Essential Readings in Light Metals

VOLUME 3

Cast Shop for Aluminum Production

Edited by
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TMS

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PREFACE

The first *Light Metals* proceedings containing cast shop related material was in 1971, with papers on vacuum treatment, DC (direct chill) casting issues, and twin roll casting.

We have selected papers for this volume that hopefully will aid industry practitioners, researchers, and equipment and technology providers. Today's research and technology groups are well advised to look at the older work. There is a treasure trove of past work in the early cast shop proceedings that does not appear in electronic database searches. Innovative concepts that perhaps the industry did not capitalize on at the time may now be viable due to the development of modern enabling technologies. DC casting of clad product is an example. G.J. Binczewski and W.K. Kramer published a paper on the method of casting clad product with two liquid streams in 1972 but the technique waited more than 25 years before reaching industrial production.

The papers have been selected based on their impact on the industry practice and development of the science and technology of casting. Citation rates, awards received, and recognition by peers influenced the selection. Many of the selected papers describe major breakthroughs in the technology or understanding of the underlying phenomena and as such have a significant impact for the industry and would be remembered as important milestones. Review papers that consolidated thinking on key topics are also included. The selection is arranged in such a way as to provide a complete overview of cast shop technology so that this volume might serve as a long-lasting reference. Overall about 12% of all papers that have been published on the topic in 1971–2011 are included. Besides the papers reproduced in this volume, each section contains a list of references from the *Light Metals* collections that could not be included due to the space restrictions but that are nevertheless important and can be recommended for further reading.

Some of the early work has been superseded and is less relevant for example in the field of automation, burner technology, and engineering systems but we have included some quirky ideas of note that were not widely adopted such as vacuum and ultrasonic degassing. We have excluded solely commercial papers except those that have now become standards for the industry or that included substantial fundamental insights. Some technologies that have faded from use such as electromagnetic casting and chlorine-aided melt fluxing we have given limited space to.

We have kept the content restricted to aluminum cast shop (with an emphasis on smelters[1]) to keep the number of papers manageable. Other light metals and recycling were also included in the *Light Metals* proceedings from time to time but not throughout the whole series.

The assistance of editorial team members A. Håkonsen and G.-U. Gruen in the screening and selection of papers was indispensable.

This collection of papers includes review papers that appeared in various years summarizing the state of the art, for example, Petersen, W.S., "The Role of Casting Technology in the Development of New and Improved Fabricated Products" (1988, pp. 329–339), which will provide starting points when researching past work.

John F. Grandfield

Dmitry G. Eskin

Lead Editors

1 Shape casting papers crept into the proceedings in the later decades.

LEAD EDITORS

John Grandfield

John Grandfield is director of Grandfield Technology Pty Ltd, a consulting and technology firm, and is an adjunct professor at Swinburne University of Technology in the High Temperature Processing Group. John has a Bachelor of Applied Science in Metallurgy (RMIT), a M.Sc. in Mathematical Modelling (Monash), and a Ph.D. in Materials Science (University of Queensland).

John has 30 years' experience in light metals research and technology in smelting, continuous casting, and metal refining (Rio Tinto Alcan, CASTcrc, and CSIRO). He has conducted plant benchmarking audits and technology reviews, optimized existing technology, managed technology transfer, and developed and commercialized new technologies.

His work on direct chill and ingot casting has been awarded both internationally and within Australia. John is regularly invited to give training courses, participate in in-house innovation workshops, and conduct R&D program reviews.

John has four patents, has published two book chapters and more than 50 conference and journal papers, and is currently co-authoring a book on DC casting of light metals. He is a member of the TMS Aluminum Committee and will be chair for Light Metals 2014.

Dmitry Eskin

Dmitry Eskin received his Engineering and Ph.D. degrees from Moscow Institute of Steel and Alloys (Technical University, Russia) in 1985 and 1988, respectively. After that he worked as Senior Scientist in the Baikov Institute of Metallurgy (Russian Academy of Sciences) with a main research focus on alloy development, heat treatment, and metal processing of aluminum alloys. In 1999–2011, he was Fellow in the Materials Innovation Institute and from 2008 also held a position of Associate Professor in Delft University of Technology (The Netherlands), where he conducted fundamental and applied research on solidification processing of metallic materials. In 2011 he joined Brunel University (West London, UK) as Professor in Solidification Research. He is a well-known specialist in physical metallurgy and solidification processing of light alloys, and is the author or co-author of more than 160 scientific papers, 4 monographs, and a number of patents. Among his books are *Advanced Aluminum Alloys Containing Scandium* (1998), *Multicomponent Phase Diagrams: Applications for Commercial Aluminum Alloys* (2005), and *Physical Metallurgy of Direct-Chill Casting of Aluminum Alloys* (2008). Dmitry has been a member of The Minerals, Metals & Materials Society since 2000 and is a regular speaker at Cast Shop Technology sessions at the TMS Annual Meeting.

EDITORIAL TEAM

Gerd-Ulrich Gruen

Gerd-Ulrich Gruen received his diploma in geophysics from Technical University of Clausthal (Germany) in 1982. After governmental project work regarding .ow in porous media related to deep drilling research he joined VAW Aluminium AG in 1990, where he was responsible for various research activities in the DC casting area mainly focusing on process chain modeling. This is documented in various papers he presented at TMS conferences. One major activity during that time was the coordination of the European-wide model development project VIR[CAST], which brought together major European aluminum producers and leading institutes and universities in the field of microstructure research.

Since 2002 he has continued his work in the research area of DC casting of aluminum alloys. He holds the position as Head of Research Department Rolling Ingots in the Research Center Bonn within the Hydro Aluminium Rolled Products GmbH. Gerd-Ulrich has been a member of The Minerals, Metals & Materials Society since 2001.

Arild Håkonsen

Arild Håkonsen holds a master's degree in physical metallurgy from NTH in Trondheim, Norway, and a Master in Technology Management at NTNU (Trondheim, Norway), NHH (Bergen, Norway), and University of California, Berkeley (United States). He started as a scientist in the R&D department of Hydro Aluminium at Sunndalsøra in 1991, and has been a Hydro employee since then. Arild is Head of Technology Management at Hycast where he also is a part of the Board of Directors. He has extensive experience within cast house technology and especially within DC casting of aluminum ingots. He has published numerous publications within the field over the last two decades.