Christian Wagner gicks@gmx.ch wagner@world-aluminium.org
29	Harmonizing of bauxite mining and alumina refining operations with neighboring communities for sustainable development in Jamaica.	Parris A. Lyew-Ayee,Snr. plyewayee@jbi.org.jm & Dianne Gordon Jamaica Bauxite Institute
30	Socio-economic and labor productivity impact of the bauxite industry on the Surinamese economy	Aditpersad Moensi Aditpersad.Moensi@alcoa.com
Alumina Production		
31	Options for processing of high silica bauxites	Peter Smith Peter.Smith@csiro.au and Bingan Xu – Parker CRC (CSIRO Light Metals Flagship)
32	Aurukun Bauxite - A high reactive silica, monohydrate bauxite and advantages and disadvantages for process design and operation.	Yuehua Jiang yh_jiang@chalco.com.cn, yjiang@chalcoaustralia.com.au Technical Manager CHALCO (Aluminium Corporation of China Ltd), Australia Pty Ltd and Juerg Theodor Wehrli JWehrli@hatch.com.au Technical Director – Bauxite & Alumina HATCH Associates Ltd
33	Utilisation of low grade Bauxite for industrial production of alumina	A. Suss, suss0@nwgsm.ru A. Panov, I. Lukyanov JSC RUSAL VAMI, St. Petersburg, Russia
34	Sustainable/energy efficient processing of low grade bauxite ores: trends, opportunities and challenges	K. Sarveswara Rao, srvswr.rao@gmail.com Hydro- & Electro-Metallurgy Department Institute of Minerals & Materials Technology (CSIR)
35	New flocculants for improved processing of high silica bauxites	Matthew Davis Matthew.Davis@cytec.com and Qi Dai Qi.Dai@cytec.com , Cytec industries inc., 1937 west main street, Stamford, CT 06904, USA
ALUMINA- I		
36	Upflow design versus downflow design for digestion flash train	Tran QK Hatch Associates Ltd, Perth, Western Australia ktran@hatch.com.au
36	Influence of Impurity on Desilication of Diluted Bayer Liquor	Yang Qiaofang, Zhao Qingjie, Qi Lijuan. Zhengzhou Research Institute
36	Impact of different additions on the green liquor desilication.	A. Suss , I. Paromova, N. Kuznetzova, A.Panov, A. Damaskin, I. Lukyanov, JSC RUSAL VAMI, St. Petersburg, Russia Andrey.Panov@rusal.com

39	Decreasing and restraining methods of scaling process in preheating surface of diasporic bauxite slurry	Yin zhonglin., yzlin123@263.net Professor, Director of Alumina Research Department Zhengzhou Research Institute
40	Study of the Flotation Desilication Technology for Boehmite-Gibbsite Bauxite	Ma Junwei, Chen Xiangqing, Liu Xi, Chen Xinghua, Chen Zhanhua. Zhengzhou Research Institute
41	Inhibiting vishnevite scale formation in Chinese refineries with the second generation of MAX HT® technology	Qi Dai, Qi.Dai@cytec.com John Carr, Frank Kula Company: Cytec Industries Inc.
42	Design and operation of disc filters in alumina refineries	Dr.-ing. Reinhard Bott rbott@bokela.com Dr.-ing. Thomas langeloh Bokela gmbh, 76131 karlsruhe, germany
Alumina - II		
43	Cost competitiveness of Indian alumina refineries	H. Mahadevan mahadevan@anrak.in
44	Color quality improvement of hydrate at ETI	Ahmet yiğit1, ahmet.yigit@etialuminyum.com bekir çelikel1, bekir.celikel@etialuminyum.com serkan ertuğrul1, gökhan kürşat demir1 ybayraktar@etialuminyum.com 1eti alüminyum aş 2hatch 3hatch associates consultans inc
45	How to improve security filtration of pregnant liquor	Dr.-ing. Reinhard Bott rbott@bokela.com Dr.-ing. Thomas langeloh Dipl.-ing. Jürgen hahn Bokela gmbh, 76131 karlsruhe, Germany
46	Some insights into gaining value from process models in alumina refining	D. Seth Equinox Software & Services Pvt Ltd, Pune, India and S.C. Sharma Mesh Process Simulation Pty Ltd, Perth, Australia SharadChandraSharma@gmail.com
47	Nanotechnology Enabled Green Nose to Smell Mercury from Alumina Refineries	Suresh Bhargava suresh.bhargava@rmit.edu.au
48	Gibbsite crystallization during precipitation process	P K Pandey*, Pranjali Joshi and Chetan Shah Innovation & Knowledge Centre, Ashapura Minechem Limited, prashantp@ashapura.com
49	Yield improvement by optimisation and online control of a/c of aluminate liquor in digestion unit while feeding miscellaneous sources of bauxite	Bimalananda Senapati, C. Satish Kumar and Tonmoy Banerjee CSatish.Kumar@vedanta.co.in Vedanta Aluminum Ltd., Lanjigarh, Kalahandi Dist., Orissa-766 027, India

Alumina - II		
50	Hydrogen production in Bayer process digestion	Allan Costine, Mark Schibeci, Joanne Loh, Greg Power and Robbie Mcdonald. CSIRO Light Metals National Research Flagship (CSIRO Process Science and Engineering)/ Parker Centre CRC for Hydrometallurgy, 7 Conlon Street, Waterford WA 6152, Australia
51	Influence of agglomeration parameters on the agglomeration process of seeded precipitation	Liu Zhanwei1,2. Li Wangxing 1,2. Chen Wenmi . 1. Central South University, 2 .Zhengzhou Research Institute
52	Adsorption of polyethylene glycol (PEG) and polyacrylate sodium (AY)on the surface of dicalcium silicate and sodium aluminate solution	Yu Haiyan Ding Tingting. Northeastern University
53	Recent advances in bauxite residue settling and washing in the Bayer process of alumina Production	Nivedita Panda, Hindustan Dorr Oliver Ltd., Dorr Oliver House, Chakala, Andheri (East), Mumbai 400 052 (India) nivedita@hdo.in Harish Chandwani, Anrak Aluminium Ltd. Plot No. 705, Banjara Hills Road No.3, Hyderabad 500016(India) hchandwani@anrakaluminium.in
54	Most modern design of pan filters – optimisation of operation and maintenance	Dr.-ing. Reinhard Bott rbott@bokela.com Dr.-ing. Thomas langeloh bokela@bokela.com Dipl.-ing. Jürgen hahn Bokela gmbh, 76131 karlsruhe, Germany
55	Improvement in capacity of high rate decanter through process modifications	Bimalananda Senapati, C. Satish Kumar and Tonmoy Banerjee CSatish.Kumar@vedanta.co.in Vedanta Aluminum Ltd., Lanjigarh, Kalahandi Dist., Orissa-766 027, India
Red Mud, disposal, treatment & Utilisation		
56	Bauxite residue and disposal database (BRaDD) - an online database resource for bauxites, residue and disposal management.	Markus Gräfe, Craig Klauber, Dave Pang and Peter Smith, Light Metals Flagship CSIRO Process Science and Engineering PO Box 7229 , Karawara WA 6152 AUSTRALIA Markus.Grafe@csiro.au, Craig.Klauber@csiro.au, Dave.Pang@csiro.au Peter.Smith@csiro.au
57	Treatment and utilization of red mud in China	Jiakuan Yang, yjiakuan@hotmail.com, Wanchao Liu,, Xiaoshen Zhang School of Environmental Science and Engineering, Huazhong University of Science & Technology
58	De-watering, disposal and utilization of red mud: state of the art and emerging technologies.	György Bánvölgyi gbanvolgyi@gmail.com, Hungary Tran Minh Huan, Vietnam huanhtqt@vnn.vn
59	Technological Solution for Processing Red mud into Bricks	Dewanand Mahadew dewanand@mahadew.net

60	Immobilisation of impurities during Thermo-Chemical Leaching for extraction of Alumina from Nalco red mud by Lime soda ash sinter process	S.N.Meher1, shibnarayanmeher@gmail.com Dr A.K.Rout1, KIIT UNIVERSITY, Dr B.K.Padhi2, National Aluminium Company Ltd, R & D department, Damanjodi
61	Heavy clay ceramics with Bayer's process bauxite residue: from laboratory to industrial scale	Y. Pontikes1, pontikes@gmail.com , D. Boufounos2, B. Blanpain1, G.N. Angelopoulos3 1Department of Metallurgy and Materials Engineering, Katholieke Universiteit Leuven, 3001 Leuven, Belgium 2Aluminium of Greece, Agios Nikolaos, Paralia Distomou, 32003 Viotia, Greece 3Laboratory of Materials and Metallurgy, Dept. of Chemical Engineering, University of Patras, 26500 Rio, Greece
62	Iron, alumina and sodium recovery from Bayer red mud.	Wanchao Liu1,2, Wanchao.Liu@csiro.au Sharif Jahanshahi2, Jiakuan Yang1, Ling Zhang2 1. School of Environmental Science and Engineering, Huazhong University of Science & Technology (HUST) 2. CSIRO Process Science & Engineering
63	Case studies in Greece for the valorization of Bayer's process bauxite residue: aggregates, ceramics, glass-ceramics, cement and catalysis	Y. Pontikes1, D. Boufounos2, G.N. Angelopoulos3 1Department of Metallurgy and Materials Engineering, Katholieke Universiteit Belgium 2Aluminium of Greece, Agios Nikolaos, Paralia Greece 3Laboratory of Materials and Metallurgy, Dept. of Chemical Engineering, University of Patras, 26500 Rio, Greece
Alternate Aluminium Ore		
64	Complex Nepheline ores processing. Assessment of commercial implementation of the process in China and North Korea.	N.N.Tikhonov, I.V. Davydov, S.A.Vinogradov JSC RUSAL VAMI, St. Petersburg, Russia N.N.Tikhonov Nikolay.Tikhonov@rusal.com I.V. Davydov oan.Davydov@rusal.com S.A.Vinogradov Sergey.Vinogradov2@rusal.com
65	Development of an innovative process for extraction of alumina from Partially Lateritised Khondalite	B.K. Satpathy, bsatpathy@nalcoindia.co.in NALCO, India and Nikolaev I.V., Vorobiyev I.B., Alenchikov N.O., MISIS, Russia
Aluminium Electrolysis		
66	New logistical concepts for 400 and 500 kA smelters	Maarten Meijer Sales Manager HENCON B.V. Email : mmeijer@hencon.nl cellphone : +31 (0)613440971 KVK Nr. 09083033 BTW Nr. NL8114.86.849.B.02

67	RA-400 smelter technology. The way from prototypes to the industrial scale	A. Zavadyak1, S. Akhmetov1, P. Spiridonov2 1Engineering and Technological Center of UC RUSAL, Krasnoyarsk, Russia 2JSC RUSAL VAMI, St. Petersburg, Russia Andrey.Zavadyak@rusal.com Akhmetovsi@Mail.ru Pavel.Spiridonov@rusal.com
68	Dubal dx pot technology successful path from prototypes to industrial projects	Marc de Zelicourt, Ali. Al Zarouni , Maryam Mohamed Al-Jallaf, Ibrahim Baggash, Kamel Alaswad, Abdulla. A. Zarouni, Michel Reverdy Dubai Aluminium Company, PO Box 3627, Dubai, U.A.E
69	"The latest development in AP Technology: A proposition to address today´s industry challenges for future greenfield and brownfield smelters"	Alain HERRMANN Technology Sales and Services-Smelter Rio Tinto Alcan Aluminium Pechiney, Aluval, alain.herrmann@riotinto.com http://www.riotinto.com/riotintoalcan
70	The new low-temperature process of aluminum electrolysis	Alexei Apisarov, Alexander Dedyukhin, dedyukhin@ihte.uran.ru Pavel Tin'ghaev, Alexander Redkin, Yurii Zaikov Institute of High Temperature Electrochemistry, Yekaterinburg, Russia
71	Modern ventilation and emission reduction from reduction cells for production of primary aluminium	Stephan Broek Director - light metals environmental engineering & technology SBroek@hatch.ca
72	Technical conditions and economic indicators for reinforcing current of aluminum reduction cell	Tan Haitang. Henan Zhongfu industrial CO., LTD
73	Vertical stud Søderberg technology development by UC RUSAL in 2004 -2009	Victor Mann, Victor Buzunov, Evgeniy Chichuk, Nikolay Pitertsev, Igor Cherskikh, Vladimir Frizorger UC RUSAL Engineering and Technology Center, Krasnoyarsk, Russia Viktor.Buzunov@rusal.com
74	Correcting alumina feeding rate with aluminum electrolysis cell temperature	Liu Tong. Zhengzhou Research Institute
75	Aluminium Carbide Formation in Hall-Heroult Cell	Stanislaw Pietrzyk, pietstan@agh.edu.pl Piotr Palimaka
76	Development of intelligent training module in aluminium electrolysis cell	A Agnihotri & V K Jha Jawaharlal Nehru Aluminium Research Development & Design Centre, Wadi, Nagpur-440 023 (India) aaagnihotri@yahoo.com vkjha_iitk@rediffmail.com
77	The use of CFD simulations to optimise ventilation of potrooms	André Maarschalkerwaard, | Technical Consultant | Cuijk | Tel: +31 485 399934 | Mobile: +31 6 22947860 | Fax: +31 485 399850

78	CHALIECO's aluminium production technology	Speaker: To be announced
79	Equipment Needs of Aluminium Smelter - Opportunities and Challenges	Dr. Andre Teissier du Cros atc@geanoverseas.com
80	New logistical concepts about smelters	Stef Sep General Manager
	Carbon Technology	
81	Calcining of Petroleum Coke in Shaft Kilns – A Technology with Great Merits	Dr. Ulrich Mannweiler Mannweiler Consulting, Hadlaubstrasse 71, 8006 Zürich, Switzerland Phone: +41 44 350 46 62, Fax: +41 44 350 46 61 e-mail: ulrich@mannweiler.ch
82	The feasibility study on calcining low ash anthracite and using for production of carbon anode	Su Ziwei, Luo Yingtao, Luo Zhongsheng, Zhao Lin. Zhengzhou Research Institute
83	The Effects of Slotted Anodes on Aluminum Reduction Cell Performance	Erik A. Jensen, jensenerika@msn.com EAJ Consulting, Mechanicsville, Virginia USA
84	Discussion on effect of moulding technology of fine petroleum coke without calcinations pretreatment on saving energy and reducing emission for aluminum production	Hu Huiping. Gansu Hualu Aluminum CO., Ltd
85	Application of paper-made protecting carbon rings of anode stub in energy saving for aluminum production	Tian Yuanhuan. Qinghai Branch of Chalco
86	Performance and environmental improvements for anode baking furnaces packing and unpacking system.	André L. Amarante Mesquita1 andre.mesquita@solveengenharia .com.br Paulo Douglas S. de Vasconcelos2, 1Solve Engenharia Ltda; Rua Curuçá, 260; Belém, Brazil 2Albras - Alumínio Brasileiro Brazil
	Aluminium Downstream	
87	Dissolution and precipitation of AlP in aluminium alloys	Zhang Ying. Zhengzhou Research Institute
88	Development of a new phosphate - free foam Filter material for aluminium filtration in cast houses	Leonard S. Aubrey1, Dr.Duan Hanqiao1 and Dr.H Sundara Murthy2 1 SELEE Corporation, 700 Shepherd Street, Hendersonville, NC 28792, USA 2 Consultant for SELEE, Fenfe Metallurgicals, Bangalore, India
	Environmental Aspects & General	
89	The global aluminium industry's perfluorocarbon emission reduction performance and GHG inventory.	Chris Bayliss bayliss@world-aluminium.org Director, Global Projects International Aluminium Institute Jerry Marks J. Marks & Associates
90	Waste utilisation in aluminium industry - The Indian perspective	Chitta Ranjan Mishra Former Dy. General Manager (R&D), National Aluminium Company Ltd. (NALCO), Bhubaneswar, (Orissa), India crmishra49@yahoo.in

91	The production and trade network of the world Aluminium industry: a century's evolution and implication	Gang Liu and Daniel B. Müller Industrial Ecology Programme & Department of Hydraulic and Environmental Engineering, Norwegian University of Science and Technology, 7491 Trondheim, Norway gang.liu@ntnu.no
92	Aluminum Industry In Iran Past – Present - Future	Farhoud Amin Manager of Research and Training Almahdi Aluminum company On behalf of Almahdi's senior management amin@almahdi.ir
93	CHALIECO as EPCM Contractor	Speaker: To be announced
94	Do Joint Ventures Work?	Anthony Kjar Managing director Gibson Crest Pty Ltd arkjar@bigpond.com