Dc Casting Of Aluminium Process Behaviour And Technology

This important book summarises the wealth of recent research on our understanding of process-property relationships in wrought magnesium alloys and the way this understanding can be used to develop a new generation of alloys for high-performance applications. After an introductory overview of current developments in wrought magnesium alloys, part one reviews fundamental aspects of deformation behaviour. These chapters are the building blocks for the optimisation of processing steps covered in part two, which discusses casting, extrusion, rolling and forging technologies. The concluding chapters cover applications of wrought magnesium alloys in automotive and biomedical engineering. With its distinguished editors, and drawing on the work of leading experts in the field, Advances in wrought magnesium alloys is a standard reference for those researching, manufacturing and using these alloys. Summarises recent research on our understanding of process-property relationships in wrought magnesium alloys Discusses the way this understanding can be used to develop a new generation of alloys for high-performance applications Reviews casting, extrusion, rolling and forging technologies, fundamental aspects of deformation behaviour, and applications of wrought magnesium alloys in automotive and biomedical engineering

The 2016 collection will include papers from the following symposia: Alumina and Bauxite Aluminum Alloys, Processing, and Characterization Aluminum Reduction Technology Cast Shop Technology Electrode Technology Strip Casting

This is a collection of papers presented at the 13th International Conference on Aluminum Alloys (ICAA-13), the premier global conference for exchanging emerging knowledge on the structure and properties of aluminum materials. The papers are organized around the topics of the science of aluminum alloy design for a range of market applications; the accurate prediction of material properties; novel aluminum products and processes; and emerging developments in recycling and applications using both monolithic and multi-material solutions.

The Continuous Casting 2000 symposium maintains the tradition established in 1976 of holding regular events. This millennium event, however, is the first international meeting of the series. The aim is to highlight the importance of continuous casting - of aluminum, copper and magnesium - to the international fabricating industry, focusing on technological advances in all the sectors that are important for the manufacture of high quality continuous cast products.

The Light Metals symposia are a key part of the TMS Annual Meeting & Exhibition, presenting the most recent developments, discoveries, and practices in primary aluminum science and technology. Publishing the proceedings from these important symposia, the Light Metals volume has become the definitive reference in the field of aluminum production and related light metal technologies. The 2014 collection includes papers from the following symposia: •Alumina and Bauxite •Aluminum Alloys: Fabrication, Characterization and Applications •Aluminum Processing •Aluminum Reduction Technology •Cast Shop for Aluminum Production •Electrode Technology for Aluminum Production •Light-metal Matrix (Nano)-composites

The 2015 collection will include papers from the following symposia: Alumina and Bauxite Aluminum Alloys: Fabrication, Characterization and Applications Aluminum Processing Aluminum Reduction Technology Cast Shop for Aluminum Production Electrode Technology for Aluminum Production Strip Casting of Light Metals

The Proceedings describe recent developments in the field of smelting, refining and fabrication of aluminum and magnesium in Canada and abroad.

Novelis Global Technology Centre (NGTC) in Kingston, Ontario ha[s] been developing a relatively new technology known as Novelis Fusion Technology, which is a new variant of the traditional direct chill (DC) casting process that allows co-casting of multi-layered composite aluminum alloy ingots. One of the first steps in this development program is to create a mathematical model of conventional DC casting and validate it through experimentation before proceeding to the next step of modeling, designing, testing, and experimenting with the co casting process. The focus of this document is on the design of the experiments, measurement technique, and analysis of the experimental results to be used to validate the models for conventional DC casting. A series of experiments w[ere] conducted using a lab scale caster using a 95 mm x 227 mm rectangular mould available at the Novelis Global Technology Centre in Kingston, Ontario. AA3003, AA6111, and AA4045 aluminum alloys were chosen for this study since these aluminum alloys are commonly used in clad products. Two series of experiments were performed to investigate the effect of casting parameters on the solidification and cooling of the ingots such as casting speed, water flow rate, and the superheat of the molten aluminum. A set of seven thermocouples were embedded in the ingot during the cast to capture the thermal history of the ingot. Melt poisoning with a zinc rich alloy was also performed as an independent method of determining the sump depth and shape. Experience gained from the first series of experiments allowed improvements to be made to the experiment design for the second series of experiments. Thermocouples must be supported so they are not pushed out of position by the jet of molten aluminum entering the mould. Grounded thermocouples of at least 1.5 mm in diameter were recommended to survive the high temperatures of the molten aluminum. Knowledge gained from the experiments of the conventional DC caster allowed design and development of an experimental co-caster mould that will be useful for future research at NGTC. Melt poisoning and thermocouples were complementary measurement methods that should be used together. In all three alloys, the liquidus sump profile generated by the thermocouple implants correlated well with the etched sumps of the melt poisoned ingots.

This text seeks to provide a comprehensive technical foundation and practical examples for casting process modelling technology. It highlights fundamental theory for solidification and useful applications for industrial production. It also details shape and ingot castings, semi-solid metalworking, and spray forming.

Novelis Inc. recently developed and patented a unique Direct Chill (DC) casting process known as Fusion Novelis Technology. In this process a chill bar is inserted into the DC casting mould which permits for the first time the co-casting of laminate of clad ingots. These ingots can then be rolled down into clad sheet and offer distinct advantages over traditional aluminum clad sheet processing routes (i.e. brazing and roll bonding). The research presented in this Master's Thesis was done as part of a larger collaborative research and development project with Novelis Inc. The main objective of this research was to investigate the Novelis Fusion Technology and understand it from a scientific viewpoint. The research has been multi faceted and has included: the creation of a thermal fluid model using the commercial software package CFD to model the first the DC and then Fusion casting process, as well as the design and testing of an experimental DC and Fusion caster at the Novelis Global Technology Centre (NGTC) in Kingston, Ontario. This MASc research has been focused on performing both traditional DC (for AA6111, AA3004 and AA4045) and novel Fusion (AA3004/AA4045) casting experiments. First the series of DC casting experiments was performed. During the experiments two arrays of 5 thermocouples were embedded in the ingot during the cast to capture the thermal history of the ingot. Melt poisoning with a zinc rich alloy was also performed as an independent method of determining the sump depth and shape. Other temperature measurements during the experiment (i.e. alloy superheat, mould temperature, cooling water temperature) were done to gather meaningful data for model validation. A series of Fusion casting experiments was performed after the DC casting trials. Three successful Fusion casting trials were performed at NGTC using a lab scale caster with a 152 mm x 381 mm rectangular mould divided in half by a water cooled copper chill bar. For the Fusion casting experiments the AA3003-Core/AA4045-Clad alloy system was chosen since this alloy system has already been commercially produced using this novel technology. In addition to embedded thermocouples in the Fusion cast ingot, and other temperature measurements as for the DC casting experiments, temperature measurements of the chill bar were performed to gather information for model validation. The effect of melt poisoning as the interface of the composite ingot forms was unknown, so only the core of one experimental ingot was poisoned; this gave enough information about the depth and asymmetrical shape of the AA3003-Core sump. The Fusion cast ingots were characterized (both optically and using SEM techniques) at four distinct locations across the width of the ingot, consistent with different thermal histories at the interface and regions where good and poor interfaces were found in the solidified ingot. No clear correlation between thermal history and the quality of the interface could be found indicating that the interface formation during Fusion casting is extremely complicated and other factors such as oxide formation and wetting mechanisms of the AA4045 on the AA3004 need to be understood to gain a more in depth understanding of the conditions necessary to form a defect free interface. Comparisons of the measured thermal histories and sump depth and shape measurements to the model predictions were excellent.

Information on the technology of melting and casting aluminium lithium alloys is rarely published. Therefore, this chapter presents important findings from many research investigations on various aspects of melting, casting and cast structure development of Al-Li alloys. Presence of reactive element such as Li in the molten alloy requires special melt protection techniques, containment materials, alloying practices and casting equipment. Problem of grain refinement, linked to the presence of Zr in most commercial compositions, has also been discussed. Finally, it is surmised that the lower Li contents present in the third generation alloys compared to their older counterparts is expected to ease difficulties in their melting and casting.

An update of the definitive annual reference source in the field of aluminum production and related light metals technologies, a great mix of materials science and practical, applied technology surrounding aluminum, bauxite, aluminum reduction, rolling, casting, and production.

Physical Metallurgy of Direct Chill Casting of Aluminum AlloysCRC Press

Aluminium is a well established modern lightweight engineering and functional material with a unique combination of specific properties like strengh, formability, durability, conductivity, corrosion resistance, etc. It is present in many intelligent solutions in established markets like building, transport, packaging, printing, and many others, in our fast moving modern society. The various aluminium alloys can be processed quite efficiently in large quantities by conventional fabrication routes, as well as in special sophisticated forms and material combinations for highly innovative high-tec solutions and applications. This book contains latest information about all these aspects in form of the refereed papers of the II th International Conference on Aluminium Alloys "ICAA", where world-wide experts from academia and engineers from industry present latest results and new ideas in fundamental as well as applied research. Since 22 years the ICAA series provides scientists and engineers with a complete overview over the latest scientific and technological developments, featuring profound technology-based overviews and new innovative perspectives. This book is a reference for the scientific community as well as for the aluminium industry working on aluminium alloy development, processing and application issues. It gives a global perspective on the current focus of international research with emphasis on in-depth understanding of specific properties and applications of conventional and advanced aluminium alloys.

Direct-chill casting is the major production route for wrought aluminium and magnesium alloys that are later deformed (rolled, extruded, forged) to the final products. To aid in this process, this book provides comprehensive coverage on topics such as the history of process development in this field, industrial applications, including vertical and horizontal casting, melt preparation, fundamentals of solidification in DC casting, and more. The first book targeted for the industrial researcher and practitioner, it pulls together the practice and process of physics with the goal of improving process performance.

Energy and sustainability are critical factors for economic development, and this comprehensive reference provides a detailed overview and fundamental analysis of sustainability issues associated with the aluminum industry. This publication brings together articles on the concepts and application of life-cycle assessments that benchmark aluminum-industry efforts towards sustainable development. Chapters provide energy-use data for primary and secondary aluminum production and processing along with future energy saving opportunities in aluminum processing. Life-cycle assessments provide basic, factual, information on the modeling of material flow in the industry, its products, and most importantly energy savings involved with recycling. Coverage includes various scrap sorting technologies and the positive impact of lightweight aluminum in transportation and infrastructure.

This state-of-the-art reference presents papers from one of the largest annual gatherings of extraction specialists from around world, the 2013 Annual Meeting of The Minerals, Metals & Materials Society. Addressing many aspects of extraction and processing metallurgy, this volume covers in three sections modeling of multi-scale phenomena in materials processing; production, refining, and recycling of rare earth metals; and solar cell silicon. Essential reading for scientists, engineers, and metallurgists in the global extractive and process metallurgy industries.

PRICM-8 features the most prominent and largest-scale interactions in advanced materials and processing in the Pacific Rim region. The conference is unique in its intrinsic nature and architecture which crosses many traditional discipline and cultural boundaries. This is a comprehensive collection of papers from the 15 symposia presented at this event.

Because lithium is the least dense elemental metal, materials scientists and engineers have been working for decades to develop a commercially viable aluminum-lithium (Al-Li) alloy that would be even lighter and stiffer than other aluminum alloys. The first two generations of Al-Li alloys tended to suffer from several problems, including poor ductility and fracture toughness; unreliable properties, fatigue and fracture resistance; and unreliable corrosion resistance. Now, new third generation Al-Li alloys with significantly reduced lithium content and other improvements are promising a revival for Al-Li applications in modern aircraft and aerospace vehicles. Over the last few years, these newer Al-Li alloys have attracted increasing global interest for widespread applications in the aerospace industry largely because of soaring fuel costs and the development of a new generation of civil and military aircraft. This contributed book, featuring many of the top researchers in the field, is the first up-to-date international reference for Al-Li material research, alloy development, structural design and aerospace systems engineering. Provides a complete treatment of the new generation of low-density AL-Li alloys, including microstructure, mechanical behavoir, processing and applications Covers the history of earlier generation AL-Li alloys, their basic problems, why they were never widely used, and why the new third generation Al-Li alloys could eventually replace not only traditional aluminum alloys but more expensive composite materials Contains two full chapters devoted to applications in the aircraft and aerospace fields, where the lighter, stronger Al-Li alloys mean better performing, more fuel-efficient aircraft

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The completely revised Second Edition of Metallurgy for the Non-Metallurgist provides a solid understanding of the basic principles and current practices of metallurgy. The new edition has been extensively updated with broader coverage of topics, new and improved illustrations, and more explanation of basic concepts. It is a "must-have" ready reference on metallurgy!

Separation processesâ€"or processes that use physical, chemical, or electrical forces to isolate or concentrate selected constituents of a mixtureâ€"are essential to the chemical, petroleum refining, and materials processing industries. In this volume, an expert panel reviews the separation process needs of seven industries and identifies technologies that hold promise for meeting these needs, as well as key technologies that could enable separations. In addition, the book recommends criteria for the selection of separations research projects for the Department of Energy's Office of Industrial Technology.

This book offers a blend of academic and industrial papers on topics including advances in controls and process simulation, ingot defect formation and characterization studies, and process parameter-material properties characterization. The collection includes papers on the following topics: Primary and Secondary Melt Processing including VIM, VAR, ESR, EBCHR, Plasma Melting Physical Property Measurements of Liquid Metals Casting and Solidification of Liquid Metals Modeling of Metallurgical Processes including Heat/Mass Flow Modeling of Liquid Metal and Solidification Ceramic, Slag and Refractory Reactions with Liquid

Metals Refining, Evaporation and Gas/Metal Reactions
Fundamentals of Reactions Involving Liquid Metals in Productions Processes

Aluminium Cast House Technology: Eighth Australasian Conference

ONE OF A FOUR-BOOK COLLECTION SPOTLIGHTING CLASSIC ARTICLES Original research findings and reviews spanning all aspects of the science and technology of casting Since 1971, The Minerals, Metals & Materials Society has published the Light Metals proceedings. Highlighting some of the most important findings and insights reported over the past four decades, this volume features the best original research papers and reviews on cast shop science and technology for aluminum production published in Light Metals from 1971 to 2011. Papers have been divided into ten subject sections for ease of access. Each section has a brief introduction and a list of recommended articles for researchers interested in exploring each subject in greater depth. Only 12 percent of the cast shop science and technology papers ever published in Light Metals were chosen for this volume. Selection was based on a rigorous review process. Among the papers, readers will find landmark original research findings and expert reviews summarizing current thinking on key topics at the time of publication. From basic research to industry standards to advanced applications, the articles published in this volume collectively represent a complete overview of cast shop science and technology, supporting the work of students, researchers, and engineers around the world.

This book contains chapters on cutting-edge developments presented at the TMS annual conference of 2012.

This collection encompasses the following four areas: (1) Solidification processing: theoretical and experimental investigations of solidification processes including castings solidification, directional solidification of alloys, electromagnetic stirring, ultrasonic cavitation, mechanical vibration, active cooling and heating, powder bed-electron beam melting additive manufacturing, etc. for processing of metals, polymers and composite materials; (2) Microstructure Evolution: theoretical and experimental studies related to microstructure evolution of materials including prediction of solidification-related defects and particle pushing/engulfment aspects; (3) Novel Casting and Molding Processes: modeling and experimental aspects including high pressure die casting, permanent casting, centrifugal casting, low pressure casting, 3D silica sand mold printing, etc.; and (4) Cast Iron: all aspects related to cast iron characterization, computational and analytical modeling, and processing.

Major casting processing advancements have been made in experimental and simulation areas. Newly developed advanced casting technologies allow foundry researchers to explore detailed phenomena associated with new casting process parameters helping to produce defect-free castings with good quality. Moreover, increased computational power allows foundry technologists to simulate advanced casting processes to reduce casting defects. In view of rapid expansion of

knowledge and capability in the exciting field of casting technology, it is possible to develop new casting techniques. This book is intended to discuss many casting processing technologies. It is devoted to advanced casting processing technologies like ductile casting production and thermal analysis, casting of metal matrix composites by vortex stir casting technique, aluminum DC casting, evaporative casting process, and so on. This book entitled Advanced Casting Technologies has been organized into seven chapters and categorized into four sections. Section 1 discusses the production of ductile iron casting and thermal analysis. Section 2 depicts aluminum casting. Section 3 describes the casting manufacturing aspects of functionally graded materials and evaporative casting process. Section 4 explains about the vortex stir casting technique to process metal matrix composite castings. All the chapters discussed in detail the processing steps, process parameters involved in the individual casting technique, and also its applications. The goal of the book is to provide details on the recent casting technologies.
Aluminium is an important metal in manufacturing, due to its versatile properties and the many applications of both the processed metal and its alloys in different industries. Fundamentals of aluminium metallurgy provides a comprehensive overview of the production, properties and processing of aluminium, and its applications in manufacturing industries. Part one discusses different methods of producing and casting aluminium, covering areas such as casting of alloys, quality issues and specific production methods such as high-pressure diecasting. The metallurgical properties of aluminium and its alloys are

reviewed in Part two, with chapters on such topics as hardening, precipitation processes and solute partitioning and clustering, as well as properties such as fracture resistance. Finally, Part three includes chapters on joining, laser sintering and other methods of processing aluminium, and its applications in particular areas of industry such as aerospace. With its distinguished editor and team of expert contributors, Fundamentals of aluminium metallurgy is a standard reference for researchers in metallurgy, as well as all those involved in the manufacture and use of aluminium products. Provides a comprehensive overview of the production, properties and processing of aluminium, and its applications in manufacturing industries Considers many issues of central importance in aluminium production and utilization considering quality issues and design for fatigue growth resistance Metallurgical properties of aluminium and its alloys are further explored with particular reference to work hardening and applications of industrial alloys
Approximately 68% of the aluminum produced in the United States is first cast into ingots prior to further processing into sheet, plate, extrusions, or foil. The direct chill (DC) semi-continuous casting process has been the mainstay of the aluminum industry for the production of ingots due largely to its robust nature and relative simplicity. Though the basic process of DC casting is in principle straightforward, the interaction of process parameters with heat extraction, microstructural evolution, and development of solidification stresses is too complex to analyze by intuition or practical experience. One issue in DC casting is the formation of stress cracks [1-15]. In particular, the move toward larger ingot cross-sections, the use of higher casting speeds, and an ever-increasing array of mold technologies have increased industry efficiencies but have made it more difficult to predict the occurrence of stress crack defects. The Aluminum Industry

Technology Roadmap [16] has recognized the challenges inherent in the DC casting process and the control of stress cracks and selected the development of 'fundamental information on solidification of alloys to predict microstructure, surface properties, and stresses and strains' as a high-priority research need, and the 'lack of understanding of mechanisms of cracking as a function of alloy' and 'insufficient understanding of the aluminum solidification process', which is 'difficult to model', as technology barriers in aluminum casting processes. The goal of this Aluminum Industry of the Future (IOF) project was to assist the aluminum industry in reducing the incidence of stress cracks from the current level of 5% to 2%. Decreasing stress crack incidence is important for improving product quality and consistency as well as for saving resources and energy, since considerable amounts of cast metal could be saved by eliminating ingot cracking, by reducing the scalping thickness of the ingot before rolling, and by eliminating butt sawing. Full-scale industrial implementation of the results of the proposed research would lead to energy savings in excess of 6 trillion Btu by the year 2020. The research undertaken in this project aimed to achieve this objective by a collaboration of industry, university, and national laboratory personnel through Secat, Inc., a consortium of aluminum companies. During the four-year project, the industrial partners and the research team met in 16 quarterly meetings to discuss research results and research direction. The industrial partners provided guidance, facilities, and experience to the research team. The research team went to two industrial plants to measure temperature distributions in commercial 60,000-lb DC casting ingot production. The project focused on the development of a fundamental understanding of ingot cracking and detailed models of thermal conditions, solidification, microstructural evolution, and stress development during the initial transient in DC castings of the aluminum alloys 3004 and 5182. The microstructure of the DC casting ingots was systematically characterized. Carefully designed experiments were carried out at the national laboratory and university facilities as well as at the industrial locations using the industrial production facilities. The advanced computational capabilities of the national laboratories were used for thermodynamic and kinetic simulations of phase transformation, heat transfer and fluid flow, solidification, and stress-strain evolution during DC casting. The achievements of the project are the following: (1) Identified the nature of crack formation during DC casting; (2) Developed a novel method for determining the mechanical properties of an alloy at the nonequilibrium mushy zone of the alloy; (3) Measured heat transfer coefficients (HTCs) between the solidifying ingot and the cooling water jet; (4) Determined the material constitutive model at high temperatures; and (5) Developed computational capabilities for the simulation of cracking formation in DC casting ingot. The models and the database developed in this project have been used to predict crack formation and to determine the optimal conditions for DC casting. The results demonstrated that cracking formation is strongly affected by casting conditions and the composition of the alloy. Scrap rate due to crack formation can be significantly reduced by controlling the cast speed and the concentrations of the alloy.

Pulling together information previously scattered throughout numerous research articles into one detailed resource, Physical Metallurgy of Direct Chill Casting of Aluminum Alloys connects the fundamentals of structure formation during solidification with the practically observed structure and defect patterns in billets and ingots. The author examines the formation of a structure, properties, and defects in the as-cast material in tight correlation to the physical phenomena involved in the solidification and the process parameters. The

book draws on the author's advanced research to provide a unique application of physical metallurgy to direct chill (DC) casting technology. He examines structure and defect formation— including macrosegregation and hot tearing. Each technology-centered chapter provides historical background before reviewing current developments. The author supports his conclusions with computer simulation results that have been correlated with highly progressive experimental data. He presents a logical system of structure and defect formation based on the specific features of the DC casting process. He also demonstrates that the seemingly controversial results reported in literature are, in fact, caused by the different ratio of the same mechanisms. Compiling recent results and data, the book discusses the fundamentals of solidification together with metallurgical and technological aspects of DC casting. It gives new insight and perspective into DC casting research.
The book contains the proceedings of the honorary symposium "Advances in the Science and Engineering of Casting Solidification" (TMS2015, Orlando, Florida, March 15-19, 2015) held in honor of Professor Doru Michael Stefanescu, Emeritus Professor, Ohio State University and the University of Alabama, USA. The book encompasses the following four areas: (1) Solidification processing: theoretical and experimental investigations of solidification processes including castings solidification, directional solidification of alloys, electromagnetic stirring, ultrasonic cavitation, mechanical vibration, active cooling and heating, powder bed-electron beam melting additive manufacturing, etc. for processing of metals, polymers and composite materials; (2) Microstructure Evolution: theoretical and experimental studies related to microstructure evolution of materials including prediction of solidification-related defects and particle pushing/engulfment aspects; (3) Novel Casting and Molding Processes: modeling and experimental aspects including high

pressure die casting, permanent casting, centrifugal casting, low pressure casting, 3D silica sand mold printing, etc.; and (4) Cast Iron: all aspects related to cast iron characterization, computational and analytical modeling, and processing.
The light metal symposia are a key part of the TMS Annual Meeting & Exhibition, presenting the most recent developments, discoveries, and practices in primary aluminum science and technology. Publishing the proceedings from these important symposia, the Light Metals Series has become the definitive reference in the field of aluminum production and related light metal technologies. Light Metals 2011 offers a mix of the latest scientific research findings and applied technology, covering alumina and bauxite, aluminum reduction technology, aluminum rolling, cast shop for aluminum production, electrode technology, and furnace efficiency. These proceedings will help you take advantage of the latest technologies in order to produce high-quality materials while cutting costs and improving profitability at the same time.