Light Metals 2015
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Proceedings of the symposia sponsored by the TMS Aluminum Committee at the TMS 2015 Annual Meeting & Exhibition, March 15-19, 2015
Walt Disney World, Orlando, Florida, USA

Edited by
MARGARET HYLAND
# Light Metals 2015

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PREFACE

It is my great pleasure to present the *Light Metals 2015* proceedings, and a very special honour to be the first woman to edit this esteemed volume. Although women are still under-represented in the light metals industry, there are a number of notable women who have made major contributions—Jacynthe Côté, first female CEO of a major aluminium company, Najeeba Al Jabri who has led in the start-up of the world’s largest potline, and Hilde Marete Aasheim to mention a few. Indeed the cultural and gender diversity of the light metals community has expanded notably since I attended my first TMS conference in the early 1990s.

These proceedings are the distillation of a huge effort on behalf of the global aluminium research community. TMS annual meetings represent a unique opportunity for the global aluminium community to share knowledge and experience. Through these proceedings, the accumulated knowledge is made accessible to others in the years to come. This knowledge transfer, from researcher to researcher, but more critically from researcher to practitioner is more important than ever, given the challenges that face our industry, such as energy consumption, raw materials quality and, in some parts of the world, attracting and retaining a skilled workforce.

New step-change approaches to smelting are the subject of this year’s plenary session “Latest Developments in the Smelting of Light Metals.” This joint session covers the major light metals—aluminum, magnesium, and titanium. This multi-metal approach allows us to look outside of our own technologies and explore how solutions being developed for other metals can be translated across to ours.

This translation—across industries, technologies and from researcher to practitioner can only occur when the lines of communication are open and parties on both sides of the conversation are receptive. An unfortunate consequence of the economic crisis is the increasing segregation between the research providers—now usually university-based—and the practitioners. Participation at the TMS conference by wide representation across all players in the industry—plant staff, research centre staff, academics, suppliers, and others is more important now than ever.

The production of these proceedings owes a great deal to the efforts of the Subject Chairs: Pete Forakis, John Griffin, Zhengdong Long, Arne P. Ratvik, Hans Werner Schmidt, Pascal Lavoie (and before him, Gary Tarcy) who have put in many hours to ensure that the quality and quantity of papers is as high as ever. I thank them for the time and energy they have volunteered. Behind the scenes, TMS staff has work tirelessly shepherding us through all stages of the production of these proceedings from the call for abstracts to the arranging of session timings. One of the fine *Light Metals* traditions is the mentoring and support of the editor by those who have gone before. I am grateful for the wise advice I received from John Grandfield and Barry Sadler.

Margaret Hyland
Editor, *Light Metals 2015*
MARGARET HYLAND
LIGHT METALS 2015 EDITOR

Margaret Hyland is a professor in the Department of Chemical and Materials Engineering, University of Auckland; Deputy Dean of the Faculty of Engineering; and a principal investigator in the Light Metals Research Centre. She has a Ph.D. in Chemistry from the University of Western Ontario.

Margaret has been active in aluminum reduction technology, working with international aluminum producers and industry suppliers for more than 20 years. She has gained international recognition for her pioneering work in environmental aspects of aluminum reduction technology and materials performance. She is an authority on the generation and capture of fluoride and particulate emissions from aluminum smelters.

Margaret has contributed to the training of professionals in the aluminum industry through the delivery of specialist courses at TMS, and through the supervision of more than 40 engineering Ph.Ds and Masters graduates. She and her colleagues in the Light Metals Research Centre established the successful Postgraduate Certificate and Masters programs in Light Metals Reduction Technology, which is now entering its tenth year.

She was elected a Fellow of the Institute of Chemical Engineers (UK) in 2008. She has authored more than 120 refereed publications and 100 technical reports. She and her co-authors are five-time awardees of TMS Light Metals and Carbon Awards.
Hans Werner Schmidt has been involved in the alumina industry for more than 30 years. He graduated from the Technical University in Darmstadt with a diploma in mechanical engineering. In the same year he joined the R&D section of Lurgi GmbH in Frankfurt where he was particularly concerned with fluid bed technology, high temperature reactions, and combustion. He also worked at the Institute of Combustion, High Temperature and Flame Research in the Technical University of Karlsruhe and was promoted to Dr.-Ing. for Chemical Engineering at the University of Karlsruhe. He has served at Lurgi as process engineer, project manager, and head of the Department for Alumina Technology. He contributed with this department to a large number of new developments such as the Circulating Fluid Bed (CFB) Technology for alumina calcination and other applications in the chemical industry. He introduced the CFB Calciners to the alumina industry starting with the first industrial unit at Lunen Germany and continued with the implementation of many more calciners to various alumina producers worldwide. He has also participated in many new developments in the alumina industry such as a Dry Gas Cleaning process for aluminum smelters, the treatment of spent pot lining from aluminum smelters and the tube digester technology for the Bayer process. The first power plant based on coal combustion in the Circulating Fluid Bed was also built under his responsibility. This power plant unit supplied energy for the alumina refinery and heat for the tube digester at the same refinery. Dr. Schmidt has published several papers in TMS Light Metals, ICSOBA, AQW/Australia and international conferences. In Outotec, who overtook Lurgi in 2001, he continued his activities in alumina technologies. After his retirement, he now works mainly for Outotec as Consultant for light metals, alumina technology, and fluidized bed engineering.

Zhengdong Long is Senior Alloy Development Engineer at Kaiser Aluminum in Spokane, Washington, United States. Dr. Long has a Ph.D. in Material Science and Engineering from China Central Iron and Steel Research and Institute in Beijing, and MBA from University of Kentucky in Lexington, Kentucky, USA. Dr. Long has been active for over a decade in the areas of physical and mechanical metallurgies of aluminum alloys and superalloys. Dr. Long’s diverse experience includes new alloys and products development and applications, process development and optimization, product integration and quality improvement, and project management. His expertise and interests are casting and thermo-mechanical processing, static and dynamic material properties, corrosion behaviors, advanced material characterization, as well as material and process modeling. He has numerous publications and patents.
ALUMINUM PROCESSING

John Griffin is Director of Aluminum Casting Technologies LLC, providing engineering consulting and manufacturing for operations and field/metalurgical process in the international aluminum industry. He has a proven consistent track record in technical sales and marketing of technologies and new engineered products to the light metals industry. He has a BSME from New York University, an MSME from New Jersey Institute of Technology, and an MSMS from Fairleigh Dickerson University. In addition, he is a licensed P.E. in New Jersey and a Licensed General Contractor in Tennessee. John has over 30 years’ experience in light metals product development and technology in primary, secondary, continuous casting, foundries and cast house processes, finishing mills and casting and rolling equipment. He has worked for Union Carbide Corporation, Hydro Aluminum, Pechiney Aluminum and Alcan and has been doing technical and marketing business in 60 countries. He has been Manager/ Director of turnkey E&C projects for clients including Norandal’s “Quantum Leap” project and Kavaerner and Middough Engineering. He has gained global expertise from all major suppliers (SNIF, Hycast, Alpur and ACD technologies) of in-line degassing and filters (BA Filters, Deep Bed) and technologies. He holds two patents and has published and presented papers in more than 14 countries including six for TMS. He has been an active member of TMS since 1983 and was one of the first contributors to launch the TMS exhibit in 1983.

ALUMINUM REDUCTION TECHNOLOGY

Pascal Lavoie obtained his bachelor’s degree in Materials and Metallurgical Engineering from Université Laval, Québec. He joined Noranda’s Magnola magnesium smelter as process engineer. When Magnola was curtailed, he moved to Noranda New Madrid smelter as metallurgical process engineer and obtained a black belt certification. In 2006, Pascal joined the Light Metals Research Centre of the University of Auckland as Manager – International projects. He led a team conducting more than 40 industrially based R&D projects. Since 2011, Pascal has been Chief Engineer of the Centre. Now a consultant based in Canada, he provides technical support to smelting operations and reduction technologies. In 2006, he received the TMS Light Metals Division Young Leader award and has been on the LMD council and various committees since.
CAST SHOP FOR ALUMINUM PRODUCTION

**Pete Forakis** is an experienced professional in the cast houses. He has worked in operations, engineering, technical services, and consulting at various top-tier metal companies as well as engineering and consulting. This includes: Reynolds Metals Company (now Alcoa), Noranda (now Glencore), Rio Tinto Alcan, Hatch, and Emirates Aluminium. This has brought him to work in multiple places around the world including Canada, the United States, Australia, and the United Arab Emirates. He now works as the Regional Director for STAS, the aluminium equipment providers in the Middle East.

ELECTRODE TECHNOLOGIES

**Arne P. Ratvik** is a senior scientist at SINTEF Materials and Chemistry, Department of Electrolysis and High Temperature Materials in Trondheim, Norway. He gained his M.Sc. and Ph.D. in inorganic chemistry from NTNU (the Norwegian University of Science and Technology) followed by a postdoctoral period at the University of Tennessee; all related to molten salt systems and electrolytic production of light metals. He has industrial research and production management experience from Elkem and Falconbridge Nikkelverk (currently Glencore Nikkelverk) followed by several positions in SINTEF (Research Director, Research Manager and Sr. Scientist). He also had a four-year term as Head of Department of Materials Science and Engineering at NTNU. Current research interests are mainly within aluminum electrolysis with emphasis on materials chemistry and electrochemical performance of carbon anodes and cathodes, besides having experience from ferro-alloy and silicon pyrometallurgical processes and metal electrowinning in aqueous solutions. He has been project manager of several large primary aluminum related projects and has co-authored more than 30 papers.
STRIP CASTING OF LIGHT METALS

Kai F. 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 18 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. He served as chair of the Aluminum Processing Committee of TMS for five years.

Murat Dündar holds the position of Director of Technology in Assan Aluminum. He joined Assan Aluminum in May 1999 as a research specialist. He has primarily focused on performance improvement of aluminum foil and sheet products produced out of Twin Roll Casting Technology (TRC), managing research and development projects on developing new alloys compatible with TRC technology, characterization of as-cast structures and related casting defects, interface between liquid metal and caster shell surface, solidification in TRC and related microstructures, tailoring microstructural features starting from casting and in further downstream operations, improvement in productivity of casting process and finally casting of high Mg-bearing and 6000-series alloys with TRC. Dr. Dündar holds a B.Sc. degree in Metallurgical Engineering from Middle East Technical University, Turkey, an M.Sc. degree in Materials Science from State University of New York at Buffalo, USA, and a Ph.D. degree in Materials Engineering from New Mexico Institute of Mining and Technology, USA.
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