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Light Metals 2012

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Edited by
Carlos E. Suarez



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PREFACE

I am honored to present you with Light Metals 2012 and welcome you to TMS 2012 Annual Meeting and Exhibition in Orlando, Florida. This year's meeting is held at the Disneyworld premises where we get to appreciate the results of sustained development, creativity and innovation in different areas of technology and human endeavors.

TMS Light Metals 2012 includes the latest technology advances and process improvements in Alumina and Bauxite, Aluminum Reduction Technology, Cast Shop for Aluminum Production, Electrode Technology for Aluminum Production and our Plenary Session "Aluminum Industry Technology 2020 – A Look Ahead".

Several years have passed since I attended my first TMS event in 1984. I have observed like the rest of you how our technical community and contributors have shaped the Light Metals industry of today. A lot of effort has been put in research and development as well as in other areas that support this industry such as health, safety and environmental, the management of our operations and the overall impact on our communities.

Today we continue facing the challenges of tomorrow, sustainability and energy. A new generation of scientists and technologists is growing in the Light Metals industry with tools, talent and determination like we have never seen before. The quest for the unknown, the questioning of the prevailing and the vision of what could be should nurture and forge their dreams of the future.

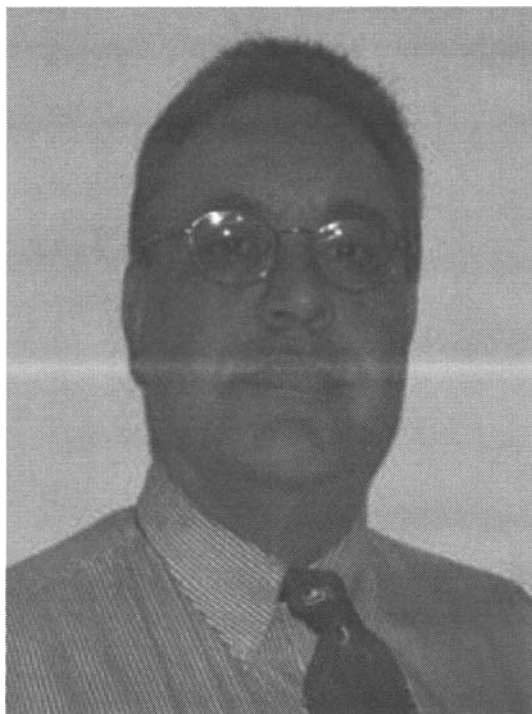
There are a multitude of mentors and colleagues that I would like to thank for having contributed to my journey and that of others in this industry. Among others: Peter Greenway, Edmund Jordine, Hans Breu, Hans Schenk, Carlos Leon Sucre, Ian Sherwin, Arvind Bahsin, Warren Pedersen, Eric Black, Joe Anjier, Paul Guelfo, Seymour Brown, Paul Bledsoe, Williams Kirsch, B.J. Foster, Gene Miller, David Kirkpatrick, Lynn Blankenship, Bud Garcia, Ramon Gil, Bob Schoen, Paul Zeringue, Patrick James, John Shim You, David Chinloy, Egon Linton, Richard Gayle, Robert Francki, Jason Berzanski, Gary Rudowski, John Visneski, Derrick Ingram, Peter McIntosh, Ian Bond, Ivan Anich, Ender Suvaci, Mehmet Arkan, Ekrem Cengiz, Everett Phillips, Geoffrey Bearne, Stephen Lindsay and John Johnson.

As previous years TMS Light Metals 2012 has been the result of collaboration between the outstanding and focused TMS staff led by Louise Wallach and the team of volunteer Subject Chairs responsible for organizing the sessions, reviewing and accepting the manuscripts. A special recognition is given to all the authors and co-authors that have found the time to write about their dedicated work that continue shaping and providing background to our industry technological development and advances.

I would like again to offer my gratitude to the authors and co-authors for their contribution, the TMS staff, the TMS Light Metals Aluminum Committee for their support and specially TMS 2012 Light Metals Subject Chairs: Benny E. Raahauge, Kai Karhausen, Edward Williams, Subodh Das, Zhengdong Long, Tongguang Zhai, Olivier Martin, Trond Furu, and Morten Sorlie. Also, a special thank goes to our "Aluminum Industry Technology 2020 – A Look Ahead" presenters: Stephan Broek, Ender Suvaci, Roberto De Andrade, Claude Vanvoren and Subodh Das.

Carlos E. Suarez

EDITOR'S BIOGRAPHY



CARLOS E. SUAREZ
LIGHT METALS 2012 EDITOR

Carlos Suarez has been associated with the aluminum industry and particularly with the alumina and bauxite areas for over 30 years. He has been a member of TMS since 1984. Carlos attended the University of Oklahoma where he obtained a degree of Science in Chemical Engineering. He also earned a Master Degree in Business Administration from the University of Phoenix. Carlos has been involved in all aspects of alumina refining for producers such as Bauxilum, Gove Alumina, Vialco Gramercy Alumina and ETI Aluminum in the areas of Process Safety, Quality, Training and Development, Technical Sales, Plant Operations, Research and Development, Commissioning and Start-Ups, Knowledge Management, Organizational Development, Technology Transfer, Business Development and Performance Improvements. Carlos also worked for Hatch where he was member of the leadership for Light Metals and senior process consultant. Carlos is currently the Technical Manager for the Alcoa Maaden JV at the Ras Al Khair Alumina Refinery in Saudi Arabia. Carlos has been an active member of TMS. He has contributed with several technical papers and was one of the instructors for the first Alumina Refinery Fundamentals and Practice course sponsored by TMS in 2008. Carlos is also member of the editorial committee of the future book “Essential Readings on Alumina and Bauxite” to be published by TMS.

PROGRAM ORGANIZERS

ALUMINA and BAUXITE



Benny E. Raahauge graduated as MSc, Chemical Engineering from Danish Technical University (DTU), Lyngby, 1972 and his current position is General Manager, Pyro & Alumina Technology at FLSmidth, Minerals Denmark. Benny has worked for FLSmidth since 1974 and has more than 36 years experience with Calcination, covering R&D, Process Development & Design, Engineering, and Dynamic Simulation of Gas Suspension Calciner (GSC) for Alumina. Headed the FLSmidth commissioning team for the 3 x 4500 tpd GSC units at Queensland Alumina, Australia, in 2004-05, currently the world largest and first alumina calciner units equipped with Bag-house instead of Electrostatic precipitators. Benny was responsible for the joint Alcan – FLSmidth project development of the Solid Liquid Calcination technology for liquor purification and destruction of salt cake. Prior to joining FLSmidth, Benny worked as Plant Engineer for the Danish Sugar Factories. Benny is the holder of several patents and has submitted several technical papers on calcination to TMS since 1980 and acted as Session Chair on Alumina and Bauxite sessions on several occasions. Benny is also co-editor of the future book "Essential Readings on Alumina and Bauxite", to be published by TMS.



Jim Metson graduated with PhD in Chemistry from Victoria University of Wellington, New Zealand, before taking up a position at Surface Science Western, University of Western Ontario Canada. He then moved to the University of Auckland, New Zealand, where he is a Professor, the Associate Director of the Light Metals Research Centre and Head of the Department of Chemistry. He is a Director of the New Synchrotron Group Ltd, a councillor of the Australian Institute of Nuclear Science and Engineering and chairs the Research Infrastructure Advisory Group (RIAG) for the New Zealand Government. His research interests are in materials and particularly surface science, with an emphasis on applications in the aluminium industry including alumina calcination and evolution of microstructure, smelting technology and in particular the impacts of alumina properties, and the surface science of aluminium metal. He has had more than 20 years of engagement with the aluminium industry and has been a regular participant at the Annual TMS meeting. He is a past Light Metals Award winner and has co-ordinated a course "Alumina from a Smelter Perspective" held as part of the 2004 TMS meeting and was a presenter in the 2009 course "Alumina Refinery Fundamentals and Practice".

ALUMINIUM PROCESSING



Kai Friedrich Karhausen is department manager for process technology at the central Rolled Products R&D of Hydro Aluminium in Bonn, Germany. Dr. Karhausen earned his doctorate at the RWTH Aachen and worked in the industrial aluminum research for 15 years both in Norway and Germany. His principal work is focused on the modeling and optimization of materials behavior in industrial production processes. Dr. Karhausen has issued 75 scientific presentations and publications. In 2003 he was awarded the Georg-Sachs-Preis of the German Materials Society (DGM) for important achievements in the field of integrated modeling of metal forming and materials behavior.

ALUMINIUM ALLOYS: Fabrication, Characterization and Applications



Dr. Subodh Das is the founder and CEO of Phinix, LLC. Dr. Das has over 35 years of global experience in industrial, academic and entrepreneurial sectors covering the entire spectrum of aluminum production, fabrication, product development and recycling segments. With numerous published papers, patents, presentations and blogs, Dr. Das - a global thought leader - is a frequent invited speaker at many international aluminum conferences with focus on industrial trends, recycling-friendly alloy development, recycling and carbon management. He is currently writing a John-Wiley Inc. / TMS contracted book on: "Carbon Management for the Global Metals Industry".

ALUMINUM REDUCTION TECHNOLOGY

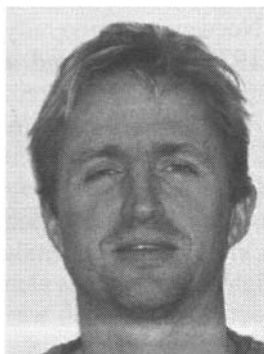


Olivier Martin joined Aluminium Pechiney Smelter R&D Center (LRF) in St Jean de Maurienne in 1988 as a R&D engineer. His main fields of interest were busbar design, MHD modelling and development of the AP30 and AP50 prototype cells. After 5 years in R&D, he held several operational positions as Reduction Manager in Greece (Aluminium De Grece) and France (Saint Jean de Maurienne). In 2002, he was appointed as Pechiney mission Leader for the start up of Mozal 2 smelter in Mozambique. Since 2005, he is back in Rio Tinto Alcan Technology group as Senior Technology Advisor, head of the Cell Development group for the Rio Tinto Alcan smelters and for AP technology (AP40, AP60 and APXe). Olivier has contributed to TMS through the submission of numerous technical papers since 1992 and as session chairman. Olivier holds a master degree in Chemistry and Materials from the National School of Chemistry in Paris.

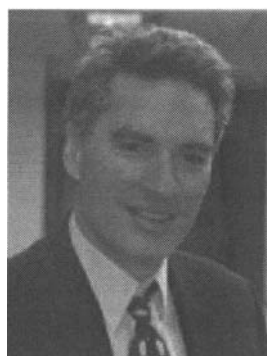


Mohammed Mahmood holds Master degree in Process Engineering from Strathclyde University in Scotland in 1989. He began his career with Aluminium Bahrain (ALBA) more than thirty years ago, rose through the ranks to various managerial positions, from Manager of Potlines, Manager Process & Quality Control to Manager Human Resources & Development and then to General Manager Metal Production from 2004 – 2009 and finally in 2009 to his present position as Chief Operating Officer. Among the major milestone in his career has been the retrofitting of pot lines 1-3 that increased the production by 21%, lead the team to further improvement and achieve 2.7% higher productivity and improve pot operation age by 16%. Being a prominent figure in Bahrain, Mohamed is very often invited to speak at International Conferences both Technical and People Development related. He is the head of the Alba Community Service Committee where his role encouraged the spirit of philanthropy amongst Alba employees and enhanced kingdom wide appreciation of Alba's corporate social responsibility initiatives. His main passion is the development of youth to become future leaders.

CAST SHOP for ALUMINUM PRODUCTION

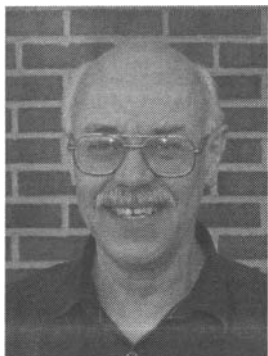


Trond Furu is senior advisor in Hydro R&D and adjunct professor at the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway. Dr. Furu earned his doctorate in physical metallurgy at NTNU in 1992 and has worked in Hydro since 1996. His principal work is focused on alloy development in the sheet ingot and extrusion ingot product sectors. This involves both experimental and modeling work with focus on microstructure control for optimization of processability and product quality of various Al-products. He has been involved in several international R&D projects with management responsibility covering the areas of modelling microstructure evolution during thermomechanical processing and forming of products. Dr.Furu has published more than 85 conference and journal papers.

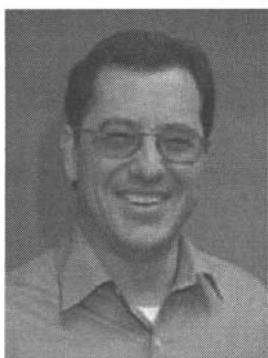


Geoffrey Brooks, B.Eng. (RMIT), B.A. (SUT), PhD (Melb.) F. I.Eng. Aust, has been a Professor in the Faculty of Engineering and Industrial Sciences at Swinburne University of Technology since 2006, where he leads the High Temperature Processing research group. He also the leader of a cluster of researchers from Australian and New Zealand Universities focussed on improving Aluminium smelting. Previously, he was a Senior Principal Research Scientist at CSIRO (2004-2006), an Associate Professor in Materials Science and Engineering at McMaster University (2000-2004) and a Senior Lecturer at the University of Wollongong (1993-2000). In the 17 years since completing his PhD at University of Melbourne, he have published over 100 papers and run many large research projects with funding from many major companies and government agencies. He is currently active in work on dross formation in aluminium processing, controlling minor elements in the casthouse, sidewall materials in aluminium cells, development of sensors for bubbling in high temperature operations, modelling of injection processes and distribution of elements in magnesium production. He has been a key reader for Metallurgical and Materials Transactions since 1998 and is a Fellow of the Institute of Engineers (Australia). Geoff has been a member of the TMS since 1990.

ELECTRODE TECHNOLOGY for ALUMINUM PRODUCTION



Morten Sorlie graduated MSc in Extractive Metallurgy, Norwegian University of Science and Technology, Trondheim, Norway in 1974 and received a PhD in Inorganic Chemistry, same place, 1978. Employed by Elkem/Elkem Aluminium since 1982 and since 2009 by Alcoa Norway ANS when Alcoa took full ownership of Elkem Aluminium. Present position is Corporate Specialist in Alcoa Norway, stationed in Kristiansand, Norway. Work areas in Alcoa Norway include cathodes and cathode materials, anodes and anode materials. Morten Sorlie has authored/co-authored more than 100 papers in international journals and conference proceedings, including several in TMS Light Metals. He is also a co-author of the textbook “Cathodes in Aluminium Electrolysis” which was published in a 3rd and extended edition in 2010.



Alan Tomsett has over twenty years experience in carbon anode and cathode technology. He received his BSc and PhD in Chemical Engineering from the University of New South Wales in Sydney, Australia. He joined Rio Tinto Alcan at the R&D centre in Melbourne in 1987. His activities with R&D Group have included leadership of the global and regional Carbon R&D program, provision of technical support for the RTA Australasian smelters, carbon raw material evaluation and carbon plant technology selection for brownfield and greenfield expansions. Since 2008, Alan has been the Technical Manager – Carbon for Rio Tinto Alcan Primary Metal Pacific. Alan has been a member of TMS since 1996. He is the coauthor of several TMS papers and is a previous TMS session chair. He is also a regular contributor to the Australasian Smelting Conference.

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