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

NEWSLETTER

Volume 4, January 2011

ICSOBA

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foreword.

At the outset we wish you a very happy, prosperous, successful and healthy new year. We are interacting with you after the successful organization of the XVIII ICSOBA Symposium in Zheng Zhou China from November 25 to 28, 2010 with the co-operation of CHALCO R& D Centre. The Symposium attracted close to 300 delegates, with more than half of them from outside China. 78 technical papers were selected from the 130 abstracts received and published in the TRAVAUX volume, copies of which were distributed to the delegates to the Symposium. Special emphasis has been given to the papers received from China, thereby ensuring that the TRAVAUX issue reflects the significant contributions of the Chinese aluminium industry. All the papers and presentations received by the ICSOBA Secretariat and the CHALCO R & D Centre were included in a pen drive which was made available to all the delegates. A complete report on the Symposium prepared by the Executive Secretary ICSOBA is included in this issue of the News Letter along with several photographs highlighting various events of the Meet. We are deeply indebted to the CHALCO R & D Centre for their monumental efforts in ensuring the success of the Meet.

The failure of the red mud storage area in the Ajka alumina plant in October 2010, the consequent loss of lives and damage to the environment have posed a great challenge to sustainable development of the aluminium industry. We had the benefit of a presentation of a key-note address on the Ajka plant failure from Mr. György (George) Bánvölgyi, a senior process consultant from Hungary. We carry an article on this topic in this issue of the News Letter embodying his personal views. In deference to the general mood of the ICSOBA participants on the gravity of the Ajka plant accident, the ICSOBA President has issued a press release, a copy of which is included in this issue of the News Letter. The ICSOBA Presidency is at present actively involved in arranging for an international meet on bauxite residue to have a detailed discussion on various aspects of this topic and to come out with proper recommendations to the alumina plants; the venue and other details are under finalisation. We shall upload information in this regard on the ICSOBA website in the near future.

Two major events are planned for the next couple of years, the proposed 2012 ICSOBA congress of Brazil and celebration of the 50th Anniversary of ICSOBA in Russia in 2013. Information about these two events will be posted on our website in due course of time.

The unprecedented success of the Zheng Zhou symposium has brought ICSOBA into international limelight. We would like to maintain this momentum and move forward. We need your continued support by way of enrolment of new members (both corporate and individual), contribution of technical papers for the News Letter and above all a feedback as to how we can scale greater heights.

We look forward to your active cooperation.

(Ashok Nandi) (T.R. Ramachandran)

Report on
XVIII INTERNATIONAL SYMPOSIUM "ICSOBA 2010"
November 25-28, 2010, Zhengzhou

Prologue

It was decided at the time of the ICSOBA congress held in Bhubaneswar in November 2008 that the 2010 symposium would be held in China in recognition of the spectacular developments in the fields of bauxite, alumina and aluminium in the past decade in that country. Based on the request from ICSOBA secretariat, CHALCO R&D agreed to cooperate in the organisation of this symposium in Zhengzhou city. The Executive secretary of ICSOBA visited CHALCO's Zhengzhou Research Institute (ZRI) in October 2009 and July 2010 to discuss various details and to make the necessary arrangements for organisation of this important event for the first time in China. The topic of the symposium was **'Overview of Bauxite, Alumina and Aluminium Industry worldwide with special reference to China'.** The first and second circulars of this symposium, highlighting the subjects of technical presentation and program, were brought out both in English and Chinese, in cooperation with ZRI. It was also agreed to organise visits to CHALCO's bauxite beneficiation plant, alumina refinery and aluminium smelters for the delegates of the symposium. A brief report on the highlights of the conference is presented here.

Technical papers and Proceedings

ICSOBA secretariat and ZRI have jointly worked for invitation of technical papers in the following areas:

I. Present status of bauxite, alumina and aluminium industries in the world with special reference to China,
II. Promising research developments aimed at improving production and productivity in the existing bauxite mines, alumina and aluminium plants,
III. Highlighting the proposed Greenfield activities of aluminium industry,
IV. Problems in development, environment and safety considerations and
V. Marketing aspects of bauxite, alumina and aluminium and their products.

In response to our invitation about 130 abstracts were received; these covered a wide range of areas of aluminium industry starting from bauxite geology to aluminium downstream and environmental aspects. ICSOBA constituted three committees to review the papers on bauxite, alumina and aluminium and about 78 technical papers including 26 from China were selected for inclusion in the TRAVAUX volume (a periodic publication of ICSOBA). Efforts have been made to include a good number of quality papers from China to ensure that this special issue would be of great interest to a large section of people interested in the aluminium industry. Copies of the TRAVAUX volume were made available to all the delegates at the time of the Conference.

All the papers and presentations received by ICSOBA secretariat and CHALCO R&D centre for this symposium were included in the special ICSOBA pen drive, which was distributed to all the delegates. The

abstracts of technical papers, advertisements and details of sponsors and supporters were published in the Souvenir volume, which was also made available to the delegates at the time of the conference.

Participation

The response to our invitation for participation in the China ICSOBA symposium has been overwhelming – nearly 300 participants from 20 countries, namely Australia, Belgium, Brazil, Canada, China, Dubai, Jamaica, Greece, Germany, Guinea, Finland, France, Hungary, India, Indonesia, Netherlands, New Zealand, Norway, Poland, Russia, South Africa, Suriname, Turkey, United Kingdom, USA and Vietnam participated in this International symposium. About 160 delegates of ICSOBA-2010 have arrived from outside China, signifying the growing interest of countries worldwide in the activities of ICSOBA. A list of delegates compiled before the start of symposium is given separately.

Sponsors

The ICSOBA China symposium was sponsored by a number of companies including Hatch (Canada), Lanzhou LS Heat Exchange Equipment Co., Ltd (China), Nalco (China) and Environmental Solutions Co., Ltd. The Co-sponsors were DUBAL (UAE) and Vedanta (India). The symposium was also supported by ANRAK Aluminium Limited (India) and Hangzhou Newtime Valve Co., Ltd. (China).

Inaugural session

The inaugural function of ICSOBA-2010 symposium started at 9AM on November 25, 2010, in the main hall of CHALCO R&D centre. Dr. Li Wangxing, President of ZRI introduced the Chinese VIP's and the ICSOBA President to the audience and conducted the Inaugural function. Dr. Li made opening remarks, followed by the Introduction of ICSOBA by Convener Dr. Ashok Nandi. Arrangements were made for simultaneous beaming of English and Chinese text on four large screens. Further in the inaugural session, Vice Mayor of Zhengzhou city spoke about the history of Henan Province and Zhengzhou city. This was followed by the address of the leader of Chinalco/Chalco on achievements and R&D objectives of company. The last address in the Inaugural session was delivered by Roelof Den Hond, President, ICSOBA emphasizing that this symposium provides an excellent opportunity for the world to know about developments in the Chinese aluminium industry and their direction of R&D work. The Inaugural session ended with the thanks to sponsors, co-sponsors, supporters and to the exhibitors, authors and large number of paper presenters for their contribution to make the Symposium successful.

Key note addresses

The following key note addresses were presented in the first session:

- Overview of China Aluminum Industry by Dr. Li Wangxing, Director CHALCO R&D
- The new horizon of development - the Rio Tinto Alcan perspective by Claude Vanvoren, Vice President Rio Tinto
- Red mud storage dam failure in Hungary: the most serious accident of the Bayer process by György Bánvölgyi, a leading alumina technologist of Hungary.

The key note addresses were widely acclaimed and evoked keen interest in the participants. The details of the key note addresses are given in the attached program.

Exhibition

An exhibition to showcase the technological developments, products and services for the global Bauxite, Alumina and Aluminium industry was organized at the venue of the symposium. The following companies participated in the ICSOBA China exhibition:

- Weir Minerals Netherlands
- GEA Process Engineering France
- Lanzhou LS Heat Exchange Equipment Co.,Ltd
- Hangzhou Newtime Valve Co., Ltd.
- Nalco(China) Environmental Solutions Co.,Ltd

Each exhibitor / sponsor was given a time slot of 5 minutes to introduce their company and provide detail of products to all the delegates.

Technical sessions

During the symposium, papers were presented simultaneously in English and Chinese by parallel beaming. Technical papers were presented in 3 parallel sessions of bauxite, alumina and aluminium smelting / downstream in three different halls as shown in the program. Paper presentations were followed by active discussion and participation by delegates.

Concluding session

In the concluding session of the symposium, Dr. George Komlossy, Past President of ICSOBA paid homage to the late Dr. K. Solymar, Former Executive Director ICSOBA. In recognition and with high appreciation of the efforts and cooperation extended, the ICSOBA secretariat presented a memento to Dr. Lee Wangxing President of R&D Centre of CHALCO for the success of this symposium. ICSOBA President awarded a medal and certificate to Dr. Yin Zhongling, Director of Alumina Research Department in acknowledgment and appreciation for his outstanding commitment in organizing and promoting the ICSOBA in China. Roelof Den Hond, President of ICSOBA highlighted future plans of ICSOBA, particularly the proposed 2012 ICSOBA congress of Brazil and celebration of 50th Anniversary of ICSOBA in Russia in 2013. It was also indicated that ICSOBA is working on the details of a two day seminar on bauxite residue in Europe or Australia. Further Prof. Chaves highlighted the achievements of Brazil in the field of bauxite mining, beneficiation, alumina production and aluminium smelting and indicated possible venues of the 2012 ICSOBA congress.

The concluding session was followed by ICSOBA council meeting and several issues were discussed in connection with the present and future ICSOBA conferences.

Cultural Program

On the first day (25th November) evening of the ICSOBA symposium, CHALCO R&D organized an excellent cultural program followed by dinner in the R&D hotel – a veritable feast for the eye and the tongue. This was highly appreciated by delegates providing glimpses of China's rich heritage. The second day dinner and opera was hosted by Lanzhou LS Heat Exchange Equipment company of China at the same venue.

A technical field visit to the alumina refinery and aluminum smelter of CHALCO on 28th November was one of the interesting attractions for foreign delegates. On 29th November ZRI organized visit to famous Shaolin temples and other touristic attraction near Zhengzhou city, the capital of Henan Province.

Photographs of the Symposium

George Banvolgi, Jeannette Sea ,Marja Brouwer , George Komlossy in Front Of The Symposium Venue

President of ICSOBA Roelof DenHond addressing the Symposium

Registration at the Hailong Hotel 24th November

Dr Li Wangxing Addressing The Symposium

Banquet Hosted by CHALCO on 25th November

Ashok Nandi, Dr Li Wangxing, Marja Brouwer ,Dr Komlossy with the delegates of Lanzhou LS Heat Exchange co

Cultural program during the dinner hosted by Lanzhou LS Heat Exchange Equipment Co Ltd on the 26th of November

Dr. Komlossy paying tribute to Dr Solymar at the closing ceremony on the 27th

Delegates at the Shaolin Temple

PROGRAMME

24th November 2010

Time	Programme	Venue
Whole Day	Registration of delegates	R&D building of ZRI/Hailong Hotel
12.00-14.00	Buffet lunch	R&D Hotel of ZRI/ Hailong Hotel
18.00-20.00	Buffet dinner	R&D Hotel of ZRI/ Hailong Hotel

25th November 2010 Forenoon

Time	Programme	Chairperson	Venue
9.00-9.10	Dr. Li Wangxing , President of ZRI, conduct the Inaugural function, introduce each VIP and make an opening speech	Li Wangxing	No.1 Meeting Hall
9.10-9.20	Introduction of ICSOBA by Convener Dr. Ashok Nandi		
9.20-9.30	Address by Vice Mayor		
9.30-9.40	Address by leader of Chinalco/Chalco		
9.40-9.50	Address by President, ICSOBA		
9.50-10.20	Exhibition /High tea		
10.20-10.50	Overview of China Aluminum Industry by Dr. Li Wangxing		
10.50-11.20	The new horizon of development - the Rio Tinto Alcan perspective by Claude Vanvoren	Rick Smith Li Henglong	No.1 Meeting Hall
11.20-11.40	Red mud storage dam failure in Hungary: the mos t serious accident of the Bayer process by Gyorgy Bandigyi		
11.40-11.50	Exhibitor introduction/Lanzhou LS		
11.50-12.00	Exhibitor introduction /Nalco(China)		
12.00-14.00	Buffet lunch(R&D Hotel of ZRI)		

25th November 2010 Afternoon

Time	Programme	Chairperson	Venue
14.00-14.30	Modern smelting technology and its impact on alumina requirements/Barry Welch	Claude Vanvoren Li Wangxing	No.1 Meeting Hall
14.30-14.40	Exhibitor introduction/Jingjin		
14.40-15.10	A Comparative Review of Bauxite Mining and Alumina Refining in China and the World/Li Henglong		
15.10-15.20	Exhibitor introduction/NT Valve		
15.20-15.50	Investigation and application of stopping or starting aluminium cells with full current /Liang Xuemin		
15.50-15.55	Exhibitor introduction /Weir Minerals Netherlands		
15.55-16.25	Tea/Coffee break		
16.25-16.55	Development & Application of Aluminum Reduction Energy Saving in China/Liu Fengqin	P.K. Padhi Liang Xuemin	No.1 Meeting Hall
16.55-17.00	Exhibitor introduction /GEA Process Engineering France		
17.00-17.05	Introduction of Bauxite residue and disposal database (BRaDD) /CSIRO, Australia		
17.05-17.35	New meaning to the word 'Challenge' for an Alumina Refinery Developer / DUBAL		
17.35-17.40	Exhibitor introduction/Haiwang Hydrocyclone		
17.40-17.45	Exhibitor introduction/Znogxuan equipment		
17.45-17.50	Exhibitor introduction/Jingwei Sci. & Tech.		
18.00-	**CULTURAL PROGRAM & DINNER in ZRI R &D Hotel, Kind Courtesy: CHALCO**		

26th November 2010 Forenoon

Time	Programme	Chairperson	Venue
9.00-9.30	The Status of Aluminum Processing in China /Ma Shiguang	Victor Mann Yang Jianhong	No.1 Meeting Hall
9.30-10.00	The Key Cost Drivers in Aluminium Industry by CRU		
10.00-10.30	Alumina-aluminium marketing in China /SMM		
10.30-10.50	Tea/Coffee Break		

	Session A	**Session B**	**Session C**
Time	No.3 meeting hall-Bauxite Chairperson：Michael Emond Chinese: Peng Xin	No.1 Meeting Hall-Alumina Special ALCOA session "The Future of Alumina Production" Chairperson：Roelof Den Hond Chinese: Ding Anping	No.2 Meeting Hall - Aluminium production & downstream Chairperson：Barry Welch Ma Shiguang
10.50-11.10	Review on global bauxites: Resources, origin and types by George Komlossy	Bauxite upgrading practices in Brazil by Arthur Pinto Chaves	/Wang Jinhe
11.10-11.30	Development of the Bauxite-Alumina-Aluminium of Vietnam by Tran Binh Huan	Cross-country bauxite slurry transportation by Yueguang Che	The latest development in AP Technology: A proposition to address today´s industry challenges for future greenfield and brownfield smelters by Alain HERRMANN
11.30-11.50	Development of a Greenfield Bauxite mining and Alumina Project in Cameroon by Ashish Jog	Bauxite, red mud and tailings dewatering by Hi-Bar filtration by Juergen Hahn	/Wang Shaopeng
11.50-12.10		Research on local flow velocities and solids concentration fluctuation in suspension vessels, using different impeller systems by Detlef Klatt	New RUSAL Aluminium Smelting technologies by Victor Mann
12.10-12.30		Barriquand interstage precipitation coolers – last	

26th November 2010 Afternoon

	Session D		Session E		Session F
Time	No.3 Meeting Hall-Bauxite Chairperson：George Komlossy Chinese: Liu Wei		No.1 Meeting Hall-Alumina Chairperson：György Bánvölgyi，Liu Baowei		No.2 Mee ting Hall - Aluminium production & downstream Chairperson：Barry Welch，Wang Jiangmin
14.00-14.20	Darling Range – The case for high grade Bauxite suitable for direct shipping operations (DSO) by Peter Senini		Global development and situation of bauxite exploitation and alumina production by Liu Zhijian, SAMI		Dubal dx pot technology successful path from prototypes to industrial projects by Marc de Zelicourt
14.20-14.40	The joint use of imagery and topographic data for inferring bauxite deposits in a Karst la ndscape by Parris A. Lyew-Ayee		Upflow design versus downflow design for digestion flash train by Tran QK		New logistical concepts about smelters by Stef Sep
14.40-15.00	Sustainable Bauxite Mining Survey by Chris Bayliss (International Aluminium Association)		Chemical Alumina Production of China /Li Wencheng		Engineering & Technology Center developments by Yuri Shtefanyuk
15.00-15.20	Harmonizing of bauxite mining and alumina refining operations with neighboring communities for sustainable development i n Jamaica by Parris A. Lyew-Ayee,Snr.		Design and operation of disc filters in alumina refineries by Juergen Hahn		On the Liquidus of KF -NaF-AlF3-based Electrolyte by Hengwei Yan
15.20-15.40	Indian bauxite from two Geo- environments: A comparative study by B.K. Mohapatra		Outotec alumina calcination received energy efficiency recognition award 2010 - Description of applied changes by Michael Missalla		The Effects of Slotted Anodes on Aluminum Reduction Cell Performance by Erik A. Jensen
15.40-16.00	Tea/Coffee break				

26th November 2010 Afternoon

	Session G		Session H		Session I
Time	No.3Meeting Hall-Bauxite Chairperson：Dr. Jeannette See Chinese： Li Wencheng		No.1Meeting Hall-Alumina Chairperson：Steve Healy，Shi Gang		No.2Meeting Hall - Aluminium production & downstream Chairperson：Stephane Bassene，Wang Jinhe
16.00-16.20	Beneficiation of Bauxite - Upgrading of rec overable Al2O3 by Stephan Buntenbach		Impact of different additions on the green liquor desilication		Thermal Stress Analysis of the Anode after its Setting by Zhou Yiwen
16.20-16.40	Research status on processing low A/S bauxite by flotation by Chen Xiangqing		Several Technical methods of restraining the preheating surface of diasporic bauxite slurry from scaling by Yin Zhonglin		Modern ventilation and emission reduction from reduction cells for production of primary aluminium by Stephan Broek
16.40-17.00	Sustainable/energy efficient processing of low grade bauxite ores: trends, opportunities and challenges by C.R.Mishra		Inhibiting vishnevite scale formation in Chinese refineries with the second generation of MAX HT® technology by Qi Dai		Numerical Investigation on the Impacts of the Novel Cathode Convex on the ElectrolyteAluminum Interface Wave in Reduction Cells by He Zhu
17.00-17.20	Socio-economic and labor productivity impact of the bauxite industry on the Surinamese economy by Aditpersad Moensi		Designing Deep Cone Settlers and Washers to Minimize Descaling by Tim Guo		The use of CFD simulations to optimise ventilation of potrooms by André Maarschalkerwaard
17.20-17.40					
18.00	Henan local opera, DINNER, ZRI R&D Hotel. Courtesy: Lanzhou LS Heat Exchange Equipment Co.,Ltd				

27th November 2010 Forenoon

	SessionJ		SessionK		SessionL
Time	No.3Meeting Hall-Bauxite Chairperson：Stephan Buntenbach Fan Dalin		No.1Meeting Hall-Alumina Chairperson：Leslie Leibenguth，Yin Zhonglin		No.2Meeting Hall - Aluminium production & downstream Chairperson：Marc de Zelicourt，Li Jie
9.00-9.20	New design and operation of the Paragominas beneficiation circuit by Fábio Araujo Mendes		Options for processing of high silica bauxites by Peter Smith		Economic analysis of current-intensification combined with low -voltage in aluminum reduction cells by Qin Hai-tang
9.20-9.40	Beneficiation options for Darling Range bauxite by Ben Ziegelaar		New flocculants for improved processing of high silica bauxites by Matthew Davis		Calcining of Petroleum Coke in Shaft Kilns – A Technology with Great Merits by Ulrich Mannweiler
9.40-10.00	Wasteless Nepheline ores processing. Assessment of commercial implementation of the process in Asian region by S.Vinogradov		Yield impro vement by optimisation and online control of a/c of aluminate liquor in digestion unit while feeding miscellaneous sources of bauxite by Bimalananda Senapati		Performance and environmental improvements for anode baking furnaces packing and unpacking system by André L. Amarante Mesquita
10.00-10.20	Development of an innovative process for extraction of alumina from Partially Lateritised Khondalite by B.K. Satpathy		Hydrogen production in Bayer process digestion by Peter Smith		
10.20-10.40	Some observation s on bioleaching of Indian bauxite by Sharma Deboja		The development and application of reciprocating diaphragm pumps by Ling Xueqin		
10.40-11.00	Tea/Coffee break				

27th November 2010 Forenoon

	SessionM		SessionN		SessionO
Time	No.3Meeting Hall-Bauxite Chairperson：Ben Ziegelaar Chinese：Lv Weining		No.1Meeting Hall-Alumina Chairperson：Benoit Cristol，Li Guagzhu		No.2Meeting Hall -Aluminium production & downstream Chairperson：Anthony Kjar，Wang Shaopeng
11.00-11.20	Bioleaching of high sulfur bauxite from Chongqing using Acidithiobaci llus Ferrooxidans bacterias by Li Hua-xia		Aurukun Bauxite – A high reactive silica, monohydrate bauxite and advantages and disadvantages for process design and operation by Yuehua Jiang		Aluminium Carbide Formation in Hall -Heroult Cell by Stanislaw Pietrzyk
11.20-11.40	A comparative study of analytical methods of trace elements in bauxites and red muds by Jeannette See		Study on Influence of Diaspore AS Ratio in Different Alumina Production Process by Zhang Baiyong		The global aluminium industry's perfluo rocarbon emission reduction performance and GHG inventory by Chris Bayliss
11.40-12.00	Analysis of Bauxite by X -ray Diffraction using Synchrotron Radiation by Frank R. Feret		An optimum approach to processing medium and low grade bauxite effectively and economically by Xinqin Liao		Study on the emission character of PFC in 300kA cells by Qiu Shilin
12.00-12.20	Characterization, microscopy and beneficiation studies of Bauxite ore by P K Pandey		Increased capacity with world-class piston -diaphragm pumping technology J. Kuenen		
12.00-14.00	Buffet lunch(R&D Hotel of ZRI)				

27th November 2010 Afternoon

	SessionP		SessionQ		SessionR
Time	No.3Meeting Hall - Bauxite Residue Chairperson：Andrey Panov，Chen Xiangqing		No.1 Meeting Hall-Alumina Chairperson：Jan Kotte Gan Lin		No.2Meeting Hall - Aluminium production & downstream Chairperson： ，Zhao Qingyun
14.00-14.20	Bauxite residue and disposal database (BRaDD) – an online database resource for bauxites, residue and disposal management by CSIRO by Peter Smith		Color quality improvement of [illegible]		Development of a new phosphate - free foam Filter material for aluminium filtration in cast houses by Leonard S. Aubrey
14.20-14.40	Alumina and Soda Recovery from Bayer Red Mud Wanchao Liu		Adsorption of Sodium Polyacrylate on the Interface of Di -calcium Silicate – Sodium Aluminum Solution by Yu Haiyan		Energy Saving Methods of Electrolytic Cell and Effect Analysis/Chao Guofa
14.40-15.00	Advanced alumina refinery residue utilisation: Red mud conversion, material blending, and Industrial know-how and applications by Lee Fergusson		Some insights into gaining value from process models in alumina refining by Gerald Roach		Do Joint Ventures Work? By Anthony Kjar
15.00-15.20	Heavy clay ceramics with Bayer's process bauxite residue: from laboratory to industrial scale by Y. Pontikes		Alumina Recovery and Cash Flow 4 modes of operation and their environmental and economic impact by M. Brouwer		Waste utilisation in aluminium industry - The Indian perspecti ve by C. R. Mishra
15.20-15.40	Red mud processing from Outotec - Some application case studies by Michael Missalla		Improvement in capacity of high rate decanter through process modifications by Bimalananda Senapati		
15.40-16.00	Case studies in Greece for the valorization of Bayer's		Most modern design of pan filters – optimisation of		

16.30-18.00	**PLENARY / CONCLUDING SESSION / ICSOBA COUNCIL MEETING** Dr. George Komlossy to pay homage to Dr. Solymar, former Executive Director ICSOBA Awards for contributions to promote ICSOBA. Approval from the General Assembly for effecting changes to the Statutes Future Plans of ICSOBA

28th November 2010

Visit to CHALCO Bauxite flotation facility, Alumina refinery and aluminium smelter

LIST OF DELEGATES
ICSOBA SYMPOSIUM, ZHENGZHOU, CHINA

S. No.	Companies / Organizations	Name of the Delegate(s) and Designation
1	AGH-University of Science and Technology, Poland	Dr. Stanislaw Pietrzyk Professor of Metallurgy
2	Australian Aluminium Council, Australia	Mr. Michael Ison Manager Policy & Research
3	AKW Apparate+Verfahren GmbH, Germany	Mr. Thomas Baumann Process Design & Sales Engineer
4	ALCOR (Technology) BV, Netherlands	Mrs. Marja Brouwer Chief chemist
5	ALCOR (Technology) BV, Net herlands	Mr. Roelof Den Hond Director
6	Aluchem Inc, USA/India	Mr. Jan Kotte Managing Director
7	Aluminium Oxid Stade GmbH, Germany	Mr.Claus Prigge
8	Alunorte - Alumina do Norte do Brasil S.A., Brazil .	Mr. Luiz Gustavo Correa General Manager
9	Alunorte - Alumina do Norte do Brasil S.A. , Brazil	Mr. Daryush Khoshneviss Director
10	Alunorte - Alumina do Norte do Brasil S.A. , Brazil	Mr. Joaquim Ribeiro Alves Filho General Manager
11	Amber Development, France	Mr. Yves Occello Owner & MD
12	Amber Development, France	Mr Thierry Guelton Advisor
13	Ashapura Minechem Ltd, India	Ms. Pranjali Joshi Executive - R & D
14	Ashapura Minechem Ltd, India	Mr. M.M. Kulkarni Assistant Manager - R & D

LIST OF DELEGATES
ICSOBA SYMPOSIUM, ZHENGZHOU, CHINA

15	Ashapura Minechem Ltd, India	Dr.P.K.Pandey Manager - R & D
16	Ashapura Minechem Ltd., India	Mr. Michael Rodrigues General Manager - Business Coordination
17	Bán-Völgy Limited Partnership, Hungary	Mr. George (György) Bánvölgyi Technical Director
18	Barriquand Technologies Thermiques, Belgium	Mr. Daniel Martin Export Manager.
19	Bauxite Resources Ltd, Australia	Mr. Geoff Beros General Manger Processing.
20	Bauxite Resources Ltd, Australia	Mr. Peter Senini
21	Bauxite Resources Ltd, Australia	Mr. Ben Ziegelaar
22	Bauxite Institute Suriname, Suriname	Ms. Rita Vaseur-Madhoeban Director
23	BHP Billiton, Guinea	Mr. Soriba Camara Exploration Manager Guinea BSH Bauxite Project
24	BHP Billiton, Australia	Mr. Michael Émond Manager, Bauxite Resources
25	BHP Billiton, Guinea	Mr. Rick Smith Project Director, BSH
26	Bokela, GmbH, Germany	Mr. Juergen Hahn Sales Director
27	Carborundum Universal Limited, India	Mr. Joggy Jacob Senior Manager – Technical
28	Carborundum Universal Limited, India	Mr. A. K. Sahu Sr. Manager-Plant & Mines
29	Clearguard Pty Ltd, Australia	Mr. Hans Ernst Sauer Chief Executive Officer
30	Colt International BV, Netherlands	Mr. André Maarschalkerwaard Technical Consultant Building Simulations
31	Colt International BV, Netherlands	Mr. Niek Menting Sales Director Ventilation Heavy Industries

LIST OF DELEGATES
ICSOBA SYMPOSIUM, ZHENGZHOU, CHINA

32	Consultant, New Zealand	Prof. Barry Welch Professor of Metallurgy
33	Consultant, Greece	Mr. Dimitri Contaroudas Consultant
34	Consultant, Australia	Dr. Gerald Roach Retired, ex Alcoa World Alumina
35	CRU, UK	Mr. Yanchen Wang Senior Consultant
36	CSIRO Light Metals Flagship, Australia	Dr.Peter Smith
37	Cytec industries inc, USA	Mr. Owen Chamberlain
38	Cytec industries inc, USA	Mr. Qi Dai Senior Research Scientist
39	Cytec industries inc, USA	Mr. Hu Dan
40	Cytec industries inc, USA	Dr. John Fang Research Scientist
41	Cytec industries inc, USA	Mr. Michael Lathouras
42	Cytec industries inc	Mr. Bernie Luo
43	Cytec industries inc	Mr. Du Qizhong
44	Cytec industries inc	Shelly Shi
45	Cytec industries inc, USA	Mr. William Steudler
46	Cytec industries inc, USA	Mr. Matthew Taylor
47	Cytec industries inc	Mr. Ruzi Zhang
48	Cytec industries inc	Mr. Simon Zhou
49	Dhaneswar Rath Institute of Engineering & Management Studies (DRIEMS)	Dr. C. R. Mishra Director(R&D and Corporate Affairs), MITS Group, BBSR
50	Dubai Aluminium Company Limited, UAE	Mr. Marc de Zelicourt GM Technology Development & Transfer
51	Dubai Aluminium Company Limited, UAE	Mr. Ashish Jog Project Manager (Alumina)
52	Dubai Aluminium Company Limited, UAE	Mr. Michel Reverdy Manager
53	EAJ Consulting, USA	Mr. Erik A. Jensen Owner
54	EAJ Consulting, USA	Mrs. Ilona Evans Jensen
55	ETI Aluminium, Turkey	Mr. Bekir Celikel,
56	ETI Aluminium, Turkey	Mr. Gokhan Kursat Demir
57	FENFE Metallurgicals, India	Dr. H. Sundara Murthy

LIST OF DELEGATES
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58	FLSmidth A/S Minerals, Germany	Mr. Jason Smith Sales Manager Alumina Technology
59	FLSmidth A/S Minerals, Germany	Mr. Benny E. Raahauge
60	Gandhi Institute of Engineering & Technology, India	Ms. Deboja Sharma
61	GEA Process Engineering, France	Mr Ronan Le Duff
62	GEA Process Engineering, France	Mr.Norbert Leick Senior Management Consultant
63	GEO-Kom Geological Exploration Ltd., Hungary	Dr. George Komlossy
64	Gibson Crest Pty Ltd, Australia	Mr. Anthony Kjar Consultant
65	Hatch, India	Mr. Joy Bose Regional Director - Light Metals.
66	Hatch, USA	Mr. Stephan Broek Director - Light Metals
67	Hatch, Australia	Mr. Ian Duncan
68	Hatch, Australia	Dr. Quoc-Khanh Tran Principal Mechanical Engineer Light Metals
69	Hatch, China	Mrs. Yalei Wang
70	Hatch, Australia	Dr. Juerg T. Wehrli Technical Director - Bauxite & Alumina
71	HENCON B.V., Netherlands	Mr. Cees Langeveld Executive Sales Manager
72	HENCON B.V., South Africa	Mr. Stef Sep General Manager Hencon South Africa
73	Hindalco Industries Limited, India	Mr. Prasanta Bose
74	Hindalco Industries Limited, India	Mr. Kausikisaran Misra
75	Hindalco Industries Limited, India	Mr.Anand Mohan Srivastava Asst. General Manager - Mines Hindalco Industries Ltd.

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76	Independent Consultancy, Vietnam	Mr. Trân Minh Huân Consultant
77	International Aluminium Institute, UK	Mr.Chris Bayliss, Deputy Secretary General & Director Global Projects
78	International Aluminium Institute, UK	Ms. Katy Tsesmelis Manager, Materials Stewardship
79	Institute of Minerals and Materials Technology, Bhubaneswar, India	Dr.B.K. Mohapatra Scientist 'G, Head, Mineralogy Dept.
80	Jamaica Bauxite Institute, Jamaica	Mr.Paris A.Lyew -Ayee, C.D. Executive Director
81	Katholieke Universiteit, Belgium	Mr.Y. Pontikes Department of Metallurgy and Materials Engineering,
82	LWL Technical Services, USA	Mr. Leslie Leibenguth President
83	McNally Bharat Engineering Group & Humboldt Wedag Minerals P. Ltd., India	Mr. B.P. Misra President - International Business Development& Dir.
84	McNally Bharat Engineering Group/ MBE Coal & Mineral Technology GmbH - China Rep Office, China	Ms. Sunny Customer Service Assistant
85	Mineral Processing Consultancy, Germany	Dr.-Ing Stephan Buntenbach Consultant
86	National Aluminium Co. Ltd., India	Mr. P.K. Padhi Director Projects & Technology
87	National Aluminium Co. Ltd., India	Dr. B.K. Satpathy Dy.General Manager (R&D)
88	National Aluminium Co. Ltd., India, India	Mr. S.N. Jena
89	Moscow Institute of Steel and Alloys (MISA), Russia	Prof. Ivan Nikolaev Department of Metallurgy of Non-ferrous, Rare and Noble Metals
90	Outotec GmbH, Germany	Dr. Michael Missalla Vice President - Light Metals / Fluidized Beds, Outotec

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91	Outotec (Australasia) Pty. Ltd., Australia	Dr. Alessio Scarsella Senior Process Engineer Alumina Refineries
92	Outotec Oyj, Finland	Mr.Jaakko-Juhani Helsto Manager - Application development, Outotec (Filters) Oy
93	Pipeline Systems Incorporated, California, USA	Mr. Jay Chapman
94	Pipeline Systems Incorporated, California, USA	Mr. Yueguang Che
95	PT. Antam Tbk, Inonesia	Mr. Yuli Andi Sata Metallurgist
96	PT. Antam Tbk, Indonesia	Mr. M. Abi Anwar
97	R&D Carbon, China	Mr. Jim Liu
98	Rio Tinto Alcan, France	Ms. Juan FENG Research and Development Engineer
99	Rio Tinto Alcan, Australia	Mr. Denis R. Audet Manager Queensland R&D Centre (QRDC)
100	Rio Tinto Alcan, France	Mr. Stephane Bassene Project Manager - Smelter Technology
101	Rio Tinto Alcan, France	Mr. François Charmier Project Manager Smelter Technology
102	Rio Tinto Alcan, Canada	Dr. Frank Feret Senior Analytical Consultant
103	Rio Tinto Alcan, Australia	Mr. Steven Ferris
104	Rio Tinto Alcan, Australia	Dr. Steve Healy GM Research & Development B&A – Technology

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105	Rio Tinto Alcan, France	Mr. Alain Herrmann Project Manager - Smelter Technology
106	Rio Tinto Alcan, France	Mr. Jean Paul Leredde Manager Development and Technical Support
107	Rio Tinto Alcan, Canada	Mr. André Pelland Project Manager
108	Rio Tinto Alcan, Canada	Dr.(Ms) Jeannette See Program Manager, Bauxite and Alumina
109	Rio Tinto Alcan, France	Mr. Claude Vanvoren VPTechnology R&D
110	Rio Tinto Alcan, Australia	Mr. Hao Zhang Manager - Reduction Dep. - Pacific Technology Centre
111	River Edge Nonferrous, LLC, USA	Mr. Peter J. Deneen Managing Director
112	STC Engineering, Germany	Mr. Detlef Klatt Managing Director,
113	STC Engineering, Germany	Janin Klatt General Manager
114	Suriname Aluminum Company L.L.C., Suriname	Mr. Aditpersad Moensi
115	UC RUSAL, Russia	Mr. Victor Mann Technical Director
116	UC RUSAL IP Ltd., Russia	Mr. Yuri Shtefanuk Director of Office
117	UC RUSAL Australia Pty.Ltd., Russia	Mr. Benoit Cristol Alumina and Bauxite Process Consultant
118	UC RUSAL ETC, Krasnoyarsk, Russia	Mr. Gennady Arkhipov Head of Math.modelling department
119	UC RUSAL ETC, Krasnoyarsk, Russia	Mr. Evgeny Chichuk Director, Aluminium Engineering & Technology
120	UC RUSAL VAMI, St Petersburg, Russia	Dr. Andrey Panov Director, Alumina Engineering & Technology

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121	UC RUSAL VAM I, St Petersburg, Russia	Dr. Alexander Suss Director Technology Department
122	University of Sao Paulo, Brazil	Dr. Arthur Pinto Chaves Full Professor
123	University of the West Indies, Jamaica	Mr. Parris A.R. Lyew -Ayee Managing Director
124	Vale S/A P aragominas Bauxite Mine (MBP), Brazil	Mr. Fábio Araujo Mendes Development Process Mananger
125	Vedanta Aluminum Ltd., India	Mr. Tonmoy Banerjee
126	Vedanta Aluminum Ltd., India	Mr. C. Satish Kumar Associate Manager
127	Vedanta Aluminum Ltd., India	Mr. Bimalananda Senapati Head Refinery
128	Vedanta Aluminum Ltd., India	Mr. Sunil Singh General Manager
129	Viet Minerals Co Ltd	Mr. Thai Duy Do Chairman
130	Viet Minerals Co Ltd, Vietnam	Mr. Nguyen Cong Vinh General Manager
131	Viet Minerals Co Ltd, Vietnam	Mr. Le Quoc Hung Project Manager
132	Virotec Global Solutions Pty Ltd, Australia	Dr. Lee Fergusson Chief Executive Officer
133	We Com Deutschland GmbH, Germany	Mr. Meng Li
134	Weir Minerals Netherlands b.v., Netherlands	Mr. Jack Kuenen Product Manager GEHO Diaphragm pumps
135	Weir Minerals Netherlands b.v., Netherlands	Mr. Zhu Saiming Chief Sales Representative
136	Weir Minerals Netherlands b.v., Netherlands	Mr. Ernst Van Koert Director Sales & Marketing
137	WorleyParsons, Australia	Mr.Ron Toussaint
138	WorleyParsons, Australia	Mr. Benyan Pie
139	Vinacomin	Alian

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140	Vinacomin	Axiang
141	BHP Billiton	Ms. Ding Ling
142	Norsk Hydro	Ms. Hui Linlin
143	AN VIEN GROUP	CAT QUANG VIAN
144	Clark & marron Pty Ltd Beijing Representative Office	Jiang Ze
145	AN VIEN GROUP	LE NGOC GIAO
146	FL Smith	Mr. Liu Naihui
147	AN VIEN GROUP	NGUYEN TUNG DUONG
148	AN VIEN GROUP	NGUYEN VANBAN
149		Wang Chuanqing
150	Norsk Hydro	Ms. Wangqing
151	Clark & marron Pty Ltd Beijing Representative Office	Lee Butler
152	Norsk Hydro	H. Marius Berntsen
153	FLSmidth A/S Minerals	Mr. Jason Smith
154	ICSOBA Organization Group	Arun Kumar Nandi
155	ICSOBA Organization Group	Mr. Ashok Nandi
156	IAI	Mr. Dave Olney
157	IAI	Ms. Pang Xiangrong
158	IAI	Mr. Ron Knapp
159	中国有色（沈阳）泵业有限公司 Shenyang Branch of China Nonferrous Pump Industry Co., Ltd.	程志远 Mr. Cheng Zhiyuan
160	中国有色（沈阳）泵业有限公司 Shenyang Branch of China Nonferrous Pump Industry Co., Ltd.	费振奋 Mr. Fei Zhenfen
161	中国科学院过程工程研究所 Institute of Process Engineering,Chinese Academy of Sciences	郑诗礼 研究员 Mr. Zheng Shili Researcher
162	中国科学院过程工程研究所 Institute of Process Engineering,Chinese Academy of Sciences	张盈 学生 Ms. Zhang Ying Student

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163	中国科学院过程工程研究所 Institute of Process Engineering,Chinese Academy of Sciences	马漱花 学生 Ms. Ma Shuhua Student
164	上海固可曼旋流设备有限公司 Shanghai AKW A+V Hydrocyclone Co.,Ltd.	戚枫 市场经理 Mr. Qi Feng Market Manager
165	上海固可曼旋流设备有限公司 Shanghai AKW A+V Hydrocyclone Co.,Ltd.	胡龙 Mr.Hu Long
166	江苏新宏大集团有限公司 Jiangsu New Hongda Group Limited Company.	马红 总助 Mr. Ma Hong Assistant of General Manager
167	Guiyang Branch of China Aluminium International Engineering Corporation Limited	Mr. Lv Weining vice Principal
168	中铝国际贵阳铝镁设计院 Guiyang Branch of China Aluminium International Engineering Corporation Limited	陈德 副总工程师 Mr. Chen De Vice Chief Engineer
170	香港丰域矿业有限公司Hongkong Fengyu Mine Industry Co., Ltd.	顾岩 总裁 Mr. Gu Yan Vice President
171	香港丰域矿业有限公司Hongkong Fengyu Mine Industry Co., Ltd.	张华军 工程师 Mr. Zhang Huajun Engineer
172	浙江超微细化工有限公司Zhejiang Ultrafine Powders & Chemicals Co.,Ltd.	柴春芳 副总 Mr. Chai Chunfang Vice General Manager
173		石磊 行政助理 Ms. Shi Lei Administrative Assistant
174	兰州兰石换热设备有限责任公司 Lanzhou LS Heat Exchange Equipment Co.,Ltd.	张曼丽 Ms. Zhang Manli
175	兰州兰石换热设备有限责任公司 Lanzhou LS Heat Exchange Equipment Co.,Ltd.	王新燕 Wang xinyan
176	兰州兰石换热设备有限责任公司 Lanzhou LS Heat Exchange Equipment Co.,Ltd.	欧兰军 Ou Lanjun
177	兰州兰石换热设备有限责任公司 Lanzhou LS Heat Exchange Equipment Co.,Ltd.	张丽梅 Zhang Limei
178	兰州兰石换热设备有限责任公司 Lanzhou LS Heat Exchange Equipment Co.,Ltd.	殷兆东 Yin Zhaodong

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179	兰州兰石换热设备有限责任公司 Lanzhou LS Heat Exchange Equipment Co.,Ltd.	李德举 Li Deju
180	杭州耐特阀门有限公司Hangzhou Newtime Valve Co., Ltd.	张孝忠 副总经理/营销总监 Mr. Zhang Xiaozhong Vice General Manager/ Marketing Director
181	杭州耐特阀门有限公司Hangzhou Newtime Valve Co., Ltd.	李洪均 Ms. Li Hongjun Export Salesman
182	杭州耐特阀门有限公司Hangzhou Newtime Valve Co., Ltd.	Mr. Guy ll.Guibert
183	淄博启明星新材料有限公司Zibo Qimingxing New Material Co., Ltd.	杨为振 总经理 Mr. Yang Weizhen General Manager
184	中国铝业广西分公司 Guangxi Branch of CHALCO	刘保伟 副总经理教授级高工 Mr. Liu Baowei Vice General Manager,Professorial Senior Engineer
185	中国铝业广西分公司 Guangxi Branch of CHALCO	甘霖 技术中心主任教授级高工 Mr. Gan Lin Professorial Senior Engineer,Head of Techonology Centre
186	中国铝业广西分公司 Guangxi Branch of CHALCO	胡玉波 氧化铝厂厂长教授级高工Mr. Hu Yub o Professorial Senior Engineer,Factory Director of Alumina Factory
187	中国铝业广西分公司 Guangxi Branch of CHALCO	黄涌波 电解铝厂副厂长教授级高工Mr. Huang Yongbo Professorial Senior Engineer,Vice Factory Director of Electrolytic Aluminium Factory
188	中国铝业广西分公司 Guangxi Branch of CHALCO	吴海文 厂长助理高工 Mr. Wu Haiwen Senior Engineer,Assistant of Factory Director

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189	中国铝业广西分公司 Guangxi Branch of CHALCO	黄华勇 矿山部矿长助理 工程师Mr. Huang Huayong Engineer,Assistant Minister of Mine Department
190	中国铝业广西分公司 Guangxi Branch of CHALCO	李鸿 研究生 Mr. Li Hong Graduate Student
191	中国长城铝业公司长兴公司ChangXing Branch of China Great Wall Aluminium Corporation	孙志昂 教授高工 Mr. Sun Zhiang Professor,Senior Engineer
192	Duofuduo Chemical Industry Company	谷正彦 Mr. Gu Zhengyan Minister
193	北京沃尔泰克科技有限公司Beijing ALTAIC Science and Technology Co., Ltd.	黄海燕 总经理 Ms. Huang Haiyan General Manager
194	北京沃尔泰克科技有限公司Beijing ALTAIC Science and Technology Co., Ltd.	高巍 工程师 Mr.Gao Wei Engineer
195	北京沃尔泰克科技有限公司Beijing ALTAIC Science and Technology Co., Ltd.	Mr.Hubert SIMONART General Manager
196	北京沃尔泰克科技有限公司Beijing ALTAIC Science and Technology Co., Ltd.	Mr.ADRIN DAGALLIER Engineer
197		Mr.Yang Jiakuan vice Principal,Professor
198	华中科技大学环境学院 School of Environmental Science & Engineering, HuaZhong University of Science and Technology	刘万超 博士生 Mr.Liu Wanchao Doctor
199	山东鲲鹏新材料科技股份有限公司 Kun Peng,Shandong New Materials Technology Co.,Ltd	李军远 总经理 Mr.Li Junyuan General Manager
200	山东华宇铝电有限公司Shandong HuaYu Aluminium Electric Co.,Ltd.	高喜柱 副总 Mr.Gao Xizhu Associate Manager
201	山东华宇铝电有限公司Shandong HuaYu Aluminium Electric Co.,Ltd.	鞠永伟 厂长 Mr.Ju Yongwei Factory Director
202	山东华宇铝电有限公司Shandong HuaYu Aluminium Electric Co.,Ltd.	陈善永 主任 Mr.Chen Shanyong Director

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203	山东华宇铝电有限公司Shandong HuaYu Aluminium Electric Co.,Ltd.	曹守法 Mr.Cao Shoufa Driver
204	河南未来铝业（集团）有限公司 Henan Weilai Aluminum Company	吴西彬 副总经理 Mr.Wu Xibin Associate Manager
205	河南未来铝业（集团）有限公司 Henan Weilai Aluminum Company	李民菁 研发中心主任 Mr.Li Minjing R&D Centre Director
206	美国西方技术服务公司 重庆威泰环保技术有限公司WESTECH Company, Weitai Environmental Pro tection Technology Ltd.	周绍华 销售经理 Mr.Zhou Shaohua Sales Manager
207	原中铝公司专家咨询委员会Expert Advisory Committee of CHALCO	厉衡隆 教授 Mr.Li Henglong Professor
208	中国科学院过程工程研究所Institute of Process Engineering, Chinese Academy of Science	王志 副研究员 Mr.Wang Zhi Associate Researcher
209	中国科学院过程工程研究所Institute of Process Engineering, Chinese Academy of Science	王明涌 博士生 Mr.Wang Mingyong Doctor
210	深圳市海王照明工程有限公司Shenzhen Haiwang Lighting Engineering Ltd.	汪汉元 经理 Mr.Wang Hanyuan Manager
211	山东鲁北海生生物有限公司Shangdong Lubei Sea Organisms Ltd.	张云峰 总经理 Mr.Zhang Yunfeng General Manager
212	山东鲁北海生生物有限公司Shangdong Lubei Sea Organisms Ltd.	崔瑞刚 生产调度长 Mr.Cui Ruigang Production Scheduling Director
213	山东鲁北海生生物有限公司Shangdong Lubei Sea Organisms Ltd.	商俊强 Mr.Shang Junqiang
214		刘殿彪 Mr.Liu Dianbiao
215	杭州锦江集团有限公司 Hangzhou Jinjiang Group	石刚 总工程师 Mr.Shi Gang Chief Engineer
216	杭州锦江集团有限公司 Hangzhou Jinjiang Group	秦爱英 高级工程师 Ms.Qin Aiying Senior Engineer

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217	杭州锦江集团有限公司 Hangzhou Jinjiang Group	庞燕 高级工程师 Ms.Pang Yan Senior Engineer
218	纳尔科（中国）环保技术服务中心 Nalco (China) Environmental Technical Service Center	Len Lawrence 亚太区销售经理 Mr.Len Lawrence Asia Pacific Region Sales Manager
219	纳尔科（中国）环保技术服务中心 Nalco (China) Environmental Technical Service Center	Shounak Banerjee 工程师 Mr.Shounak Banerjee Engineer
220	纳尔科（中国）环保技术服务中心 Nalco (China) Environmental Technical Service Center	Sana Khan 行业发展经理 Mr.Sana Khan Industry Development Manager
221	纳尔科（中国）环保技术服务中心 Nalco (China) Environmental Technical Service Center	黄秀荣 大区销售经理 Mr.Huang Xiurong Region Sales Manager
222	纳尔科（中国）环保技术服务中心 Nalco (China) Environmental Technical Service Center	蔡小返 行业发展经理 Mr.Cai Xiaofan Industry Development Manager
223	纳尔科（中国）环保技术服务中心 Nalco (China) Environmental Technical Service Center	许宝海 产品专员 Mr.Xu Baohai Product Specialist
224	威海市海王旋流器有限公司 Weihai Haiwang Hydrocyclone Co., Ltd.	张永刚 经理 Mr.Zhang Yonggang Manager
225	威海市海王旋流器有限公司 Weihai Haiwang Hydrocyclone Co., Ltd.	锁军 工程师 Mr.Suo Jun Engineer
226	威海市海王旋流器有限公司 Weihai Haiwang Hydrocyclone Co., Ltd.	王丽娟 工程师 Ms.Wang Lijuan Engineer
227	香江万基铝业有限公司 Xiangjiang Wanji Aluminum Ltd.	彭欣 总经理 Mr.Peng Xin General Manager
228	香江万基铝业有限公司 Xiangjiang Wanji Aluminum Ltd.	金立业 总工程师 Mr.Jin Liye Chief Engineer

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229	东北大学设计研究院 Design and Research Institute of Northeastern University	吕定雄 顾问 Mr.Lv Dingxiong Consultant
230	东北大学设计研究院 Design and Research Institute of Northeastern University	苗瑜 办公室主任 Mr.Miao Yu Office Director
231	上海汉胜工业设备有限公司 Hansheng Industry Equipment Ltd.(Shanghai)	方志安 销售经理 Mr.Fang Zhian Sales Manager
232	中国铝业兰州分公司 Lanzhou Branch of CHALCO	王江敏 副总经理 Ms.Wang Jiangmin Associate Manager
233	中国铝业兰州分公司 Lanzhou Branch of CHALCO	陈军 厂长 Mr.Chen Jun Factory Director
234	中国铝业兰州分公司 Lanzhou Branch of CHALCO	刘牧 区域主管 Mr.Liu Mu Region Director
235	沈阳铝镁设计研究院 Shenyang Aluminum & Magnesium Engineering & Research Institute	廖新勤 副总工程师 Mr.Liao Xinqin Deputy Chief Engineer
236	沈阳铝镁设计研究院 Shenyang Aluminum & Magnesium Engineering & Research Institute	马朝建 副总工程师 Mr.Ma Chaojian Deputy Chief Engineer
237	沈阳铝镁设计研究院 Shenyang Aluminum & Magnesium Engineering & Research Institute	张佰永 Mr.Zhang Baiyong
238	沈阳铝镁设计研究院 Shenyang Aluminum & Magnesium Engineering & Research Institute	姜跃华 技术开发部主任 Mr.Jiang Yuehua Head of Technology Development Department
239	沈阳铝镁设计研究院 Shenyang Aluminum & Magnesium Engineering & Research Institute	周东方 副主任 Mr.Zhou Dongfang Vice director
240	沈阳铝镁设计研究院 Shenyang Aluminum & Magnesium Engineering & Research Institute	许海飞 Mr.Xu Haifei
241	沈阳铝镁设计研究院 Shenyang Aluminum & Magnesium Engineering & Research Institute	宋海琛 Mr.Song Haichen

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242	沈阳铝镁设计研究院 Shenyang Aluminum & Magnesium Engineering & Research Institute	刘伟 Mr.Liu Wei
243	龙口东海氧化铝有限公司 Donghai alumina Company	皮溅清 副总经理 Mr.Pi Jianqing Vice General Manager
244	山东省茌平县茌平信源铝业有限公司 Xinyuan Aluminum Company	张德程 厂长 Mr.Zhang Decheng factory director
245	万基控股集团炭素有限公司 Carbon Limited of Xiangjiang Wanji Group	王瑞奇 副总经理 Mr.Wang Riqi Vice General Manager
246	中南大学 Centre South University	李劼 教授博导 Mr.Li Jie Professor,Ph.D. adviser
247	中国铝业青海分公司 Qinghai Branch of CHALCO	张生凯 厂长 Mr.Zhang Shengkai factory director
248	中铝国际工程有限责任公司China Aluminum International Engineering Co., Ltd.	马宁 副总经理 Mr.Ma Ning Vice General Manager
249	中铝国际工程有限责任公司 China Aluminum International Engineering Co., Ltd.	朱佳明 经理 Mr.Zhu Jiaming Manager
250	中国铝业股份有限公司中州分公司 China Aluminum International Engineering Co., Ltd.	刘伟 副总经理 Mr.Liu Wei Vice General Manager
251	香港爱择中国有限公司北京代表处 Hongkong Aize Co., Ltd.(China)	康学梅 市场分析师 Ms.Kang Xuemei Market Analyst
252	郑州天马微粉有限公司 Zhengzhou Tianma Micro powder Co., Ltd.	马淑云 董事长 Ms.Ma Shuyun Board Chairman
253	中南大学 Centre South University	陈文汨 教授 Mr.Chen Wen mi Professor
254	河南有色汇源铝业有限公司 Youse Huiyuan Aluminum Co.,Ltd.	冯运伟 副总 Mr.Fen Yunwei Vice General Manager

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ICSOBA SYMPOSIUM, ZHENGZHOU, CHINA

255	河南有色汇源铝业有限公司 Youse Huiyuan Aluminum Co.,Ltd.	马应春 技术中心主任 Mr.Ma Yingchun Head of techonology centre
256	河南有色汇源铝业有限公司 Youse Huiyuan Aluminum Ltd.	Mr.
257	澳大利亚克拉克和马伦公司北京代表处 Clark & marron Pty Ltd Beijing Representative Office	姜泽 行业分析师 Mr.Jiang Ze Industry analyst
258	澳大利亚克拉克和马伦公司北京代表处 Clark & marron Pty Ltd Beijing Representative Office	Lee Butler 行业分析师 Mr.Lee Butler Industry analyst
259	加拿大SNC兰万灵国际公司北京代表处 SNC-LAVALIN Ltd.(Canada) Beijing Representative Office	范江虹 经理 Ms.Fan Jianghong Manager
260	郑州经纬科技实业有限公司 Zhengzhou Jingwei S&T Ltd.	王旭东 总经理 Mr.Wang Xudong General Manager
261	郑州经纬科技实业有限公司 Zhengzhou Jingwei S&T Ltd.	曹国法 副总经理 Mr.Cao Guoafa Vice General Manager
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263	中国铝业股份有限公司重庆分公司 Chongqing Branch of CHALCO	贺誉清 科长 Mr.He Yuqing Section Chief
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265	中国铝业山东分公司技术中心 ``````````````````````````````````Shangdong Branch of CHALCO	李文成 主任 Mr.Li Wencheng Director
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270	兖矿电铝公司 Aluminum Company of Yanzhou Mining Group	钱建勋 总工程师 Mr.Qian Jianxun Chief Engineer
271	兖矿电铝公司 Aluminum Company of Yanzhou Mining Group	孙丰勇 工程师 Mr.Sun Fengyong Engineer
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The failure of the red mud storage area in the Ajka alumina plant Hungary

As we were preapring for the organisation of the ICSOBA Symposium in Zheng Zhou China, we received news of the accident in the red mud area of the Ajka alumina plant, Hungary. We wanted to make available some more information on this accident apart from what has been reported in the media and hence requested Mr. György (George) Bánvölgyi, a senior process consultant from Hungary to present a key-note address on this topic. A technical paper covering his presentation with introduction to the Ajka plant, photographs of the surroundings before and after the accident, the steps taken to neutralise the waste before it reached the Danube river and possible causes of the accident, is included in the following pages. The views expressed in the paper are the personal ones of Mr. Bánvölgyi and do not necessarily reflect those of ICSOBA.

The intense interest that this topic has evinced and its impact on sustainable development of the global aluminium industry are adequately reflected in the Press release of the ICSOBA President, a copy of which is included immediately after Mr. Bánvölgyi's paper. ICSOBA would like to initiate a discussion as to how the recurrence of such accidents can be prevented. Many points raised in the paper deserve more serious consideration – do the design aspects of the storage area receive the attention they deserve, what are the measurements to be made to ensure the safety of the area, what is the periodicity of these measurements, in the event of a calamity what are the immediate steps to be taken and are there any better methods available for neutralisation. These, questions, we are sure, will raise a lot of discussion. We invite correspondence from you in this regard and we will be happy to present your views to all our readers . We sincerely hope that we will have good response to our suggestion.

"I am telling you: Man is not yet grown, yet as he believes he is, he does not know his own limits."
Ars Poetica, Attila József*

Failure of the embankment of a red mud pond in Hungary: The most serious accident of the Bayer process

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Abstract

There was world-wide media coverage of the failure of the embankment of the Chamber 10 red mud pond of the Ajka Alumina Refinery of MAL Zrt (Hungarian Aluminium Production and Trade Company Limited) on October 4, 2010. A serious accident of this magnitude, claiming the loss of ten lives and hundreds of injured, is the first since the invention of the Bayer process in 1887 and 1892. The obvious reaction is "what happened and why". It seems reasonable to present the circumstances and immediate consequences even though investigations are in progress and their duration is difficult to predict. The successful attempt to contain the subsoil water contaminated with caustic (due to seepage from the red mud pond) is probably the reason for the unpredicted consequence, the tragic failure of the embankment. This paper focuses on the technical aspects of the failure based on publicly available information. The media coverage and the legal aspects are out of the scope and space of this paper.

Keywords: bauxite residue, red mud, storage, embankment, failure

Introduction

The failure of the embankment of the Chamber 10 red mud pond of the Ajka Alumina Refinery of MAL Zrt (Hungarian Aluminium Production and Trade Company Limited by Shares) on October 4, 2010 has attracted world-wide attention with widespread coverage by the media. This accident has claimed ten lives, left hundreds people injured and led to extensive damage to the environment. It is an unprecedented serious accident of the Bayer process in more than a century. In the aftermath of such a calamity the obvious questions asked are "what happened and why". Investigations are on the way and it is difficult to predict the timeframe by which the findings would be available. It appears reasonable to present the circumstances that have led to this accident and the immediate consequences. This paper focuses on the technical aspects of the failure based on publicly available information. The media coverage and the legal aspects are out of the scope of this paper. The paper is divided into three major sections – the first one deals with details of the Ajka alumina refinery, the second with illustrations of the scene before and after the accident and the final section with an analysis of the situation.

*Ars Poetica, Attila József, Hungarian poet (1905-1937). Translated by Dr László Cseresnyési

The Ajka Alumina Refinery

Where is Ajka?

The single operating alumina refinery in Hungary is at Ajka, located some 160 km West-SouthWest of Budapest, the capital of Hungary (Fig. 1). The red mud disposal sites were gradually extended in the western direction over the 67 years history of the alumina refinery at Ajka.

Fig. 1 Location of Hungary and Ajka [1]

The owner of the Ajka alumina refinery

The Ajka alumina refinery is a production facility of MAL Zrt (Hungarian Aluminium Production and Trade Company Limited), owned by Hungarian individuals. The product range of MAL[2] includes

- aluminium hydroxides (wet and dry, ground and fine precipitated hydrates)
- aluminas (calcined, ground, activated and polishing aluminas)
- synthetic zeolites
- gallium metal.

The ancestor company of MAL Zrt acquired Ajka Alumina Refinery, Unit No. 2 in 1997 from the Hungarian Aluminium Corporation which was held by the Hungarian state.

Typical composition of the bauxite feedstock

- Al_2O_3 : 50 %
- Fe_2O_3 : 21 %
- SiO_2 : 7.5 %
- TiO_2 : 2.5 %
- L.O.I : 14 %

The soluble alumina is predominantly in boehmite, the dominant silica mineral is kaolinite. The majority of the iron content is in hematite. This specific composition relates to the bauxite as obtained from the local mines in the Bakony hills. During the recent years better quality bauxites from Bosnia-Herzegovina and Montenegro have been processed in the alumina refinery as well.

Brief history of the Ajka Alumina Refinery

Alumina production at Ajka started in 1943. The original design capacity was 20 ktpy floury alumina. The batch digestion was converted to continuous in the early sixties and the operating temperature was increased from 185°C to 210°C in 1963. The production capacity was later increased to 185 ktpy stepwise by upgradation and debottlenecking, while the digestion temperature was increased to 240°C. This alumina plant was named later Unit No. 1 of the Ajka Alumina Refinery. The alumina industry of Hungary lost most of its markets due to the termination of the the Hungarian-Soviet alumina-aluminium agreement in 1990. Unit No. 1 was shut down in 1992. The outdated 22 ktpy capacity Vertical Stud Söderberg anode aluminium smelter at the same location was shut down at the end of 1991 since it was not profitable.

A power plant in the vicinity of the alumina plant and aluminum smelter based on the local brown coal supplied the steam for the alumina production and the power for the smelter. The power plant used the non-contaminated condensate from the indirect live steam heaters of the alumina refinery, though it belonged to a separate company.

Alumina production in Unit No. 2 started in 1972. The design capacity was 240 ktpy, which was later increased to 300 ktpy by debottlenecking. The rationale of Unit No. 2 was to supply alumina for the abovementioned Hungarian-Soviet alumina-aluminium tolling agreement. The product was floury alumina as well. The digestion temperature was 240°C, the A/C ratio of the digester effluent was 0.663 (caustic molar ratio 1.45). Some 3-4% CaO was added to the bauxite to reduce the chemically bound caustic losses. The total extraction yield (relative to the theoretical extraction) was ~ 93%. Flat bottom settlers and washers with perimetric discharge were implemented. Under these circumstances the underflow solid concentration was relatively low, ~ 25%. In 2009 vacuum rotary drum filters were installed, though the original red mud slurry transportation and disposal system was not altered.

It should be pointed out that at the time of designing of Unit No. 2, all the alumina refineries excepting those located at the seashore used the lagoon type (wet) disposal of the red mud.

Between 1990 and 2006 the total production of the Ajka Alumina Refinery was gradually converted to various non-metallurgical grade aluminas.

Typical composition of the red mud

- Al_2O_3 : 15-19 %
- Fe_2O_3 : 33-40 %
- SiO_2 : 10-15 %
- TiO_2 : 4-6 %
- CaO : 3-9 %

- MgO : 0.3-1.0 %
- Na_2Obound : 7-11 %
- V_2O_5 : 0.2-0.4 %
- P_2O_5 : 0.5-1.0 %
- CO_2 : 2-3 %
- SO_3 : 0.8-1.5 %
- F : 0.1-0.15 %
- C : 0.15-0.20 %
- L.O.I. : ~ 9 %

Some 1.2-1.3 ton of bauxite residue as dry matter is formed for each ton of alumina.

Schematic of the red mud disposal

A schematic of the red mud disposal system is shown in Fig.2. The embankment of the red mud ponds was constructed by utilizing the pozzolanic/hydraulic character of the fly ash and bottom slag of the power plant having considerable CaO content. The fly ash and bottom slag was slurried in water and transported to the embankment being built. The excess water was collected and pumped back to the power plant. The mixture solidified by itself and resulted in a material analogous to a concrete of fairly low quality. This procedure has been in place since 1943.

In 1990 it was found that some seepage of Chamber 9 or any other chambers built earlier contaminated the subsoil water with caustic. Building of a water sealing wall started downwards somewhat into the water sealing clay layer located at 8-18m depth. It prevented spreading of the caustic contamination of the subsoil water: therefore it was considered to be a success story. The water sealing wall was completed after the takeover of the refinery (in 1997) at the request of the environmental authorities. The Chamber 10 was put into operation in 2002.

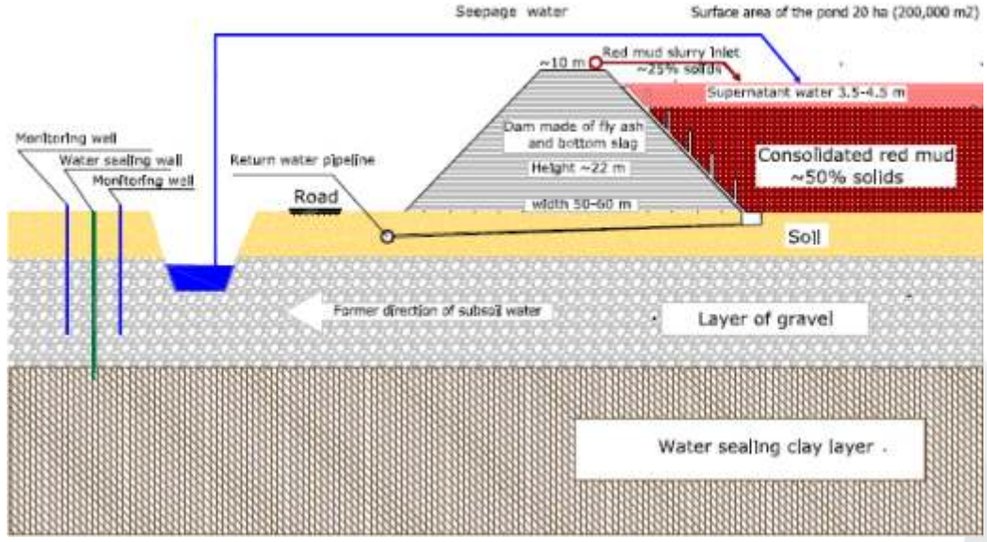

Fig. 2 Schematic of the red mud disposal system at the Ajka alumina refinery [4]

An estimated amount ranging from 700,000m^3 to 900,000m^3 supernatant water was released, and the surface of Chamber 10 is about 20ha (200,000m2), therefore the height of the supernatant water before the embankment failure was 3.5-4.5m. The higher value seems to be more probable.

Typical composition of the supernatant water

- Na_2Ocaustic : ~ 3.7 g/l
- (C as Na_2CO_3) : ~ 6.3 g/l
- Na_2Ototal : ~ 4.6 g/l
- Al_2O_3 : ~ 1 g/l
- pH : ~13.0

This supernatant water is practically a solution of ~0.5% NaOH.

Scene before and after the accident

The scene before and after the failure of the embankment wall of Chamber 10 is illustrated by a number of photographs in this section (Figs. 3 to 15); the extensive damage caused to the surroundings is clearly seen without any need for comments or explanations.

Fig.3 An aerial view of Chamber 10 before the accident [5]

Fig. 4 The area next to the embankment of Chamber 10 before the failure[6]

The reed and the still water next to the embankment suggest that the soil surface water was not properly discharged. The rainfall in Summer 2010 was about 2.5 times more than in the previous year.

Fig. 5 The caustic flood at Devecser town after the failure of the embankment[7]

Fig. 6 The rescue workers did their best to save people[8]

Fig. 7 Fireman to rescue people[9]

The signs of the caustic tsunami

Fig. 8 A badly damaged house made of adobe at Kolontár village[10]

Fig. 9 Affected houses at Kolontár village[11]
Traces of a 2 m high red mud sludge wave can be seen

Fig. 10 Cars are piled up in a flooded parking lot in Devecser town[12]

Fig. 11 An aerial view of the flooded Devecser town[13]

Fig. 12. The affected area of 10km2 - an aerial photo[14]
The failed embankment

Fig. 13 The ruptured NW corner of the embankment one day after the failure[15]
The western edge is almost perfectly vertical.

Fig. 14 The affected corner [16]. The upper part of the edge of the western embankment is not contaminated with red mud

Neutralization of the caustic contamination

Fig. 15 Gypsum was put into the Torna creek to reduce the pH as Step 1. Ca-nitrate, Mg-nitrate and acetic acid were used downstream in the Marcal river as Step 2. By this way the pH was reduced to about 9 from the original 12-13 before the contaminated water reached the Danube[17]

What happened and why?

It is not possible to give a comprehensive answer to these reasonable questions within such a short time, a few weeks after the regrettable accident. It should be pointed out that when an airplane crashes, several months may be needed to collect all the pieces of the wreckage and put them together, like a jigsaw puzzle. This is followed by the difficult intellectual exercise facilitated by the use of different instruments and mathematical models to figure out the most probable reason(s) – the whole exercise may take years. Another point for consideration is that this type of accident is unprecedented over the 120 years history of the Bayer process. The scenarios which have been publicized so far to explain the failure of the embankment are summarized below.

Scenario 1

The red mud slurry was disposed in an uneven manner, i.e. no sufficient bauxite residue was delivered to the affected corner. A spring may have formed at the bottom of the embankment due to the pressure of the water column and this caused the soaking of the soil below the embankment; eventually the embankment failed [18].

Scenario 2

According to an interim expert assessment, predominantly flood basin meadow soil is below Chamber 10, though a clayey soil block is included in it at the Northern embankment. The water sealing wall diverted the extreme rainfall of 2010 below the embankment. The two types of soils moved due to the soaking in a different way and resulted in a soil failure (a local subsurface dislocation) that happened probably at a depth of 30-50m[19]. In other words, the failure was an act of God. Most probably the lower section of the embankment slipped in outward direction, (see Fig. 16, middle part). This is why the upper edge of the rupture is not contaminated with red mud.

Fig. 16 A schematic representation of the rupture [20]

Scenario 3

Persistent Scatterer InSAR (PSI) analyses of Synthetic Aperture Radar Interferometry (InSAR) data was carried out for the time span of Mar 2003-Aug 2010 by Dr Grenerczy and Dr Wegmüller [21]. This assessment reveals that a continuous sagging of the embankment happened especially at the affected corner and this may have led an important role in the rupture. The details are demonstrated in Figs. 17 to 19.

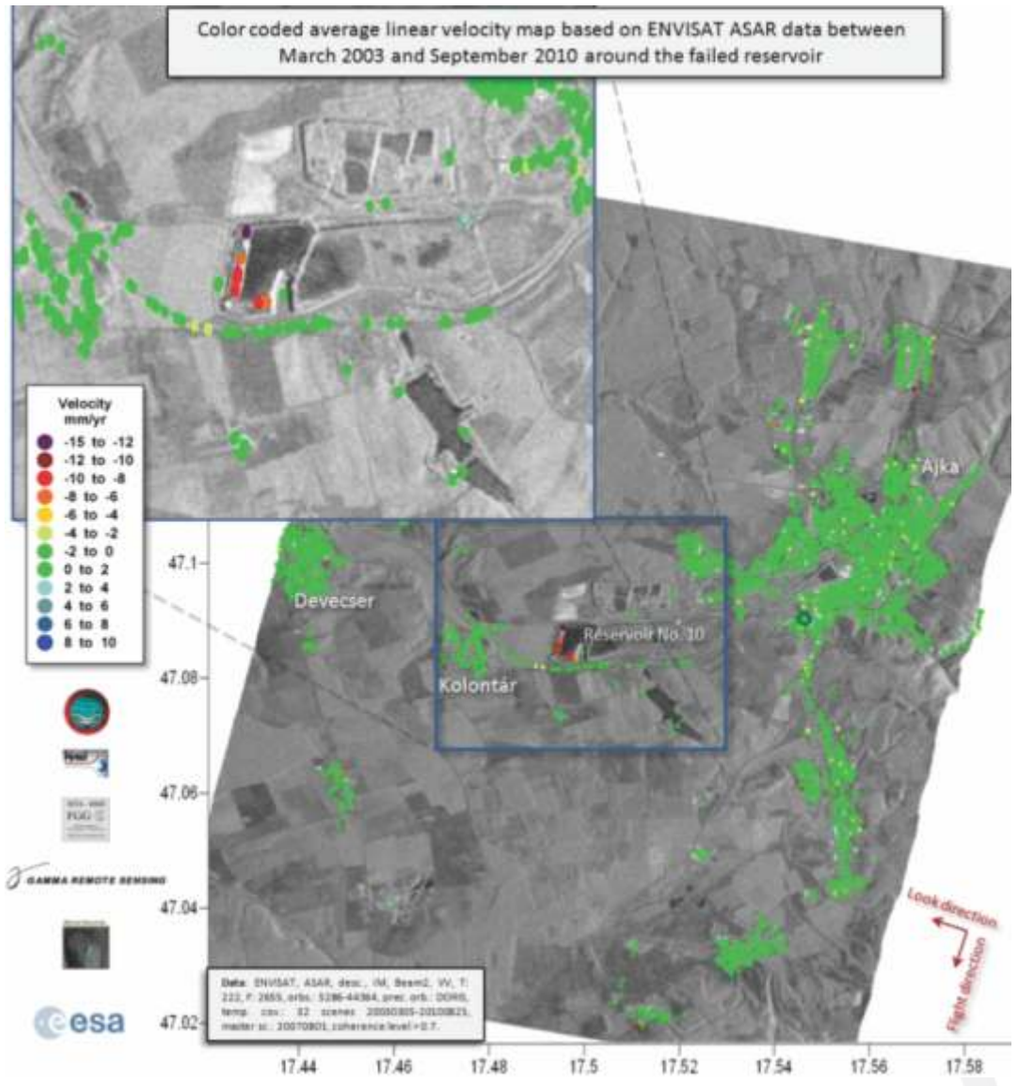

Fig. 17 Motion of the embankment, 2003-2010. Linear velocity map based on ASAR data around the failed storage Chamber10. Green: no motion at all. Red and violet: sagging

Fig. 18 Sagging of the embankment, March 2003 - August 2010

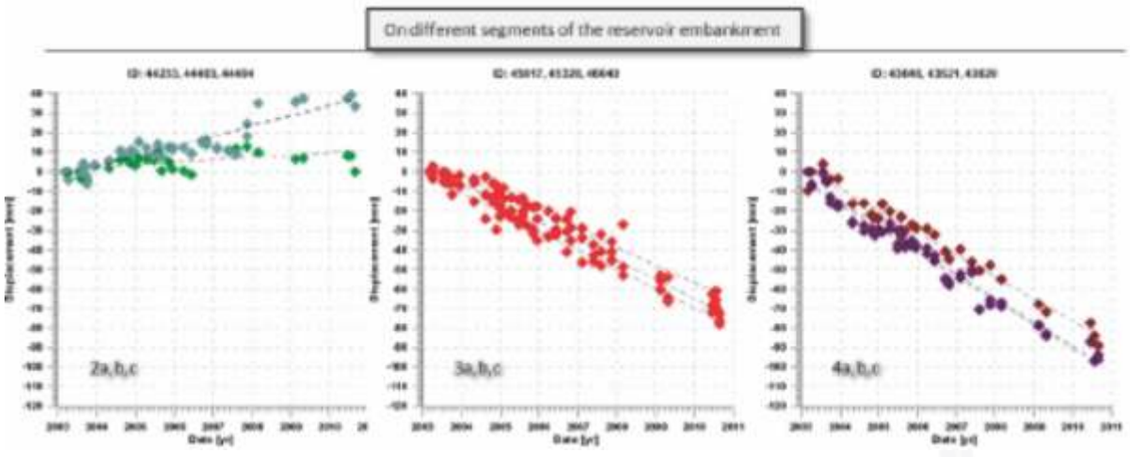

Fig.19 Motion history. Different segments of the embankment

The real hazard

The loss of 10 lives was largely caused by the enormous amount of water that was released instantaneously and caused a tsunami of 2m height in Kolontár village and to some extent by its dissolved caustic content. The caustic concentration of the liquid phase was equivalent with a 0.5% NaOH solution, some victims suffered severe caustic burns due to the OH- ion exposure that lasted for hours.

When the bauxite residue (red mud) dries out, the dissolved NaOH content of the liquid phase gets gradually more and more concentrated. It is probable that the NaOH content of the bauxite residue dust, originating from the liquid phase, by this underlying mechanism, causes irritations when the dust is inhaled, or, when it gets into the eyes.

Toxic metal content of the red mud, and its dissolution properties

As per the summary of the Hungarian Academy of Sciences Cd, Cr, Ni, Hg, Pb and Zn contents of the 16 red mud samples taken at Kolontár village and Devecser town area were low, occasionally much less than the threshold limits set for the municipal sewage sludges (Table 1). The As content was less than the threshold limit in the samples taken at Kolontár, in two samples which were taken just at the dam failure the As content was higher. The reasons for this discrepancy are under study.

The scientists of the Hungarian Academy of Sciences have come to the conclusion that the metal content of the red mud represents a hazard only in those cases when these metals dissolve from the red mud, thereby facilitating easy absorption by the living organisms.

Table 1 The crude analytical results of red muds (solid phase)

Samples, taken by and date	Metal contents of red muds (mg/kg)						
	As	Cd	Cr	Hg	Ni	Pb	Zn
MTA KK AKI, 05.10. 2010	135-144	n.m.	632-677	1.64-8.59	192-219	189-195	47.9 56.7
MTA KK AKI, 05.10. 2010	33.4-35.7	n.m.	83.4-85.8	n.m.	64.3-73.1	43.2-53.9	36.8-43.6
[illegible]	43.6-44.5	2.30-2.42	689-721	0.54-0.67	281-289	80.9-83.2	142-155
Bálint Analitika 05.10. 2010	27.9-32.3	0.24-0.34	57.6-74.5	0.18-0.28	26.3-36.4	7.52-11.8	64.2-77.9
MÁFI 06.10. 2010	81.6-131	0.82-1.44	360-694	0.61-2.83	143-322	96.2-177	108-172
Threshold limits for sewage sludge[1]	***75***	***10***	***1000***	***10***	***200***	***750***	***2500***

Remarks:
1: Threshold limits for sewage sludge that can be used in the agriculture
n.m. not measurable
MTA KK AKI – Institute of Materials and Environmental Chemistry, Hungarian Academy of Sciences
MÁFI - Hungarian Geological Institute

The dissolution of certain metal contents of the dry red mud samples was investigated and determined after their treatment by strict standards in distilled water and also in ammonic-acetate buffer at pH 4.5. As per the experimental data the investigated metals do not dissolve out of the red mud at the given conditions (Table 2).

Table 2 Dissolution results of certain metals red mud with distilled water and ammonium-acetate buffer, pH 4.5

Samples, taken by and date	Metal content of solutes (µg/l)						
	As	Cd	Cr	Hg	Ni	Pb	Zn
MTA KK AKI 2010.10.05 [1] distilled water	b.d.l.	b.d.l.	b.d.l.	b.d.l.	190	60	b.d.l.
MTA KK AKI 2010.10.05 [1] ammonium-acetate buffer	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.
Detection limit	***20***	***3***	***1***	***4***	***0,7***	***8***	***0,8***
Threshold limits for sewage water	***200***	***20***	***2500***	***10***	***1000***	***1000***	***5000***

Remarks:
b.d.l. – below detection limit

A possible sequence of reasons for the failure of the embankment

There is no comprehensive assessment available on the probable reasons and their sequence which may have led to the failure of the embankment. It is not even possible to predict when such an assessment will be available. The author thinks it is reasonable to make a trial to compile an explanation on as many facts as are available at present, even though, his resources and knowledge on specific sciences are limited. Another aspect is that this accident is a complicated and unprecedented one. Therefore this paragraph is an essay that may facilitate the better understanding of the underlying reasons.

It is probable that the water sealing wall which was deepened into the soil (between 1991 and 1997), as discussed earlier, played a role that the subsoil got saturated with water to some extent. The geotechnical properties of the saturated subsoil probably changed compared with the design conditions. The saturated subsoil may have weakened and led to the continuous sagging of the embankment. It is also probable, that the sagging started before the data were available (March 2003). Further analyses may clarify this aspect. The sagging of the western embankment was far from being even. Somewhat south of the failed corner, the embankment neither sagged nor elevated, meanwhile the failed corner sagged at the highest speed, close to 100mm over 7.5years. This probably caused a shear stress on the material of the embankment. The concrete-like material of the embankment was resistant to pressure loads, but not sufficiently resistant to shear stress. This shear stress seems to be the direct cause of the rupture of the affected corner of the embankment. The sharp vertical edge of the failure is where the embankment may have split at first. The 2.5 times higher rainfall in the summer of 2010 compared with the previous year probably played a role in the deterioration of the subsoil below the embankment.

Without having hard evidences, there is no ground to confirm or reject the theory of the soil failure.

There are doubts on the theory of uneven disposal of the bauxite residue just at the ruptured corner, since the large amount of supernatant water washed away an estimated amount of 100,000t bauxite residue,

and before the rupture these solids should have been just at the affected corner.

Summary of the industrial accident at the Ajka Alumina Refinery

- Attempts to contain the subsoil water contaminated with caustic (due to seepage from the red mud pond), though successful, is probably the reason for the unpredicted failure of the embankment.
- The embankment of a red mud pond of the Ajka Alumina Refinery ruptured at 12.20 on 4th October, 2010. Some 100,000 tons of bauxite residue („red mud") as dry matter and an estimated amount of ~ 700,000-900,000m^3 supernatant water discharged instantaneously causing a tsunami of caustic red mud sludge of 2m height at the closest village, Kolontár. Devecser town was also severly affected, while Somlóvásárhely village was slightly affected.
- Altogether 10 lives were lost. 120 injured people were treated in hospitals for chemical burns. It has regrettably been re-confirmed that it takes several days until the chemical burns fully develop.
- 321 houses became damaged or inhabitable in three locations, an area of 1000 ha (10 km^2) was flooded.
- The living creatures of the Torna stream and Marcal river perished due the caustic contamination of pH~13.
- The caustic contamination was successfully neutralized before it reached the Danube river.
- Reputation of the alumina industry became badly damaged all over the world.
- Victor Orbán, PM of Hungary announced: the CEO of MAL was taken into custody, MAL was taken under state control[23]. (The CEO was released 3 days later by the county court.)
- Four employees of MAL (CEO and three others) have been charged for professional misconduct of causing death and impair of the environment.
- A Government Disaster Commissioner was appointed, who took MAL under control.
- A Government decree was issued holding the MAL responsible for the accident[24]. This is contested by MAL, claiming that it complied with all the requirements of the legislations[25].
- Implementation of the dry mud disposal has commenced[26] and is expected to be commissioned within 6-8 months.

Lessons to learn

- The design, construction and operational methods of existing disposal sites should be reviewed based on the best available methods. Special emphasis is to be put on the monitoring of the integrity of engineered construction.
- Dry mud stacking should be used as extensively as possible.
- People who might be affected even in extraordinary circumstances should not be allowed to live downstream of a possible embankment failure. People in the neighbourhood should be aware of the methods to treat any injury which might be caused by caustic.
- Public relation of bauxite processing is to be improved, misconceptions are to be handled.
- Bauxite residue washing, de-watering and disposal should be driven by environmental considerations rather than "pure" economy.
- Term 'bauxite residue' is recommended to be used instead of the ambiguous term 'red mud'.
- The criterion of Basel Convention[27] (pH <11.5) is recommended to be adopted at national and

European level when the bauxite residue is classified. Classification of bauxite residue as a hazardous waste, without any furher consideration, would greatly hinder the otherwise desirable use of bauxite residue (red mud).

- **Significantly more emphasis is to be laid on**
  - *development of the red side of the Bayer process*
  - *dewatering techniques*
  - *utilization of the bauxite residue and the re-assessment of previous results.*

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13. Photo: AFP/Getty Images, Kisbenedek Attila
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ICSOBA

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

14 December 2010

Recently the International Committee for the Study of Bauxite, Alumina & Aluminium (ICSOBA) held its 18th Symposium in Zhengzhou, China. The recent dam failure of a red mud storage basin near Ajka in Hungary was high on the agenda.

ICSOBA, as independent organization of professionals involved in the bauxite-alumina-aluminium value chain, trusts that relevant parties will carry out a thorough and transparent investigation of the Ajka tragedy and will make outcomes and recommendations available to the public.

Based on available information, it is ICSOBA's opinion that injuries and the tragic loss of lives were caused by the sudden release of an enormous amount of water and by the caustic soda content of that water. At this stage there is no evidence of harm that was caused by red mud solids, also named bauxite residue.

The use of modern bauxite residue storage technology would have avoided the Ajka calamity and ICSOBA advocates that governments re-examine applicable legislation. Due consideration should be given to the use of modern technology, such as dry storage of residue, rehabilitation & utilisation of closed storage areas and the use of bauxite residue as feed-stock for further processing.

To promote the safe and sustainable management of bauxite residue worldwide, ICSOBA is organising a Bauxite Residue Seminar in the second half of 2011. This Seminar will bring together experts from academia, industry and other parties from all over the world. The agenda includes:
- Washing, de-watering and neutralization of bauxite residue slurries
- Dry storage of residue solids, avoiding hazardous discharges to the environment.
- Rehabilitation and safe utilisation of storage areas once they are full.
- Re-working of outdated residue storage areas, to meet today's environmental standards.
- The use of bauxite residue as feed-stock for further processing.

ICSOBA welcomes all suggestions that may help to shape a productive agenda and asks interested parties to submit their papers. Further details, such as timing and location of the Bauxite Residue Seminar, will be published on ICSOBA's website (www.icsoba.org).

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ICSOBA

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

ICSOBA, the International Committee for Study of Bauxite, Alumina & Aluminium, was formed in 1963 in Zagreb, Yugoslavia. The goal of ICSOBA, a non-profit organization, is to promote exchange of ideas and results of work from different fields of research related to bauxite exploration & exploitation and alumina and aluminium production.

Over the past 48 years ICSOBA has developed into a prestigious, international organization. In total 18 symposiums and 10 congresses were organized, in various parts of the world. The most recent ICSOBA symposium, held late November 2010 in Zhengzhou, China, was attended by more than 300 delegates from 20 different countries whilst some 100 papers were presented.

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