114th Metalcasting Congress Schedule by Date

(As of February 19, 2010)

Friday, March 19, 2010

1:30 PM
Special Events
Room: S210 A/B

Workshop: Cost Reduction & Quality Improvement - A Formula for Success

John Campbell, University of Birmingham, Ledbury, Herefordshire, United Kingdom.

The workshop will draw attention to the latest concepts regarding the filling and feeding of castings and ways to use the techniques in the foundry to reduce scrap, raise quality, and reduce costs. Principles will apply to all foundry casting processes and metals will include case study data from operating foundries. The workshop will also discuss the effect of entrainment defects on the structure and properties of castings and techniques to avoid the creation of entrainment defects. Separate registration required.

1:30 PM
Special Events
Room: S210 C/D

Workshop: Misused, Abused and Too Little Used Quality Tools

Ted Schorn, Enkei America Inc., Columbus, IN.

You can always tell a master mechanic by looking at his tool box. He invests in the best tools, keeps them in ready, working condition and has a wide range for any situation. He knows how to use them and always applies the right one for the job. Spend time in this workshop with a casting quality “master mechanic.” In this workshop, master mechanic Ted Schorn will show applications of common and not so common tools that can help solve quality, environmental and safety problems. You’ll learn the common mistakes in tool use and pick up some new tools for some frequently occurring casting problems. Among the many subjects you will learn at the workshop: Learn to avoid common mistakes people make using: SPC, Auditing, Visual Inspection, Pareto Charts, Why-Why Analysis to name a few. Learn some little used tools such as: P, C, NP and U Charts, process mapping, failure mode and effects analysis and scatter diagrams among others. Separate registration required.

Saturday, March 20, 2010

7:15 AM
AUTHOR/CHAIR BREAKFAST
Room: S310 E

AFS Author/Chair Breakfast

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For AFS session participants, this breakfast provides the opportunity for authors, session chairs, students and staff to meet and coordinate details for the educational sessions for the day.

8:30 AM
COPPER ALLOY
Room: S320 C

Presiding: Michael Jones, Ford Meter Box Co Inc, Wabash, IN; Michael Buyarski, The Federal Metal Co, Bedford, OH.

PANEL: Safety in the Copper Alloy Foundry (10-158)

James Mallory, Non-Ferrous Founders Society, Park Ridge, IL; Christopher Shanks, Ford Meter Box Co Inc., Wabash, IN; J. Leigh Omer, Fresno Valves & Castings Inc., Selma, CA; Paul Arneson, MetalTek International, Waukesha, WI.

Panel Topics:
Mallory: General Safety Issues
Shanks: Case Study of Improvements
Omer: One Company's approach to Continuing Improvment on the Safety Front
Arneson: Case Study of Improvements

Three foundries present case studies from their foundries. They tell the stories of the safety improvements they made. In addition a general overview of safety issues in the copper alloy foundry will be presented.

8:30 AM
ENVIRONMENTAL, HEALTH AND SAFETY
Room: S320 A
Presiding: James Schifo, Keramida Inc., Indianapolis, IN.

PANEL: What's Hot, What's New: What Could Impact Your Foundry in 2010 (10-107)
Jitendra Radia, McWane Inc., Birmingham, AL; Mark Remlinger, Matthews International Corp., Pittsburg, PA; Thomas Slavin, Navistar Inc., Warrenville, IL.

Panel Topics:
Radia: Air Topics
Remlinger: Water & Waste Topics
Slavin: Safety & Health Topics

Update on activities in areas of air topics, water and waste topics along with safety and health topics that affect metalcasters.

PANEL: EHS Strategies in a Difficult Economy (10-111)
Dwight Barnhard, Superior Aluminum Castings Inc., Independence, MO; George Doremus, Morrison Brothers Company, Dubuque, IA.

Managing your EHS Compliance is difficult even under normal circumstances. Trying to juggle EHS Compliance issues during difficult economic times can task even the most accomplished foundry manager. This panel will discuss how your foundry can develop and manage an effective EHS program that will not only serve your needs during normal times, but will also achieve your goals during the lean times.

8:30 AM
LOST FOAM CASTING
Room: S320 D
Presiding: Jamey Reynolds, Citation Columbiana, Columbiana, AL.

Sponsored Research: Vacuum Assisted Filling of Lost Foam Castings (10-062)
Harry Littleton, Alan Druschitz, University of Alabama at Birmingham, Birmingham, AL.

Research in the UAB/AFS/DOE Lost Foam consortium has shown that the pressure differential between the sand and molding cavity plays a dominant role in the removal of pattern pyrolysis products. This phenomenon was first discovered during pouring of high silicon aluminum alloys that historically produce large amounts of surface defects commonly named “alligator skin”. Studies at various pressure differentials, using vacuum during pouring, revealed that the alligator skin could be eliminated. A subsequent study, pouring an engine block with A319 at various temperatures, has revealed that improved mechanical properties can be achieved with moderate vacuum levels and pouring temperatures as low as 12500 F (6770 C). This lower pouring temperature alloys for a significantly lower hydrogen content of the melt, resulting in lower metal porosity, a major factor controlling mechanical properties, especially elongation.

Porosity Reduction in Lost Foam Casting of Cylinder Heads by an Advanced Metal Stirring Process (10-155)
Ginat Muginstein, Esther Kiperwasser, Ran Rosen, Dan Yardeni, Netanya Plasmatec Ltd, Netanya, Israel.

The Plasma Treatment Casting (PTC) process applies moving plasma arc to stir molten metals and alloys during the solidification stage in conductive and nonconductive dies. The intensive stirring has several major benefits: finer microstructure, better chemical homogeneity and improved feeding in both macro and micro scales, thus resulting in reduction of porosity size and porosity ratio. In recent years, the need for lighter and geometrically complicated cylinder heads designs drove designers and producers to rediscover the advantages of Lost Foam casting. Lost Foam could turn to be a preferred casting method of the future if it will overcome the major problem of porosity level. The PTC technology can be the solution.

Lost Foam Foundry Safety (10-162)
Bruce McMellon, Vulcan Engineering Co. Inc., Helena, AL.

Lost Foam provides significant advantages in Safety and working conditions compared to most other processes. This presentation and discussion will compare the results of these advantages to other foundry processes using information provided by several operating Lost Foam foundries.

8:30 AM
MAGNESIUM
Room: S320 B
Presiding: Mahi Sahoo, CANMET - MTL, Ottawa , ON, Canada.

Grain Refinement of AZ91E with TiB2 and Al4C3 Additions (10-071)

Kenneth Lee, Comondore Ravindran, Ryerson University, Toronto, ON, Canada; B.S. Murty, Indian Institute of Technology-Madras, Chennai, Tamil Nadu, India.

An inexpensive and effective grain refiner for magnesium-aluminum systems will enable greater applications of these popular alloys. Novel addition of either Al-5TiB2 or Al-Al4C3 into aluminum alloys has resulted in effective grain refinement. TiB2 and Al4C3 compounds also provide heterogeneous nucleation sites for magnesium alloy grains. Thus these novel additions were investigated for their enhanced grain refinement of AZ91E. The AZ91E melts with master alloy additions (0.1, 0.2, 0.5 and 1.0 wt %) were poured at 720°C into graphite molds pre-heated to 750°C. For each master alloy concentration, the holding times at 720°C were 5, 10 and 20 minutes. The microstructures were characterized by scanning electron microscopy and light optical microscopy. Grain size and hardness measurements were also performed, along with cooling curve analyses. Both additions showed significant grain refinement of the base metal. The Al-Al4C3 master alloy was the most effective refiner in terms of smallest grain size and consistency of grain size across the various concentrations and holding times.

Grain Refinement and Fading of Aluminum-Titanium-Boron Based Refiner on AZ91E Magnesium Alloy (10-072)

Abdallah Elsayed, Comondore Ravindran, Ryerson University, Toronto, ON, Canada; B.S. Murty, Indian Institute of Technology-Madras, Chennai, Tamil Nadu, India.

The reduction of vehicle weight in the aerospace and automotive industries is essential to reducing carbon emissions and improving fuel economy. Magnesium is known as a competitive alternative to aluminum alloys in structural applications. However, the strength of magnesium alloys are lower than those of aluminum alloys. Grain refinement can significantly improve the mechanical properties of alloys. This study investigates the effectiveness and fading of two aluminum-titanium-boron based grain refiners in AZ91E magnesium alloy. The grain refiners used were Al-5Ti-1B and Al-1Ti-3B. Each grain refiner was stirred into the molten AZ91E at 750°C for 30 seconds at addition levels of 0.1, 0.2, 0.5 and 1.0 wt% grain refiner. To examine fading of the grain refiner particles, the refiners were allowed to settle in the molten metal prior to pouring. Fading tests were conducted using settling times of 5, 10 and 20 minutes. The results suggest that the addition level for minimum grain size for Al-5Ti-1B and Al-1Ti-3B grain refiners were 0.2 wt% and 1 wt% respectively. The grain refinement in both cases is due to TiB2 particles providing nucleating sites for the magnesium matrix. Minimum fading was observed with 0.1 wt% of the Al-5Ti-1B grain refiner and 1wt% of the Al-5Ti-1B grain refiner. Determination of the optimal levels of grain refiners to minimize grain size and fading allows for the production of magnesium castings with increased mechanical properties that can be implemented in industry. The improved mechanical properties of these refined magnesium alloys will promote their use for more structurally demanding applications.

Design of a Step Permanent Mold for Casting Magnesium Alloy AJ62 (10-007)

Zhizhong Sun, Henry Hu, Jonathan Burns, Xueyuan Nie, Lihong Han, University of Windsor, Windsor, ON, Canada.

Presently, high pressure die casting processes are the dominant technique which manufactures almost all magnesium automotive components. To further expand magnesium applications in the automotive industry, alternative manufacturing techniques need to be developed. Permanent mold casting could potentially be one of them due to its high popularity in the aluminum casting industry. However, documentation on design rules and procedures for magnesium permanent castings is limited. In this paper, a design procedure for magnesium permanent molds is proposed. A permanent mold for step castings of magnesium alloy AJ62 which is currently used for die cast engine blocks was design with the help of CAD design and simulation of cavity filling and solidification. The designed mold with four steps of 20, 10, 6 and 4 mm was also fabricated and poured with die casting magnesium alloys AJ62. The results show that die temperature-controlled heat transfer during mold filling and vent design play key roles in completely filling the cavity which involves relatively thin wall sections. The success in manufacturing the permanent mold step casting of magnesium alloy AJ62, which was originally developed for high pressure die casting, demonstrates the feasibility of the proposed design procedure.

10:15 AM
COPPER ALLOY
Room: S320 C

Presiding: William Surman, I Schumann & Co., Bedford, OH; Jeff Sorenson, Neptune Technology Group Inc, Tallassee, AL.

PANEL: Health, Safety, and Regulatory Issues (10-159)

James Michel, Copper Development Association Inc., New York, NY; Sam Sahu, Waukesha Foundry Inc., Waukesha, WI; James Mallory, Non-Ferrous Founders Society , Park Ridge, IL.

Panel Topics:
Michel: Update on Anti-Microbial Aspects of Copper Based Alloys
Sahu: Use of Dairy Metals in Food Industry
Mallory: New Area Source Rule

An update on the anti-microbial aspects of copper based alloys, a discussion of the USDA regulations regarding copper alloy castings in food handling equipment, and a discussion of the new area source rule for non-ferrous foundries.

10:15 AM
DIE CASTING
Cast Materials I
Room: S320 E

Presiding: Yeou-Li Chu, Ryobi Die Casting (Usa) Inc., Shelbyville, IN.

Current Research and Challenges in the Die Casting of Metal Matrix Composites (T10-011)

Zili Xu, University of Wisconsin-Milwaukee, Milwaukee, WI.

Die casting is an important technology for the synthesis and production of near-net shape Metal Matrix Composite (MMC) components, however there are still a number of challenges in the production of these materials including the need for special tooling, die wear, and casting quality. This paper reviews the advances of recent years on die casting and squeeze casting of metal matrix composites, including fiber and particulate reinforced aluminum and magnesium alloys. The

unique process modifications, resulting microstructures and properties of die-cast MMCs are reviewed. In addition, research imperatives addressing the unique challenges and opportunities in the development of die-cast metal matrix composites will be discussed.

SHS-Die Casting of Metal Matrix Composites Phase II (T10-012)

John Moore, Colorado School of Mines, Golden, CO.

SHS-Die-casting is a novel process that couples in-situ exothermic self-propagating, high temperature (combustion) synthesis (SHS) of ceramics within the molten metal and die-casting. This paper describes the coupled SHS Die-Casting (SHS-DC) of net shaped Al-TiC metal matrix composites (MMC) in which the ceramic TiC phase is increased from 20 to 60 volume percent. The underlying principles of controlling the exothermic SHS reaction within the molten metal are discussed as is the coupling of this synthesis route with semi-solid die casting to produce net shaped Al-TiC MMC components. Wedge test specimens and larger plate components were die cast and the mechanical properties and microstructural development of the MMCs determined as a function of processing parameters and volume fraction of the TiC ceramic phase. SHS-DC has been shown to provide a rapid, affordable production route in the production of net shaped metal matrix composites. Further discussion is presented on the potential for this novel manufacturing route for net shaped MMC components for application in ground and air transportation.

CASTCOMP – Metal Over Composite Casting (T10-013)

Frida Hallstrom, Swerea SWECAST, JÖNKÖPING, Sweden.

A lightweight product is usually produced by integrating composite components into classical metal structures, resulting in a complex multi-material product. One of the biggest challenges in producing complex multi-material products is the need of joining the different materials together. Today, such products are usually produced by the means of mechanical and/or adhesive joints. However, all of the current joining techniques result in a number of difficulties, and therefore, an alternative method of joining metal and composite materials is considered in the following work. Within the framework of the CASTCOMP project, an innovative manufacturing concept, based on casting of lightweight metal onto polymer matrix composites, has been developed. In this method, a metal layer is cast directly onto composite bars, whereby the joint is formed by means of thermal shrinkage of the solidifying metal surrounding the composite component. Several casting methods and joint geometries have been tested during the course of the project. The most promising results, in terms of joint strength and cost efficiency, were reached with high pressure die casting. This method, in conjunction with optimised geometric features, ensured minimal exposure time for the polymeric matrix material at high temperature. Hence, it did not decompose considerably while the metal solidified. Evaluation of the joints mechanical performance clearly demonstrated that the joining technique has large potential.

10:15 AM
ENVIRONMENTAL, HEALTH AND SAFETY
Room: S320 A

Presiding: Jack Schuldt, Safety Specialties Inc , Mulberry, FL.

Top OSHA Foundry Citations (10-168)

Rich Fairfax (Invited), Occupational Safety & Health Administration (OSHA), Washington, DC.

Find out what the most prevalent OSHA citations issued to metalcasting NAICS codes during the last OSHA fiscal year (Oct 1, 2008 through Sep 30, 2009).

Quality Management for Safety (10-090)

Theodore Schorn, Enkei America Inc., Columbus, IN.

At least 30 years ago it was formally established that industrial hazards could be dramatically reduced through a management system where a performance feedback loop was established (Sulzer-Azaroff, de Santamaria, 1980). Since then the intuitive understanding that management's establishment of an appropriate safety culture and safety climate is necessary for good safety performance has been well documented in the literature of human behavior and safety engineering. This paper adds to the discussion by reflecting on the broad correspondence such findings have with the work done in the quality profession. Quality performance improvement rests on the same principles and requires the same organizational climate/culture. This finding should serve to open a new avenue for investigation and suggest mutual support for quality and safety responsible individuals in an organization.

10:15 AM
LOST FOAM CASTING
Room: S320 D

Presiding: Bruce McMellon, Vulcan Engineering Co Inc , Helena, AL.

PANEL: Lost Foam - Castings for a Diverse Market (10-161)

Chris Campbell, Bombardier Recreational Products, Spruce Pine, NC; David Thrash, Neptune Technology Group Inc., Tallassee, AL; Jamey Reynolds, Citation Columbiana, Columbiana, AL; Franz-Josef Woestmann, University of Paderborn, Paderborn, Germany.

Panel Topics:
Campbell: Aluminum Lost Foam Recreational Products
Thrash: Lost Foam Brass Valves
Reynolds: Iron Applications in Lost Foam
Woestmann: E-mobility - New Assignments for Foundry Electric Motors and Fuel Cells

The process advantage of lost foam casting continues to be weight reduction, reduced machining content, and integration of components. This combination leads to a lower cost solution for the casting purchaser. This panel will showcase the advantages of three different material applications including, iron, aluminum, and brass. The panel will also discuss the application of lost foam to new components, fuel cells and electric motors for the new generation of Electric Vehicles.

10:15 AM
MELTING METHODS & MATERIALS
Room: S320 B

Presiding: Richard Volk, United Refractories, Sharonville, OH.

Carbon Footprint Comparison, Electric Versus Cupola Melting (10-106)

David Kasun, Kuttner LLC, Port Washington, WI.

A comprehensive comparison of the carbon footprint and CO2 emissions will be made for electric and cupola furnace melting of cast iron. For the electric furnace operation, the study will evaluate coal consumption, power plant losses, transmission losses, melting losses and production output and will account for carbon alloying requirements. For cupola melting, the study will consider coal consumption (for coke production), coking process heat reclamation, coking byproducts production, energy losses and waste heat recovery and will consider the carbon alloying conditions afforded by the use of coke. Consideration will also be given to the potential for additional waste heat recovery from the waste gas. CO2 emissions would be accounted for along each step of the process for each scenario. Total carbon units and CO2 emissions estimates per unit of iron, will be provided for each scenario.

How Treated Ductile Iron Returns Contribute to Lining Wear (10-012)

William Duca, Duca Manufacturing, Boardman, OH; Russ Seider, Pryor Giggey Company, Chilton, WI; Jerry Beaird, Rochester Metal Products, Rochester, IN.

The historical explanation for silica lining wear in the lower portion of the lining in a coreless induction furnace when melting grey iron is due to the reduction of silica by carbon in the molten iron, However, this explanation does not adequately address the situation when melting ductile base iron. While the reduction of a portion of the silica lining by carbon still takes place, the primary wear mechanism is the melting and sloughing of the hot face of the lining. The reactive elements from MgFeSi treated ductile iron returns reduce silica and form oxides that mix with and lower the melting point of the hot face of a silica lining. When the molten bath temperature rises above the melting point of the altered lining, that portion of the lining is washed away by the electromagnetic stirring action in the furnace and becomes surface slag.

11:45 AM
Special Events
Room: Metalcasting Technology Theatre

Economic Forum

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Is the recession over for the Metalcasting Industry? Which sectors of the economy will first see resurgence? Is the industry prepared for resurgence in business? Where do we stand with Cap and Trade legislation and what impact will it have on our industry? Hear the views of Redmond Clark (CBL Industrial Services), Raymond Monroe (Steel Founders Society of America), Alfred Spada (American Foundry Society), and Daniel Twarog (North American Die Casters Association) on these crucial topics plus ask the panel your most pressing questions regarding the economy

11:45 AM
Special Events
Room: S310 F

AFS Copper Division Luncheon

Chris Norch, Denison Industries, Denison, TX.

This luncheon will include a presentation by Chris Norch, President of Denison Industries, who will provide an up-to-date discussion involving the latest political issues affecting AFS, methods in addressing these issues with our elected representatives and the need for a collaborative effort from within our society to protect our industry.

2:00 PM
CAST DESIGN & PURCHASING
Room: S320 F

How to Identify a Quality Casting Supplier (10-169)

Robert Mueller Jr., P & H Mining Equipment, Milwaukee, WI.

When sourcing components, it is critical you have confidence in your suppliers. They need to meet lead time and quality requirements while also providing value-added services that make them more than a commodity supplier. This presentation details one purchaser's opinion of how to select "World-Class" suppliers of engineered cast components to ensure your needs are met today and into the future.

Casting Simulation: A Primer for Casting Buyers & Designers (10-133)

Christof Heisser, Steve Sikorski, Magma Foundry Technologies Inc., Schaumburg, IL.

Casting process simulation is widely used and accepted in metalcasting facilities throughout the U.S. and the entire world. They use simulation software as a communication tool to designers to support the part development process with the following objectives: ·Reducing development time and costs through improved virtual component design ·Reliable assessment of fatigue life considering local material behavior .Exploitation of full material potential ·Scrap reduction through early integration of process simulation ·Castable designs ·Early identification of potential problems ·Robust quality and improved reliability In many cases, casting process simulation is an afterthought, when the design of a part is already finalized. Often this is too late to make any changes on the design, limiting the full potential castings have to offer. The goal is to create a fully integrated CAE process through simultaneous optimization by utilizing simulation and, eventually, no need for prototypes. The seminar will present examples of the successful application to and implementation in to the part development process.

2:00 PM

CAST IRON

Room: S320 A

Presiding: Fred Linebarger , Miller and Company , Rosemont, IL; George Kokos, Caterpillar Inc., Peoria, IL.

Lustrous Carbon on Gray Iron (10-136)

John Campbell, University of Birmingham, Ledbury, Herefordshire, United Kingdom; Rodney Naro, ASI International Ltd., Cleveland, OH.

During the filling of a mold, the hydrocarbons released from resin binders decompose on the liquid surface of cast irons, releasing carbon and hydrogen. The layer of pyrolytic type of carbon known as lustrous carbon seems likely to form on the oxides, FeO or SiO2, which form initially on the melt surface. As the melt advances, the carbon layer is trapped between the melt and the mold, its rigidity assisting to bridge sand grains and thus improve the surface finish of the casting. Later the opening of the so-called 'air gap' because of casting contraction and mold expansion creates an oxygen-free environment in which the decomposition of the mold gases no longer has a planar substrate, and can grow as a fiber. The fibrous graphite fills the gap and fills spaces between grains, causing the lustrous carbon layer to adhere to the sand mold. The planar lustrous carbon layer in association with the oxide layer on the melt surface and the fibrous growth in the absence of oxygen is seen to be the vapor phase growth equivalent of the solidification growth of (i) graphite flakes on oxide bifilms and (ii) the worm-like growth of compacted graphite irons in which planar oxide substrates have been eliminated by the addition of Mg.

Solidification Pattern of Un-inoculated and Inoculated Gray Cast Irons in Wedge Test Samples (10-010)

Stelian Stan, Mihai Chisamera, Iulian Riposan, Eduard Stefan, Politehnica University , Bucharest, Romania; Michael Barstow, Consultant, Fremont, CA.

The present work exploits the chill wedge casting as having a range of modulus values and compares with thermal analysis to develop an understanding of chill, and associated structures. Wedges from the 'W' range in ASTM A 367, are used to evaluate the chilling tendency of hypoeutectic gray irons; cooling modulus (CM) especially confers different solidification conditions. New parameters relative clear chill, relative mottled chill and relative total chill were introduced to compare chill sensitivity of iron samples with a different cooling modulus (0.1-0.4 cm) and inoculation influence, at preferred Mn, S and Al content in the final irons. Thermal analysis was recorded within the wedge body at different distances from the apex, and into the thermal center of the wedges. Eutectic undercooling and cooling rate decrease from the apex up to the thermal center of the wedge (0.5-0.6 H level), but increase again after this, despite the greater width, due to the end (corner) effect favoring carbides and/or undercooled graphite. This effect was stronger for lower cooling modulus (W1, W2 wedges) and/or for lower inoculation. Solidification of a standard Quik-cup sample (CM = 0.75 cm) appears to be similar to the thermal center of a W31/2 wedge, or W3 wedge with a Te-addition. The difference between un-inoculated and inoculated irons increases from clear chill, through the mottled area up to the total chill, especially for faster solidification. There appears to be a difference in chill evaluation methods, for inoculated irons, between macro- and micro-analyses, especially for thin wall casting conditions. If an iron has the recommended Mn, S and Al content [(%Mn) x (%S) = 0.04and 0.005%Al] then low chill tendency is possible at low inoculant additions.

Sponsored Research: Aging Effect on Gray Cast Iron Machinability: Importance of Microstructure (10-035)

Von Richards, Jared Teague, Simon Lekakh, Missouri University of Science and Technology, Rolla, MO.

Previous research has concluded that age strengthening in gray cast iron from nano-nitride precipitation can improve the machinability of the iron. In the presented research the opposite behavior is shown, where age strengthening reduced the machinability of gray iron, based on tool forces. These results are compared to previous results and microstructure analysis used to determine why there are differences in how gray cast iron machinability reacts to age strengthening. The conclusion is that gray iron decreases in machinability after aging when there is essentially no free ferrite present in the casting. Suggests for applying age strengthening in industry, including for improvements in machinability, are provided.

2:00 PM

COPPER ALLOY

Room: S320 C

Presiding: Geary Smith, G & W Electric Co, Blue Island, IL; Stephen Ducharme, H Kramer & Co., Chicago, IL.

PANEL: Case Studies in the Use of Solidification Modeling to Transition Away From Leaded Alloys (10-160)

Patrick Kluesner, Jonathan Remakel, A Y McDonald Mfg Co., Dubuque, IA; Shelly Dutler, MAGMA Foundry Technologies Inc., Schaumburg, IL; Ronald Karg, Mark Biehl, Ford Meter Box Co Inc, Wabash, IN; Sam Scott, ESI Group, Farmington Hills, MI.

Two foundries present case studies of their use of solidification modeling to ease their transition from leaded to non-leaded alloys. In addition there is a presentation on re-engineering with solidification modeling.

2:00 PM

DIE CASTING

Cast Materials II

Room: S320 E

Presiding: Frank Goodwin, Int Lead Zinc Research Org Inc., Durham, NC.

Dynamic Properties of High Performance Die Casting Alloys (T10-021)

Diran Apelian, Worcester Polytechnic Institute, Worcester, MA.

In collaboration with North American Die Casting Association (NADCA) and the American Metal Casting Consortium (AMC), the Advanced Casting Research Center (ACRC) at Worcester Polytechnic Institute (WPI) embarked on a project that aims to develop new high performance aluminum die casting alloys. Specifically, the three-year project aims to develop aluminum die casting alloys with enhanced room and elevated temperature mechanical properties compared to those of standard A380 alloy. Towards this goal, three aluminum die casting alloys were developed. Two are variations of 380 alloy, and one is an aluminum alloy with a relatively high Mg content. In this paper, we present results of measurements of the dynamic properties (fatigue strength and impact toughness) of die cast ASTM standard specimens of these alloys and we compare these results to those obtained from die cast ASTM standard specimens of commercial A380 alloy. Two of the new alloys show significant increase in fatigue life and one alloy shows significant increase in impact toughness compared to commercial A380 alloy.

The findings are analyzed and discussed in relation to the alloys' chemical composition and tensile properties.

Semi-Solid Casting of High-Quality Aluminum Turbocharger Impellers (T10-022)

Greg Wallace, Aluminum Complex Components, Denver, CO.

The semi-solid thixocasting process is capable of producing castings with extremely high internal quality. In the T6 heat treated condition, the mechanical and fatigue properties of thixocast aluminum castings approach those of wrought products. This paper describes the semi-solid casting of aluminum turbocharger impellers. A turbocharger converts waste energy from the engine by using exhaust gases to drive a turbine wheel, causing an impeller to compresses air and push it into the engine. The compression ratio for modern diesel engines can be up to 5:1, which can be only achieved with very high rotation speeds (up to 150,000 rpm for small impellers). The complex geometry and very high running speeds of impellers creates high stresses and so impellers normally fail from fatigue. Therefore, it is vital to minimize defects while fabricating turbocharger impellers. The intricate form of turbocharger impellers represents an extremely complex shape for production in a metal mold. The technology used to produce the semi-solid impellers will be described in detail, and it is the subject of a world-wide patent application. The semi-solid cast impellers are heat treated to the T6 temper. Results from testing will be presented demonstrating that the impellers are free of porosity and other internal defects. Both mechanical property and fatigue data will be presented showing that the semi-solid impellers have better properties than impellers produced by conventional casting and similar properties to forged + machined impellers.

Mechanical Property Improvements of Die Cast Engine Blocks (T10-023)

Mohammad Irfan, Case Western Reserve University, Cleveland, OH.

Increasing use of high pressure diecast aluminum automotive powertrain components (such as engine blocks) places greater demands on the mechanical properties resulting from the casting process. While very fast cooling rates are typical in the thin walled die castings, the same cannot necessarily be achieved in thicker sections commonly encountered in larger castings. The results of an experimental investigation on the improvement of mechanical properties of die cast engine blocks are reported. The focus of this study was to seek improvement in mechanical properties of aluminum die cast engine blocks by a reduction in the secondary dendrite arm spacing (SDAS) and modification of the acicular Si microstructure in the eutectic phase. Introducing additional cooling in the thick sections of the casting resulted in reduction of SDAS and consequent improvement of mechanical properties. However the effect of increased cooling faded with increasing distance from the core. Eutectic modification was achieved by modification with Sr. A target modification of 140 ppm led to significant improvements in elongation.

2:00 PM
MAGNESIUM
Room: S320 B

Presiding: David Weiss, Eck Industries Inc., Manitowoc, WI.

Microstructure and Mechanical Properties of Magnesium-Aluminum-Manganese Cast Alloys (10-079)

Alan Luo, Anil Sachdev, General Motors Research & Development Center, Warren, MI.

The Mg-Al-Mn (AM) based cast alloys were optimized for balanced tensile properties (strength and ductility) and reasonable response to heat treatment. The microstructure and mechanical property testing suggested an optimized 7-8%Al in Mg-Al-Mn based alloys. The die casting of AM70 (Mg-7%Al-0.3%Mn) alloy show very good properties, i.e., yield strength of 157 MPa, ultimate tensile strength of 252 MPa and elongation of 5.6%. Both T5 (artificial aging after as-cast condition) and T6 (artificial aging after solution and water quench) provide similar strength improvement for AM alloys containing more than 7% Al.

Numerical Simulation and Process Development for Low Pressure Die Casting of Magnesium Alloy Wheels (10-077)

Liming Peng, Yingxin Wang, Penghuai Fu, Wenjiang Ding, Shanghai Jiao Tong University, Shanghai, China; Alan Luo, Ravi Verma, General Motors Research & Development Center, Warren, MI.

This paper summarizes the numerical simulation and experimental study on low pressure die casting of JDM1 magnesium alloy wheels. JDM1 alloy is a Mg-Zn-RE based high-strength magnesium alloy recently developed by Shanghai Jiao Tong University, China. AnyCasting, a commercial casting simulation software based on the finite difference method, was employed to simulate the low pressure die casting process. The effect of die filling time, die temperature, casting temperature and cooling system on filling and solidification sequence of magnesium wheel casting was studied by simulation. The potential defects, such as shrinkage at the rim/spoke junction part, were predicted by simulation and validated by casting trials. The use of cooling system was found to be effective in reducing the shrinkage based on the simulation results and casting experiments. JDM1 magnesium alloy wheels were successfully cast by low pressure die casting process without visible casting defects. The bench test results suggest that cast JDM1 magnesium alloy wheels meet the structural and fatigue requirements of automobile wheels.

Corrosion of Permanent Mould Cast Mg Alloy AJ62 in NaCl Solutions (10-022)

Jonathan Burns, Henry Hu, Xueyuan Nie, Jun Feng Su, University of Windsor, Windsor, ON, Canada.

To meet heightened demands for lightweight materials in the transportation industries, casting magnesium alloys, their manufacturing processes, and their properties are being further developed and studied. Of particular significance for its high temperature performance is the AJ62 alloy. At present, an understanding of corrosion for the permanent mould (PM) cast variant of this alloy must be expanded to enhance the longevity of such cast components. In particular, components manufactured for chassis and suspension applications, which are subject to salty road conditions, must have sufficient electrochemical integrity. Microstructure, determined largely by casting processes, has a noteworthy effect on the corrosion of magnesium alloys. This study attempts to determine the threshold of NaCl concentrations above which the effect of grain structure becomes negligible on corrosion potential. Experiments include potentiodynamic testing of two permanent mould cast microstructures with markedly different grain sizes in each of four NaCl solutions having different concentrations. The preliminary results indicate that the severity of AJ62 corrosion increases with the concentration levels of the tested NaCl solutions. The effect of grain sizes on the corrosion resistance of the PM castings reduces as the concentration levels rise.

2:00 PM
MELTING METHODS & MATERIALS
Room: S320 D

Presiding: Peter Satre, Allied Mineral Products Inc , Columbus, OH.

PANEL: Tuyere Injection in Cupolas (10-130)

Daniel Smithburg, Dexter Foundry Co, Fairfield, IA; Ron Beyerstedt, Mastermelt LLC, Winona, MN; Greg Jarski, Grede Foundries Inc., Iron Mountain, MI.

Tuyere injection in cupolas has been demonstrated to provide foundries with an important tool to efficiently and cost effectively control melt composition. The panel will discuss the theory behind tuyere injection, as well as present real world results. Practical aspects of bring injection technology into the foundry will be presented.

3:45 PM
CAST DESIGN & PURCHASING
Room: S320 F

A Buyer's & Designer's Intro to Metalcasting Processes & Alloys (10-170)

Alfred Spada, Leo Baran, American Foundry Society, Schaumburg, IL.

To understand how to design and source engineered metal castings, you must understand the relationship between the various metalcasting processes and alloys and how that marriage can unleash the geometric power metalcasting offers. This presentation reviews those processes and alloys, and illustrates some successful designs achieved through the marriage.

3:45 PM
CAST IRON
Room: S320 A

Presiding: MIke Riabov, Neenah Foundry Co, Neenah, WI; Andrew Adams, Foseco Metallurgical Inc., Cleveland, OH.

PANEL: CSI: Foundry. Practical Aspects of Casting Defects Resolution (10-123)

Nick Lashway, Foseco Metallurgical Inc., Cleveland, OH; Robert Bigge, ICRI, Columbus, OH; Gregory Miskinis, ThyssenKrupp Waupaca, Waupaca, WI.

Panel Topics:
Lashway: "Defect Resolution: Basic Detective Work"
Bigge: "Resolving a Fatigue Life Issue"

Anyone who ever worked in a foundry was also involved (directly or indirectly) in scrap troubleshooting. This panel is organized by the AFS 5-H committee and will concentrate on the "detective work" that should take place to determine true cause(s) of a number of common iron casting defects. Panel presenters will cover the basics of defects resolution as well as present case studies showcasing some of troubleshooting approaches.

3:45 PM
DIE CASTING
Cast Materials III
Room: S320 E

Presiding: John Jorstad, JLJ Technologies Inc, South Hill, VA.

The Optimization Of Cu And Mg For The Development Of Strength And Ductility In Heat Treated ADC12/383/A383/B384 Alloys (T10-031)

Roger Lumley, CSIRO Light Metals Flagship, Victoria, Australia.

Recently, it has been shown that industrially produced aluminium alloy high pressure diecastings (HPDC's) can be successfully heat treated without encountering problems with surface blistering or dimensional instability. This procedure involves using severely truncated solution treatment times at lower than normal temperatures followed by conventional quenching and T4 or T6 ageing procedures. For the T6 tempers, 0.2% proof stress values may be doubled whereas, for a T4 temper, simultaneous increases in 0.2% proof stress and ductility are possible. The present paper reports further advances that have been made with the heat treatment of Al-Si-Cu HPDC alloys (ADC12/383/A383/B384) through compositional changes. Special consideration is given to the roles of copper and magnesium and the ways these elements can affect microstructures and mechanical properties in both the as-cast and heat treated conditions. Interrelationships between heat treatment, composition and quality indices are discussed and strategies are described to produce higher ductility variants of these HPDC alloys.

Effect of Thermal Treatment on Tensile Properties of Vacuum Die Cast Modified Aluminum Alloy A356 (T10-032)

Henry Hu, University of Windsor, Windsor, ON, Canada.

In the past three decades, aluminum have increasingly been used in automobiles and are projected to continue doing so reaching 300 pounds per vehicle worldwide by 2020 due primarily to rising demand on vehicle weight reduction and fuel economy. Recently, vacuum assisted high pressure die casting processes (HPDC) appear to gain popularity in the automotive industry to manufacture aluminum components with high requirement on engineering performance since they are capable of offering high component integrity with enhanced quality, and high productivity. However, HPDC processes often result in residual stresses in castings which could cause distortion and warping in components with relatively thin walls and long geometry. To release residual stresses, a thermal treatment is applied to as-cast components. In this study a number of thermal treatment schemes over a wide range of temperatures between 120˚ to 350˚ C have been experimented in an effort to understand the effect of thermal treatment on tensile properties of vacuum die cast modified A356 alloy. It was found from this study that, the morphology of eutectic silicon has a sound effect on the tensile properties of the tested alloy. The content of magnesium-based intermetallic phase, their morphology and distribution throughout the matrix affect on the mechanical properties as well. The reduction in the strengths of the alloy treated at 350˚C for two

hours should be at least attributed partly to the absence of the magnesium-based intermetallic phase. However the presence of sufficient amount of magnesium intermetallic phase had played important role in strengthening the alloy thermally treated at 200˚C.

3:45 PM
ENVIRONMENTAL, HEALTH AND SAFETY
Room: S320 C
Presiding: Jitendra Radia, McWane Inc, Birmingham, AL.

PANEL: Climate Change Panel (10-110)
James Schifo, Keramida Inc., Indianapolis, IN; Alicia Oman, AFS Washington Office, Washington, DC.

This panel will consist of an update on the Climate Change initiatives. The requirements of the USEPA Greenhouse Gas Reporting Rule will be reviewed as it applies to metalcasting operations. A Legislative Update on the Cap-and-Trade Bill being proposed in Washington will also be covered in detail.

How to Implement an Energy Conservation Program in Your Foundry (10-109)
James Schifo, Keramida Inc., Indianapolis, IN.

This presentaion will provide basic guidance on how to develope an energy conservation program in a metalcasting facility. It will include the essential elements of an energy conservatin program along with providing the listner a general understaning of thier energy bills and how to reduce costs associated with energy use.

3:45 PM
MAGNESIUM
Room: S320 B
Presiding: Rob Bailey, BS Metallurgy Inc., Manitowoc, WI.

Modification of As-Cast Microstructure of AZ91-1Si Magnesium Alloy Using Al-5Ti-1B Master Alloy (10-070)
Sophie Lun Sin, Saad Khan, Commondore Ravindran, Ryerson University, Toronto, ON, Canada.

In recent years, the quests to improve the elevated temperature properties of magnesium alloys have resulted in the introduction of Mg-Al-Si alloys. However, the processing of magnesium alloys containing silicon is limited to die casting, since the formation of coarse Chinese script Mg2Si phase leads to poor mechanical properties. Modification and refinement of Mg2Si phase could improve the mechanical properties of Mg-Al-Si alloys. In this investigation, varying amounts (0.1-1.5 wt.%) of Al-5Ti-1B master alloy was added at various holding times to the AZ91 magnesium alloy (with 1%wt silicon). The morphology and size of the Mg2Si phase were studied. Results showed that Al-5Ti-1B master alloy modified the Mg2Si phase from Chinese script to a refined polygonal shape. As a result, mechanical properties of the new alloy have significantly improved. The modification effects also proved to depend on the amount of Al-5Ti-1B, and it was also demonstrated that holding time have distinct effect on the modification of inter-metallic phase. This research presets a potential to improve the adaptability of magnesium alloys by the casting industry.

Influence of Silicon on the Microstructure and Mechanical Properties of Lost Foam Cast AE42 Magnesium Alloy (10-044)
Anthony Lombardi, Sophie Lun Sin, Comondore Ravindran, Ryerson University, Toronto, ON, Canada.

The continuing improvement of magnesium alloys with regards to mechanical properties and castability is important in order to reduce the weight of engineering components and thereby reducing the energy consumption. AE42 is a magnesium alloy that was developed for elevated temperature applications, but its castability is poor and its mechanical properties deteriorate rapidly above 150 °C. The addition of silicon to magnesium alloys, such as AZ91, has resulted in significant improve of the mechanical properties due to the formation of a thermally stable Mg2Si intermetallic phase. In this research, various amounts of silicon (0.3, 0.7 and 1.0 wt% Si) were added to the AE42 alloy and the specimens were prepared using the lost foam casting process. The microstructure of the specimen were characterised by optical microscopy, scanning electron microscope and electron probe microanalysis. Tensile testing was performed at ambient temperature and at 150 °C. Preliminary results show that the Al-Si-RE phase that formed during solidification caused the tensile strength to decrease but the ductility to increase at ambient temperature. The addition of silicon however improved the tensile properties at 150 °C.

Precipitation During the Solidification of Mg-3wt%Al-1wt%Zn-(0.001-1%) Sr Alloys (10-114)
Alireza Sadeghi, Mihriban Pekguleryuz, McGill University, Montreal, PQ, Canada.

Microstructural investigation and thermal (cooling-curve) analysis were carried out to study the precipitation in AZ31 magnesium alloy containing up to 1wt% strontium. Results indicate that small amounts of Sr refine the β-Mg17Al12 globular phase and increase its thermal stability during annealing. With higher concentrations of Sr, the amount of the β phase decreases and the weight percent of Sr-rich (Al-Mg-Sr) interdendritic precipitates increases. The precipitation temperatures of the different phases as determined by thermal analysis are in close agreement with Scheil cooling results obtained using the thermodynamic calculations via FactSage.

3:45 PM
MELTING METHODS & MATERIALS
Room: S320 D
Presiding: William LaFramboise, Auburn Analytical Labs Inc, Midland, MI.

Safety and Predictability in Cupola Melting Systems (10-085)

Keith Fehlinger, U S Foundry & Mfg. Co., Medley, FL.

Theme will focus on the methods of good data collection and the interpretation of that data to facilitate sound decisions regarding continuous improvement and safety in the melt department. Too many times, the melting department is run a certain way because 'we've always done it that way'. By thinking outside the box and yet utilizing sound judgment based on the data, higher levels of safety, economy and predictability can be achieved while the values of continuous improvement multiply themselves. By citing examples of improvements, I will show how catastrophic failures can be avoided and thereby reduce exposure to the associated hazards. In describing methods of creating good work habits, I will show how safety becomes an end and a means. Any program of this nature would not be complete without an emphasis on the need for follow-up. Good thorough, conscientious follow-up on a job or procedure is often the second most important supervisory act in the scope of running a good melt department (next to good training). The presentation will have a series of pdf files to accompany the discussion. This will include a sample of our "Cupola 101" training program and our "Cupola Challenges" program. A summary will complete the presentation, showing how our whole program comes together in our Melt Department's Mission, which is "the consistent, uninterrupted supply of 'in-spec' iron to the production units in a safe and professional manner".

PANEL: Safety in Melting & Holding Iron (10-147)

Robert Keshecki, Inductotherm Corp., Rancocas, NJ; Keith Fehlinger, U S Foundry & Mfg Co., Medley, FL.

The goal of this presentation is to make all foundry workers and management aware of the lifesaving precautions that must always be taken whenever metal is melted. Sadly, many of the deaths and injuries that have occurred could have been prevented by observing common-sense safety precautions. This presentation will bring to your attention many safety hazards associated with foundries and will provide safety information of a general nature. While it is impossible to remove the risk from melting metal entirely, it is possible to make the melt shop an accident-free workplace. This presentation should be attended by anyone who wishes to learn more on how to make their foundry a safer place to work.

5:30 PM
Special Events
Room: 3rd Level Concourse

AFS/NADCA Welcome Reception

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The American Foundry Society and the North American Die Casting Association would like to welcome all attendees to this reception, which will provide the opportunity to meet with customers, vendors and other attendees. Cocktails and hors d'oeuvres will be served.

Sunday, March 21, 2010

7:15 AM
AUTHOR/CHAIR BREAKFAST
Room: S310 E

AFS Author/Chair Breakfast

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For AFS session participants, this breakfast provides the opportunity for authors, session chairs, students and staff to meet and coordinate details for the educational sessions for the day.

8:30 AM
CAST IRON
Room: S320 A

Presiding: Gerald Wilkinson, Kohler Co, Kohler, WI; Gregory Miskinis, ThyssenKrupp Waupaca , Waupaca, WI.

PANEL: Trace Elements in Cast Iron Review of Vanadium, Niobium, Antimony, Tin, Nitrogen and Titanium; Summary Reference Sheet Overview of Additional Elements (10-113)

Chantal Labrecque, Rio Tinto Iron and Titanium, Sorel-Tracy , Quebec, Canada; Kathy Hayrynen, Applied Process, Livonia, MI; Von Richards, Missouri University of Science and Technology, Rolla, MO; Jana Fogarty, Kohler Co., Kohler, WI.

Panel Topics:
Labrecque: Presenter of Vanadium and Niobium Elements
Hayrynen: Presenter of Antimony and Tin Elements
Richards: Presenter of Nitrogen and Titanium Elements
Fogarty: Presenter of Reference Card and Online Resources

Panel (4 members) will describe the effects of the following trace elements on gray and ductile cast iron. Elements include Vanadium, Niobium, Antimony, Tin, Nitrogen and Titanium. Information is a compilation of a literature review done by the 5I committee. Panel will also present a summary chart of trace elements and their effects. The chart will be available as a reference card through the AFS store and online as a clickable research tool. The article that the information was taken from will be linked to the chart for additional research the user can review.

8:30 AM
DIE CASTING
Process Control & Engineering
Room: S320 E
Presiding: Jonathan (Scott) Kirkman, Die Therm Engineering LLC, Ada, MI.

Casting Quality Improvement Using a Dynamic Gating System in the Pressure Die Casting Process (T10-041)
Laihua Wang, CSIRO, Victoria, Australia.

The traditional die casting process uses a stationary thin gate in the die design. This thin gate restricts pressure transmission during intensification at the end of cavity fill since metal at the gate normally solidifies much earlier than that in the casting and the runner. The use of a variable gate to overcome this problem has been proposed as a concept for nearly three decades. However, very little implementation or experimental results have been reported in the literature. It is believed that this is due to the complexity of the die design. This paper will present results from an experimental die incorporating a dynamic gating system. In this system, the gate is capable of being set small initially, in order to achieve an atomised flow during cavity fill. The gate opening is then enlarged during the pressure intensification, to allow more metal to feed into the cavity. Finally the gate opening is contracted back to small once again towards the end of the solidification phase to facilitate the trimming of the casting. It has been found that the use of such a variable gate leads to significant improvement in the casting quality, as determined by the measurement of the casting density and X-ray examination of internal defects.

An Extension to PQ2 Analysis: Selecting Die and Machine to Maximize Operating Flexibility (T10-042)
Allen Miller, Ohio State University, Columbus, OH.

This paper develops a way to extend the standard PQ2 relationships and use them to match a machine to the die in a quantitatively optimal way. The method grew out of work to optimize shot yield that showed an optimal yield solution to be undesirable in general, with the optimal operating point at one of the corners of the operating window. Such a solution is not desirable or practical. A better solution would place the operating point in the interior of the window so that normal process variations would leave the operating point inside the operating window. The issues with yield optimization led to a more detailed analysis of the machine/plunger/gate area selection issues that are discussed in this paper. The ideas and procedures developed in the paper include the concept of a machine power hyperbola that delineates feasible from infeasible operating points that a given machine could realize depending on the shot sleeve selected. The main advantage of this construct is that it separates the contribution of the machine from that of the shot sleeve and enables each to be systematically selected to achieve a flexible and desirable operating point. The characteristics of the approach are analyzed and several performance metrics compared. A normalized power index (the ratio of maximum usable power minus minimum usable power to maximum available machine power) is found to be a consistent way to select a machine, shot sleeve and gate area with the maximum amount of operating flexibility while maintaining a satisfactory shot sleeve fill percentage. An interesting characteristic of the normalized power index is that it determines the minimum power machine and the optimum shot sleeve area that produces maximum flexibility given that the gate is properly sized. Using a machine with power greater than the minimum results in no penalty with respect to the normalized power index (index does not change), but larger diameter shot sleeves are required compared to optimal. The concept of the power hyperbola and the normalized power index are introduced in the paper. Simple techniques are introduced to enable the caster to quickly determine the optimal parameters given the quality constraints imposed by the part. Methods to covert the theoretically optimal values into practical solutions using only available machines and shot sleeves are also described. The methods described in the paper have been incorporated in PQ2 software.

Development of Wax-Free Release Agents for Pressure Diecasting (T10-043)
Paul Spackman, Henkel Corporation, Port Huron, MI.

The use of wax polymers in formulating pressure die casting release agents is well established and generally considered essential for the casting of any large, heavy section or thick-walled components. It is the wax element of the formulation that ‘sticks’ the release agent film in place and prevents it being pushed to the extremities of the cavity during injection. Over the past 20 years, the trend in release agent formulation has been to include a higher proportion of wax to allow release agent performance to keep up with the increased process demands that come with producing bigger castings on bigger presses with lower cycle times. Whilst wax fulfills the essential function of maintaining the lubricant film during injection, it is this same tenacious characteristic that brings the disadvantages associated with its use. Without sufficient heat in the die and component after injection, wax will quickly build-up. This requires press downtime for die cleaning, causes scrap through underfilled dies and gives problems in subsequent plating or painting operations. Recent formulation developments have delivered a series of wax-free release agents that allow for the casting of large, heavy section or thick-walled components. Without any wax content they maintain an integral film through the injection phase and can therefore be used without the problems associated with wax as described above. The use of an effective wax-free release agent in the production of such heavy castings can significantly increase production rates and reduce scrap, therefore delivering profitable improvements to the die casters process.

8:30 AM
ENGINEERING
Industrial Engineering
Room: S320 C
Presiding: Donald O'Connell, Neenah Foundry Co., Neenah, WI.

PANEL: Performance Measurement Metrics to Measure and Manage Continuous Improvement. (10-132)
Donald O'Connell, Neenah Foundry Company, Neenah, WI; Julie DeWeese, Dalton Foundries, Warsaw, IN; Janet Valek, Grede Foundries, Kingsford, MI.

Panel Topics:
O'Connell: Safety Performance Metrics
DeWeese: Overall Equipment Effectiveness
Valek: Day Work vs Piece Work Incentive Systems

The development, implementation and use of metrics are key to the success of continuous improvement efforts. This panel will introduce attendees to metrics that have been used to improve performance in areas such as equipment utilization, productivity, safety and quality. The panel will also cover the integration of goal setting and corrective action with the use of performance measurement tools.

8:30 AM
MARKETING
Marketing
Room: S320 D
Presiding: Dana Cooper, Fairmount Minerals Ltd, Benton Harbor, MI.

Marketing Your Leadership in Safety (10-163)
Dana Cooper, Fairmount Minerals Ltd., Benton Harbor, MI.

Safety records have an impact on your business. The presentation will provide pointers on how to include positive safety records in your metalcasting marketing message.

PANEL: What Casting Buyers are Thinking? (10-164)
Robert Mueller Jr., P&H Mining Equipment, Milwaukee, WI; Eduardo Salinas, Cifunsa, Coahuila, Mexico.

Seize the opportunity to hear from casting buyers on the panel discussing the current and future metal casting needs. Learn from the individuals and take away ideas to improve your marketing message for your castings.

Golden Age of Castings, 2005-2010, Revisited (10-060)
Michael Swartzlander, Cast Strategies LLC, Dublin, OH.

The global economic recession of 2008/2009 has been a severe blow to metal casters, short term. Production volumes have been reduced by 20 to 50%, and the industry has experienced an unprecedented number of bankruptcies. The prediction of “doubling” the rate of castings growth globally, first presented in 2005 in the AFS paper, “The Golden Age of Castings, 2005-2050”, seems absurd given the current climate. However, the basic premises of the paper remain in tact, and castings will experience extraordinary growth over the next few decades. In fact, the severity of the economic recession’s impact on the castings market, short term, has been partially caused by the rapid cooling in the boom in mining, oil & gas extraction and refining, renewable energy, and infrastructure build-out in the emerging markets. This is, however, a pause in the action. What has changed dramatically in the five years since the original paper are the societal and political forces driving profound environmental and energy conservation changes globally. While the specific impacts of these changes cannot yet be entirely envisioned, without doubt the general trends will create extraordinary opportunities, as well as threats, for metal casters. This paper revisits represents a significant update on the original thinking behind the “Golden Age of Castings, 2005 – 2050”. While the conclusion of a boom in castings remains valid, there will be huge shifts in casting market segments, driven by the huge changes we have witnessed in economic, societal, and political changes of the past 5 years. This paper provides some guidance on what metal casters need to be doing now to ride the wave.

Circumstances of the Automotive Industry Impact on Aluminum Foundries (10-004)
Rafael Gallo, Molten Metal Equipment Innovations, Middlefield, OH.

The global foundry industry has undergone a significant change in recent years. The collapse of the U.S.A. auto industry in 2008 and the continued downsizing had and will continue to have broad implications in the U.S.A. and Mexico. While the U.S.A. foundry industry has been dramatically shaped in the last 62 years, the Mexican foundry has been shaped in the last 20 years. There have been thousands of foundries closing down, and recently consolidating. Aluminum foundries on the other hand experienced continuous growth from the 1950s up to the mid 2000s. The total shipment of castings in 2005 was 12.9 tons. Shipments of aluminum castings in the USA have quintupled in the last five decades, with an average of 2.1million tons per year in the first five years of the 2000s. On the other hand, aluminum casting tonnage shipments in Mexico were about 32% of the American market (0.660 million tons in 2005). The steady increase of aluminum castings have resulted from the Government-mandated fuel economy standards, and continued pressures to improve fuel efficiency on the automotive industry. The prospects for the aluminum foundry industry in the USA and Mexico are mixed. Forecasting of the aluminum casting tonnage was reasonably predicted until 2007. For the last two years, market conditions and global completion have proven to be a challenge to predict with higher levels of confidence the future of aluminum casting tonnage shipments. This article will cover 4 areas. 1) general perspective between U.S.A. and Mexico aluminum foundries, 2) overview and analysis of the American and Mexican aluminum casting industry, 3) factors of competition, and 4) global issues.

8:30 AM
STEEL
Room: S320 B
Presiding: Larry Wolfe, Carmeuse North America, Pittsburgh, PA.

Breaker Core Optimization (10-017)
Ronald Aufderheide, Ralph Showman, Nitin Jain, Ashland Performance Materials, Dublin, Ohio.

Ever since the use of risers to supply feed metal to a solidifying casting was developed, foundrymen have been developing ways to facilitate the removal of these risers. The riser must be removed once the casting has solidified, a step which costs money. In 1908 Edwin C. Washburn patented the use of a core that reduced the contact area between the riser and the casting, which made it easy for the riser to be removed. In fact, after Washburn’s invention, many risers could now be removed with a hammer. Ever since that time this breaker core has also been known as a Washburn core. Throughout the years different materials have been tested to make breaker cores, from silica sand to ceramics. Silica sand bonded with a resin is the most common material used to make breaker cores today, and the most common shape of the opening in the breaker core is a round hole. The diameter of the hole in the breaker core typically varies from 40% to 70% of the inside diameter (ID) of the sleeve it fits into depending upon the metal being poured and the design of the casting. The focus of this paper was twofold: to determine if the use of a different shape in the opening of the breaker core makes the removal of the riser easier; and to determine if the use of breaker cores made from materials other than silica sand would allow the use of significantly smaller openings in the breaker core. Tests were conducted comparing the use of traditional round breaker core openings to openings that were star shaped. Other tests were run comparing the use of various traditional sand-based, exothermic-based and insulating-based breaker cores with varying opening sizes, attached to feeder sleeves employed to make steel

Macroinclusion Sources within the Steel Casting Process (10-059)

Robert Tuttle, Saginaw Valley State University, University Center, MI.

The project documented in this paper attempted to identify macroinclusion formation sources by sampling throughout the steel casting process. Liquid steel samples were taken at furnace tapping, prior to pouring, and after the casting solidified. Dissolved oxygen readings were also acquired after blowing and just after tapping. A multitude of process variables were recorded in an attempt to determine relationships between process variables and macroinclusion content. Metallographic analysis of the steel samples determined the number and size of inclusions larger than 20µm. These measurements were then compared to oxygen levels and process variables. Statistical analysis found a statistically weak correlation between the number of oxides and the blow temperature and after blow oxygen content of the steel. While not statistically significant, sampling location appeared to play a role in the macroinclusion count. Macroinclusion size was determined to decrease from the furnace to the ladle but increased within the casting. The reduction in inclusion count was attributed to oxide flotation. The increased inclusion size within the casting is potentially the result of turbulence and reoxidation within gating system.

10:15 AM
ALUMINUM
Room: S320 B
Presiding: Rafael Gallo, Molten Metal Equipment Innovations, Middlefield, OH.

Silver Anniversary: Aluminum Foundry Equipment Progress (10-166)
Bruce McMellon, Vulcan Engineering Co. Inc., Helena, AL.

Over the last quarter century foundry equipment technology has made some significant advances. We will discuss the evolution of aluminum foundry equipment during the last quarter century, from casting to finishing of the part. We will also take a glimpse as to what the future will present to the foundry.

PANEL: E-357 Statistical Properties (10-165)
Thomas Prucha, American Foundry Society, Schaumburg, IL; Gerald Gegel, Material and Process Consultancy, Morton, IL; Paul Olson, Magparts, Azusa, CA; Steve Sikorski, Magma Foundry Technologies Inc., Schaumburg, IL.

This panel will provide an update of the AFS research project to produce statistically validated property data (A&B design allowables) for aluminum alloy E-357 for inclusion in the MMPDS handbook. Presentations will include an overview of the project, property data test results and the correlation between property data and computer modeling property predictions.

10:15 AM
CAST IRON
Room: S320 A
Presiding: Brad Steinkamp , Wells Manufacturing Co , Woodstock, IL; Kathy Hayrynen, Applied Process Inc , Livonia, MI.

Honorary Lecture: Overview of Age Strengthening of Cast Iron (10-146)
Von Richards, Missouri University of Science and Technology, Rolla, MO.

Since 1997, AFS has supported a number of studies to improve the understanding of the age strengthening in gray cast iron. This has resulted in a series of publications and presentations that have addressed aging behavior in a piecemeal fashion. The purpose of this presentation is to knit together those pieces of research in the context of the literature on age strengthening in ferrous alloys. The conclusion reached from these studies is that the age strengthening appears to be a nitride precipitation process describable by Avrami-Johnson-Mehl kinetics. Machinability effects have been observed and are touched upon, but these are explained in more detail in other papers given at this conference.

10:15 AM
DIE CASTING
Die Cavitation
Room: S320 E
Presiding: Stephen Midson , The Midson Group , Denver, CO.

Keynote Presentation (T10-051)
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Success Story - New Approach to the Cause of High Pressure Die Erosion and Breakout - Cavitation (T10-052)
Jerald Skoff, Badger Metal Tech, Inc., Menomonee Falls, WI.

Success Story (T10-053)
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PANEL: Panel Discussion (Jerry Skoff, Gary Lockwitz) (T10-054)
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10:15 AM
ENGINEERING
Quality Systems
Room: S320 C
Presiding: Theodore Schorn, Enkei America Inc., Columbus, IN.

PANEL: Making the Most of Your Customer's Visit (10-138)
David Hughes, DS & D Cast Solutions, Inc., Pelham, AL; Nick Fox, Galesburg Castings Inc., Galesburg, IL; Ted Schorn, Enkei America Inc., Columbus, IN.

Panel Topics:
Hughes: Customer Expectations of Your Quality System
Fox: Demonstrating to Customers World Class Control
Schorn: Projecting Your Best to Customers: Image and Culture

Every customer visit is important, but those visits to investigate new business or to confirm your capability ahead of a new business award are especially critical. What are customers looking for? What should you do to maximize the value of those visits and put your best foot forward? How do you effectively prepare so to only do things that will add value to your operation (no window dressing)? This panel will first explore customer expectations, then discuss both systems and image-building ideas to get you through that next customer visit and improve your operations along the way."

10:15 AM
MOLDING METHODS & MATERIALS
Room: S320 D
Presiding: Gerard Thiel, University of Northern Iowa, Cedar Falls, IA; Daryl Hoyt, Foundry Sand Technology, Marseilles, IL.

Evaluation of a Modified Cone/Jolt Test on Green Sand Properties (10-046)
Sam Ramrattan, Jorge Rodriguez, Alamgir Choudhury, Western Michigan University, Kalamazoo, MI.

Foundry engineers have long known that certain AFS standard green sand properties tests provide limited information. This limitation is especially apparent when strict casting dimensional control is required. Furthermore, since sand conditioning involving moisture and/or clay directly affects mold quality thus a more sensitive sand test is needed. Too much clay in the system is expensive, and reduced bond usage can diminish green strength essential for mold handling. Similarly, lower moisture levels equate to reduce moisture-related defects however insufficient moisture can cause friable molds. This paper addresses the benefits of a modified cone/jolt green sand test. For this study green sand specimens from working foundries were tested at various target compactability levels; their major green properties were obtained and their inherent variability reported. The purpose of this paper was to identify if a foundry can monitor changes in sand properties caused by small changes in clay and moisture levels when using a modified cone/jolt test. The modified cone/jolt test was able to better differentiate among various compactability levels when compared to other green property tests.

Bonding Properties of Olivine Sand (10-015)
Victor LaFay, Stephen Neltner, S&B Industrial Minerals N.A. Inc., Cincinnati, OH; Mark Ziegler, UNIMIN Corporation, Rockford, IL.

The objective of this paper is to review the selection/practical use of olivine sand and green sand bonding materials that are used in nonferrous foundries in North America. One of the more recent trends in these nonferrous foundries is to pour multiple metal types (for example: aluminum and brass) in the same molding sand process. The increased expectations of these green sand foundries is to have the olivine sand and bonding mechanism to be robust enough to be used with multiple metal types with various molding operations and handling systems. This study will review the various grades of olivine sand and their physical properties. In addition, an extensive laboratory testing program was completed on a traditional bonding material and compared to a product that is designed to be more robust in a green sand molding system for non-ferrous foundries. The final segment of this paper will review information from foundries that utilize olivine sand as the aggregate and the bonding materials that were tested in the laboratory.

11:45 AM
Special Events
Room: S310 F/G/H

AFS Recognition Luncheon
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This luncheon will feature the Best Paper and Division Awards as well as the presentation of the Howard Taylor Award and Ray Witt Award.

1:30 PM
Special Events
Room: S210 A/B

2:00 PM
ALUMINUM
Room: S320 B
Presiding: Mark Osborne, General Motors Corp., Pontiac, MI.

Appropriate Heat Treatment Procedures for Improving Strength and Quality in 354-Type Casting Alloys (10-039)
Hany Ammar, Fawzy Samuel, Agnes Samuel, Université du Québec à Chicoutimi, Chicoutimi, QC, Canada; Geoffrey Sigworth, Alcoa, Rockdale , TX; Jen Lin, Alcoa Technology, Alcoa Center, PA.

Aluminum 354-type casting alloys are promising candidates for high strength applications in the automotive and aerospace industries. Appropriate heat treatment procedures applied to these castings provide significant improvements in their strength and quality values. In the current study, the influence of solution heat treatment and aging conditions on the strength and quality of 354-type castings was investigated. Increasing the solutionizing temperature up to 525°C increased the strength and quality values of 354 castings containing different levels of iron. A prolonged solutionizing time was also found to further improve the alloy mechanical properties and quality. The addition of strontium to the 354 alloys noticeably affected the response of these castings to solution heat treatment through reducing the solutionizing time required to achieve the same level of properties as the non-modified castings. Aging treatment provided a wide range of mechanical properties and quality values according to the aging conditions (temperatures/times) employed. Aging at 245°C provides significant economical benefits as peak aging occurs after only 15 min of aging. However, this is accompanied by a slight reduction in tensile properties and quality values of the alloy as compared to aging at a lower temperature of 155°C.

Sponsored Research: The Effects of Solidification Under Pressure on the Porosity and Mechanical Properties of Cast Aluminum Alloys (10-063)
Santosh Ghanti, Edward Druschitz, Alan Druschitz, John Griffin, University of Alabama at Birmingham, Birmingham, AL.

The mechanical properties of aluminum alloy castings are severely affected by porosity. Previous results showed that solidification under pressure can reduce the size of the hydrogen / gas porosity and improve the mechanical properties. In the current study, the effects of solidification under pressure on the porosity and mechanical properties of aluminum alloy A356 were determined. Wedge shape castings were produced in chemically bonded sand molds. The wedge shape provides directional solidification, various section sizes and a range of cooling rates. The results showed an increase in ultimate tensile strength and elongation due to a decrease in porosity of ~ 10 fold for castings solidified under pressure. Density was measurably increased with the application of pressure during solidification, but density did not show any direct relationship with tensile strength or elongation.

Effects of Additives on the Microstructure and Tensile Properties of a New Al-Cu Based Alloy Intended for Automotive Castings (10-042)
Emad Elgallad, Fawzy Samuel, Agnes Samuel, Université du Québec à Chicoutimi, Chicoutimi, QC, Canada; Herbert Doty, GM Powertrain Group, Metal Casting Technology Inc., Milford, NH.

This article will discuss the effects of melt treatment and addition of alloying elements on the tensile properties of a new Al-2.0%Cu-1.0%Si-0.4%Mg cast alloy. Several alloys containing Sr, TiB2, Zr, Ag, Fe, Mn, Sn and Bi were prepared from the base alloy. The mechanical properties of these alloys were investigated in the as-cast and two different heat-treated conditions, namely T6 and T7 tempers. The results show that the effect of Sr modification on the mechanical properties is not pronounced because of the low Si content of the base alloy. The addition of Zr produces a significant improvement in the mechanical properties as a result of its grain refining action. Excess amounts of Fe increase the precipitation of Chinese script α-Fe particles and thereby diminish the values of tensile properties, particularly ductility. The addition of silver does not induce considerable increase of strength in heat-treated conditions; this may be ascribed to the presence of Si which hinders the vital role of silver in the precipitation-hardening of Al-Cu-Mg-Ag alloys. The softening effect of the soft Sn-rich phases, and the replacement of Si with Sn in the Mg-hardening phases, as well as the formation of porosity arising from the melting of Sn during solution heat treatment were all found to decrease the strength properties of Sn-containing alloys. The addition of Bi reduces the tensile properties in the as-cast and heat-treated conditions to a noticeable degree. Such a reduction may be attributed to the presence of Bi in the form of undissolved particles in the Al matrix and to the Bi-Mg interaction which suppresses the precipitation of the Mg-hardening phases.

2:00 PM
CAST DESIGN & PURCHASING
Room: S320 F

Cost-Effective Casting Design: A How to for Designers and Purchasers (10-131)
Mike Gwyn, Advanced Technology Institute, North Charleston, SC.

Your customers need cost effective, durable, often lightweight, usually structural components as part of their manufactured products. They can choose among many manufacturing methods and materials, and the one powerful choice they typically miss is metalcastings. Your customers recognize the structural and cost efficiency of castings, but they generally don't know how to design them. Helping them learn can be very good for your sales and margins. Although "turnkey" casting designs provided to customers in the form of a finished part, designed from concept to assembly, is a worthy approach, metalcasters can grow more new business faster by assisting their customers with their in-house design process. For over 20 years, the American Foundry Society, its Cast Metals Institute, and its MetalCasting Design & Purchasing magazine have been reaching out to the designers of components with the principles of Cost Effective Casting Design. The North American Die Casting Association, its Die Casting Design Council, and Die Casting Engineer magazine offer similar help in its specialized domain. As a metalcasting producer, you can leverage those outreaches to build new casting business. You can intervene in your customers' usual choices of fabricating, forging, or fully machining components, and help them design castings instead. Successful casting designs interest your customers greatly, and they will return to you for more. This session will briefly summarize why castings are so structurally and cost efficient, and summarize the principles you need to know to participate in the casting design process with your customers. As liquids first, castings easily form complex, creative geometries. It turns out that those geometries, of which there are 4 aspects, are the key to the elegance of successful casting designs. Those 4 are 1) geometry that integrates with alloy castability; 2) structural geometry, recognizing that stress is controlled simply by shape while

2:00 PM
DIE CASTING

Die Materials I
Room: S320 E
Presiding: Corwyn Berger, Exova Inc., Glendale Heights, IL.

Development of an Engineered Die Coating System for Al Pressure Die casting: Towards a 'Smart' Die Coating (T10-061)
John Moore, Colorado School of Mines, Golden, CO.

This paper will present the present state-of-the-art of an ongoing research program whose objective is to develop a 'smart' die coating based on a thin film piezoelectric sensor embedded into a tribological coating system. The design and deposition of both the thin film piezoelectric sensor and the overall coating system will be discussed in detail. The effect of deposition parameters using pulsed closed field unbalanced magnetron sputtering (P-CFUBMS) on the piezoelectric response of the thin film sensor will be given and the overall coating design concepts will be discussed together with future research and development directions for this 'smart' coating system.

Diamond Polishing to Extend Cavity Life (T10-062)
Gary Lockwitz, Harley-Davidson Motor Co, Milwaukee, WI.

A great deal of research has gone into die steel used for a die cast tool cavity: grain size of the steel for a cavity; effect of the specific heat treat process on the life of the cavity; effect of compressive stresses induced into the cavity by outside forces; and, surface coatings applied to the cavity. These are all important factors, but very little research has gone into the effect of the scratches from the polish of the cavity surface. Recently, a cavity for a cosmetic part was run and observed with 20X magnification regularly during its life. At this magnification heat checks could be seen as early as 1425 shots. These heat checks seemed to be directly related to the polishing scratches left in the die during the tool build. Based on these results, a trial was set up where a cavity was polished as normal (300 stone), except for the cavity fillet radii which was diamond polished. In this trial, the cavity was run as normal in production. It was compared at a pre-determined frequency to the baseline cavity for tool life with photographic documentation. This continued until tool life was exhausted. After the run, the tool was reviewed and it was observed that the fillet radii on the cavity (corner radii on the casting) did not heat check as rapidly as normal. On this first cavity tool life was increased greatly over previous cavities. This new process (diamond polishing the fillet radii) has been conducted on multiple cavities since, and all regulated tests display similar positive results. The supplier is confident enough with the results that they have increased the guaranteed tool life by 25%. This paper will present the results of these trials, and the tremendous increase in die life seen (>40% increase in average tool life) for this cosmetic part.

Understanding How Combining Shot Peening and Ferritic Nitrocarburizing can be an Effective Proactive and Reactive Maintenance Program for Die Casting DiesJerald Skoff (T10-063)
Jerald Skoff, Badger Metal Tech, Inc., Menomonee Falls, WI.

2:00 PM
ENGINEERING
Process Modeling
Room: S320 C
Presiding: David Schmidt, Finite Solutions Inc , Slinger, WI.

PANEL: Using Casting Process Simulation for Casting Design (10-157)
Jiten Shah, Product Development & Analysis (PDA) LLC, Naperville, IL; Richard Huff, Caterpillar Inc., Champaign, IL; Christoph Beckermann, University of Iowa, Iowa City, IA.

Panel Topics:
Shah: Casting Conversion Using CAE and Virtual Casting Data Library Tool - CADS
Huff: Casting Design Validation Using Integrated Process and Product Simulation
Beckermann: Integrated Design of Steel Castings - Effect of Discontinuities

To be submitted later.

2:00 PM
MARKETING
Management
Room: S320 A
Presiding: Stephen Lane, Southland Metals Inc., Maumelle, AR.

Safety Performance: Leading your Company to Business Excellence (10-097)
Dana Cooper, Fairmount Minerals, Chardon, OH.

Leadership, organizational culture, and working interface drive safety enabling and organizational sustaining systems. Why do some organizational do well with safety improvements while other do not? Behaviors of Management, the presentation will address safety leadership and engaging workers at every level in creating an injury free workplace. Everyone is charge of safety. The safety leadership model will highlight the how safety leadership assures business excellence.

Sustainability - Meet the Needs of the Present Without Compromising the Future (10-096)

Chuck Fowler, Fairmount Minerals Ltd., Chardon, OH.

Sustainability Meet the needs of the present without compromising the Future. People, Planet, Prosperity The presentation will explain the importance and requirements.

Management Perspective: Improving Costs Through Automated Casting, Cleaning & Finishing (10-167)

Roberto Sammartin, Maus S.p.A, Padua, Italy.

One of the great bottlenecks in a metalcasting operation is the cleaning and finishing departments. It often requires heavy levels of labor, but most of metalcasters still have piles of castings sitting in bins as in-process inventory. This presentation looks at the cleaning and finishing process from a management perspective and explains how to determine if automation may be a fit for your operation as a means of eliminating the bottleneck.

2:00 PM

MOLDING METHODS & MATERIALS

Room: S320 D

Presiding: Michael Bartol, American Colloid Co., Hoffman Estates, IL; Mark Ziegler, Unimin Corp., Rockford, IL.

Silver Anniversary: Iron Oxide in Molds and Cores for the Production of Iron and Steel Castings (10-148)

Raymond Monroe, Steel Founders' Society of America, Crystal Lake, IL.

Iron oxide is a common addition to silica sand mixtures used to produce iron and steel castings. The addition of iron oxide and its effect on the mold-metal interface are still poorly understood. The survey done by the AFS Committee identified sand expansion defect prevention as the dominant reason to add iron oxide. Other benefits reported included the prevention of pinhole porosity particularly in phenolic urethane bonded systems, the reduction in veining, the reduction of carbon pick up or lustrous carbon, the prevention of orange peel surfaces, the reduction of metal penetration and the ability to color certain sand mixtures. New work highlights the complex behavior of silica sand molds and the effect of iron oxide.

Study of an Example of a Loop Sand System with Ceramic Sand for Steel Casting, Which Achieved Environmental and Economical Benefits (10-055)

Kenji Wakita, Gaku Takimoto, ITOCHU International Inc., Schaumburg, IL; Fred Saltarelli, Independent Consultant, Gig Harbor, WA; Ho-Kyu Kwon, Daechang Metal Co Ltd., Busan, Republic of Korea.

Our report is about benefits that were achieved in an overseas steel casting foundry who has applied a loop sand system solely with ceramic sand to alpha-set process with mechanical reclamation method. Properties of the loop sand have been being monitored for several years since its start-up and the data shows that the loop sand system works well, which will be given in our presentation. The foundry, producing larger steel castings, started the loop sand operation in 2004. Before that they had used two types of natural sand, special sand for facing and silica sand for backing. After switching to the ceramic sand, the foundry has been monitored properties of the loop sand such as L.O.I. and particle size, which shows the quality of the loop sand has hardly changed, even with little additional new sand. Also the foundry has achieved the below improvements. First, they could reduce the amount of disposed sand because of the high strength and heat resistance of the ceramic sand, which provided the foundry with the reputation of an environmentally friendly metal caster. The properties of the ceramic sand are hardly changed even under high temperature so addition of new sand for freshness could be reduced, leading to decrease of disposed sand. Second, the amount of dust taking place in shake-out process and other parts of foundry operation was reduced, resulting in clean and safe working sites in the foundry. This was achieved because the ceramic sand is hardly broken down. Third, its molding process was simplified by using only one type of sand for both of facing and backing. Because the reclaimed ceramic sand still has little thermal expansion and high heat resistance, it can be applied for facing, not only for backing.

3:45 PM

ALUMINUM

Room: S320 B

Presiding: David Weiss, Eck Industries Inc., Manitowoc, WI.

Effect of Zr Addition and Aging Treatment on the Mechanical Performance of Al-2%Cu Base Alloys (10-040)

Ehab Samuel, Agnes Samuel, Fawzy Samuel, Université du Québec à Chicoutimi, Chicoutimi, QC, Canada; Herbert Doty, GM Powertrain Group, Metal Casting Technology Inc., Milford, NH.

In the Al-Cu system, the supersaturated solid solution decomposes into various series of age-hardening phases. The addition of Zr to this alloy aids in age hardening, as the coherent Al3Zr phase precipitates and offers a high strengthening effect. In this study, the effects of Zr were investigated in terms of the mechanical properties and age-hardening behavior on the performance of a new Al-2%Cu base alloy for automotive applications. Four Al-Cu alloys containing different Zr contents (0. 0.15, 0.3 and 0.5 wt%) were subjected to an aging treatment at varying temperatures (155, 180, 200, 220, 240 and 300°C) for 5 hours, followed by mechanical (UTS, YS and %El) and hardness testing. It was found that the strength of the base alloy increases as the Zr content increases. The addition of Zr alters the grain structure from a columnar one to an equiaxed one, thereby improving alloy mechanical properties, as well as encourages grain refining via pinning. Moreover, all Al-Zr alloys demonstrate a resistance to softening for alloys aged at high temperatures (220°C

Zirconium-Scandium Interactions in Al-2Cu Base Alloy (10-041)

Ahmed Nabawy, Agnes Samuel, Fawzy Samuel, Université du Québec à Chicoutimi, Chicoutimi, QC, Canada; Herbert Doty, GM Powertrain Group, Metal Casting Technology Inc., Milford, NH.

This study was undertaken to investigate the effects of zirconium- and scandium-containing intermetallics on the microstructural constituents and grain morphology in Al-2Cu base alloys under slow cooling rate conditions (0.3oC/s), using nine different alloy compositions. A number of primary Zr-, Sc-, and Zr-Sc-containing

intermetallics were observed in the investigated alloys, namely the star-like Al3(Sc1-xZrx) phase, the Al3Sc phase, the V-phase, the Al3Zr phase, in addition to two other Zr-intermetallic compounds. Al3Zr crystals act as nuclei for the star-like phase which grows by the precipitation of layers of Al3(Sc,Zr) on these nuclei, with the successive substitution of Zr by Sc atoms. It is also reported that the star-like phase continues to grow in the solid state by absorbing Sc to form the Al3Sc phase, observed in the form of a rim along the edges of the particle. Ternary AlZrSi and quaternary AlZrTiSi intermetallic compounds were also detected. It was found that Zr-Sc combined additions alter the grain size/morphology of the base alloy greatly. The grain size decreases linearly with the increase in the volume fraction of intermetallics resulting from the combined Zr-Sc additions which, in turn, lead to the formation of the star-like phase in profusion.

Poisoning in Grain Refinement of A319 Aluminum Alloy and its Effect on Hot Tearing (10-065)

Francesco D'Elia, Comondore Ravindran, Ryerson University, Toronto, ON, Canada.

Aluminum alloy A319 is one of the most commonly used aluminum casting alloys. This alloy possesses good strength and excellent wear resistance. However, when A319 is processed via the permanent mold casting (PMC) process, it shows a high susceptibility to hot tearing. Grain refinement has shown promise as a means to eliminating hot tears. In this study, the effect of grain refiner on hot tearing of A319 was investigated during PMC. Titanium was added in four levels (0.15, 0.20, 0.25 and 0.30 wt%) in Al-5Ti-1B cut rod form to A319. The results suggest that Ti additions reduced grain size in A319, but did not eliminate hot tears. Scanning electron microscopy identified a Ti-Si compound, which likely poisoned the grain refining efficiency of the Ti-B grain refiner. As a result, the grain morphology of A319 remained dendritic, despite the addition of grain refiner, which thereby resulted in no elimination of hot tears.

3:45 PM
CAST DESIGN & PURCHASING
Room: S320 F

Designing with Austempered Ductile Iron (ADI) (10-129)

John Keough, Kathy Hayrynen, Applied Process Inc., Livonia, MI; Greger Pioszak, University of Michigan, Dewitt, MI.

Much of the specific metallurgical and engineering property data related to Austempered Ductile Iron (ADI) has been thoroughly explored in the past three decades. However, design engineers have largely been unaware of ADI as an option in their design decision making process. Faced with a wide array of material/process options, the design engineer must consider everything from cost, to mass to dynamic performance and manufacturablity. This paper outlines and analyzes the engineering decision making process and uses ADI as the material under consideration.

Designing Aluminum Casting Success (10-171)

American Foundry Society Marketing Division, Schaumburg, IL.

The trend toward light-weight metals in design has opened up tremendous levels of new applications for aluminum. With the power of geometry available with the metalcasting process, aluminum is unleashed even further into structural applications replacing steel. This presentations reviews successful aluminum casting designs to provide tips for designing in the future.

3:45 PM
CAST IRON
Room: S320 A

Presiding: Kathy Hayrynen, Applied Process Inc , Livonia, MI; George Goodrich, Stork Climax Research Services, Wixom, MI.

PANEL: Aspects of Measuring Nodularity in Ductile Cast Iron (10-126)

Richard Gundlach, Stork-CRS, Wixom, MI; Gabriel Lucas, Buehler Ltd., Lake Bluff, IL; Bryan Burton, ThyssenKrupp Waupaca, Tell City, IN.

Panel Topics:
Gundlach: Methods for Measuring Nodularity / Development of DIS Wallchart for Measuring Nodularity
Lucas: Developing a Standard to Measure Nodularity Using Image Analysis Techniques
Burton: Practical Experience with Measuring Nodularity in a High Volume Ductile Iron Foundry

Methods for measuring nodularity in ductile cast iron have historically depended on the use of standard photomicrographs to which comparisons are made. Consequently, the results are typically dependent upon the "trained eyeball" that makes the measurement. This panel will discuss the following aspects of measuring nodularity: (1) What methods are available to measure nodularity; (2) how the DIS wall chart for nodularity was developed; (3) efforts to create an image analysis standard for quantifying nodularity and (4) practical experience with measuring nodularity from one of the largest producers of ductile iron castings in North America.

3:45 PM
DIE CASTING
Die Materials II
Room: S320 E

Presiding: Peter Ried, Ried & Associates LLC, Portage, MI.

Development of High Toughness Ductile Cast Iron of 2-Layer Structure Suitable for Holding Die of Die Casting (T10-071)

Toshitake Kanno, Kimura Chuzosho Co., Ltd., Nagasawa, Japan.

A new ductile cast iron is developed for the holding die of die casting as a substitute for cast steel. The new cast iron has 2-layer structure which consists of the ferritic matrix in surface and the pearlitic matrix inside. This cast iron is strong against notch due to the ferritic matrix in surface. It has excellent property in both

strength and toughness. Ductile cast iron has not been used for the parts where strength and elongation are required simultaneously, because of a contrary relationship between strength and elongation. In this development, the fault of the usual ductile iron is overcome by 2-layer structure of this new material. The strength of this ferritic surface is higher than that of usual ferritic cast iron, and inside pearlitic part has sufficient strength and toughness. Therefore, the mechanical properties of this material are almost equal to those of cast steel.

3:45 PM
ENGINEERING
Process Modeling
Room: S320 C

Presiding: Richard Huff, Caterpillar Inc, Champaign, IL; Philip Dahlstrom, Foseco Metallurgical Inc., Cleveland, OH.

Design of Experiments and Casting Process Simulation (10-019)

Ingo Hahn, Dr. Joerg C. Sturm, MAGMA Giessereitechnologie GmbH, Aachen, NWE, Germany; Christof Heisser, MAGMA Foundry Technologies Inc., Schaumburg, IL.

Casting process development efforts in foundries need constantly to be adjusted to the tougher competitive environment. Foundries need to get better and faster, all the time. This is especially important in regard to the development of robust, economic layouts of casting processes in ever shorter time frames. The development process for a new casting is in foundries often only characterized by factors like „Experience“ and „Trial and Error“. Casting Process Simulation has established itself as valuable tool in the methodical casting process layout over the last two decades. It avoids numerous casting trials for several gating approaches, which cannot be justified anymore due to time and cost constraints. Hence, only one version is poured to validate the final layout. Casting Process Simulation provides results for each version using exactly defined fixed process parameters. Still, the casting process needs to be seen within a relatively large process window, as it cannot be avoided that many process parameters vary over a certain range. Only this approach provides a robust but economic production of high quality castings. The knowledge of a foundry process expert is therefore irreplaceble even when simulation is used. If every possible parameter change of the casting process would be evaluated, a unrealistic high number of experiments or simulation runs would need to be performed. Therefore, processes have been developed to achieve valuable conclusions from a reduced number of experiments. These processes include methodes for Design of Experiments (DoE), which are used successfully for real world experiments. They also offer themselves to be used in conjunction with simulation runs. Design of Experiments together with casting process simulation ideally compliments the nowadays used methode of autonomous optimization of casting processes, which can provide exact process windows. This paper will show this process on a steel casting process layout development example.

Numerical Simulation and Experimental Validation of Core Blowing Using A Non-Newtonian Fluid Model (10-024)

Sam Scott, Adi Sholapurwalla, ESI Group NA, Bloomfield Hills, MI; David Reich, Laempe+Reich Corporation, Trussville, AL; Marlin Brule, Doug Finkhousen, Le Sueur Inc., Le Sueur, MN.

In the world of Metalcasting, as casting defects are experienced, the industry formulates methods to predict and correct issues which may lead to scrap castings. For over 20 years, numerical simulation of heat transfer, solidification, fluid flow, stress and other physics of the casting process has led to an understanding of the intricacies of the alloy side of metal casting, enabling the prediction of defects and the primary goal of making a casting “right the first time”. Industry reports 85% of scrapped castings result from an error with the alloy or casting process itself, while 15% are attributed to mold preparation, including core manufacture. As casting knowledge continues to expand, the percentage scrap due to mold preparation will continue to increase, establishing a need to understand the creation of the mold components. ESI Group’s QuikCAST Simulation Software provides a tool for understanding and predicting the core blowing process. By treating the sand injection as a non-Newtonian flow, much insight is gained into the core manufacturing process, allowing engineers to properly design the core box, venting locations and sizes, and injection pressures. This paper discusses the analysis methodology and trials of two very different cores with experimental validations. Certain lessons learned during the validations will also be discussed.

Diffusion Modeling and Experimental Verification of Pearlite/Ferrite Formation in Ductile Iron (10-083)

Simon Lekakh, Von Richards, Missouri University of Science and Technology, Rolla, MO.

The eutectoid reaction in ferrite and Cu-alloyed pearlite/ferrite industrially produced ductile irons (DI) was modeled and studied experimentally using thermal analysis and quantitative SEM/metallography. A non-steady state diffusion model with a moving reaction boundary was applied for a three-dimensional spherical cell representing a graphite nodule surrounded by a ferrous alloy matrix. The experimentally verified rate of eutectoid reaction was in agreement with that calculated for ferritic DI. Transformation in Cu-alloyed DI occurred at larger undercooling due to alloying element segregation. For the experimental study of this phenomenon, additional homogenization by heat treatment and hot plastic deformation was applied. Comparison of the ferrite/pearlite ratio and calculated final segregation of alloying elements having different diffusion mobility was done. In the first stage of homogenization, decreasing Cu and Mn segregation increased ferrite content while homogenization at longer times also eliminated Si-segregation and increased pearlite content and hardness of the matrix. These results could be used in future work for quantitative prediction of the complex interaction effects of inoculation, cooling rate and alloy composition on DI properties.

3:45 PM
MOLDING METHODS & MATERIALS
Room: S320 D

Presiding: Sara Joyce, Badger Mining Corp , Berlin, WI; Stephen Neltner, S & B Industrial Minerals NA, Cincinnati, OH.

PANEL: Core Room Safety (10-102)

Joseph Muniza, Douglas Trinowski, HA International LLC , Westmont, IL; Jarek Olszak , Laempe + Reich Corp., Trussville, AL; Dave Jablonski, Badger Mining, Berlin, WI.

Panel Topics:
Jablonski: Refractory Coating Safe Storage and Handling

Panel will discuss health, safety and environmental issues and concerns as it relates to the core room. Specifically, the presenters will discuss safe handling practices and procedures for the major chemical binder systems along with typical core room equipment, such as mixers, core blowers and scrubbers. The panel will also cover safe handling practices for refractory coatings.

7:00 PM
Special Events
Room: Peabody Hotel, Plaza D&E

AFS Annual Banquet

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Highlights of the annual banquet include the presentation of the AFS Gold Medal followed by an evening of entertainment.

Monday, March 22, 2010

7:15 AM
AUTHOR/CHAIR BREAKFAST
Room: S310 E

AFS Author/Chair Breakfast

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For AFS session participants, this breakfast provides the opportunity for authors, session chairs, students and staff to meet and coordinate details for the educational sessions for the day.

8:30 AM
ALUMINUM
Room: S320 B
Presiding: Brian Began, Foseco Metallurgical Inc, Cleveland, OH.

Sponsored Research: Energy Efficient Melting, Transportation, and Holding in Aluminum Casting Operations (10-084)
Mark Osborne, General Motors Powertrain, Pontiac, MI; Edward Eckert, Mike Kinosz, Apogee Technology Inc., Verona, PA; Ray Peterson, Aleris International, Rockwood, TN.

Uncertainty in the energy and regulatory markets create a significant threat to the economic viability of domestic aluminum casting operations. New technology for melting, transporting, and holding of aluminum reduces energy requirements and lowers the plant emissions, both mitigating the impact of such threats. A new electric melting technology known as Isothermal Melting allows foundries to melt aluminum at near theoretical efficiency, and without the production of in-plant emissions . The integration of Isothermal Melting with an advanced self-heated ladle design with controlled metal dispensation capability will also allow for inter or intra plant energy efficient delivery of molten aluminum.. Conductively heated launder systems and heated ladle wells (blisters) provide a robust method for metal delivery to the casting cell with precise temperature management. Such a system also has low inertia and is capable of operation over a throughput range with near level thermal efficiency. Metrics associated with this system will be described in this paper.

Mechanical Properties and Machinability of an Al-16 wt. % Si Alloy Modified by 0.5 and 1.0 wt. % Bi (10-032)
Peisheng Chen, Ahmet Alpas, University of Windsor, Windsor, ON, Canada.

The addition of bismuth, like other low melting temperature elements, has been considered to improve dry machinability of cast Al-Si alloys; thereby providing environmental benefits. However, castings' mechanical properties should not be compromised. Effects of 0.5 and 1.0 wt.% bismuth addition on the mechanical properties and dry machining performance of an Al-16 wt.% Si alloy were examined. Two different cooling rates of 9.4 ˚C/s and 26.0 ˚C/s were used. About 60% of primary silicon particles have Bi particles precipitated at their interface in 1.0 wt.% Bi alloy, and 30% in 0.5 wt.% Bi alloy regardless of cooling rates. Bi particle size was refined upon solidification at 26.0 ˚C/s. Large bismuth particle size and high fraction of primary silicon with Bi precipitation caused deterioration of mechanical properties. The hardness and tensile strength of 0.5 wt.% Bi modified alloy solidified at 26 ˚C/s was similar to those of the base alloy. Dry machinability of the base and Bi modified alloys was evaluated using turning tests during which Bi modification lowered thrust and cutting forces and promoted discontinuous chip formation. Thus, Al-Si alloys with 0.5 wt.% Bi and high solidification rate maintained the mechanical properties of the base alloy while improving its machinability.

Prediction of Microstructure and Mechanical Properties in Aluminum Castings After Heat Treatment (10-033)
Jianzheng Guo, ESI US R&D, Columbia, MD; Tony Kronenberger, Joe Hirvela, CPP-Minneapolis, Minneapolis, MN; Weisheng Cao, Computherm LLC, Madison, WI; Sam Scott, ESI North America, Farmington Hills, MI.

A comprehensive numerical model is being developed for the calculation of the final microstructure and mechanical properties of aluminum casting alloys after heat treatment. After specifying the alloy chemical composition, solidification process, and heat treatment parameters, the model predicts the microstructure and potential defects through various stages of the component lifecycle: casting, solid solution heat treatment, and artificial aging. The calculation is chained such that the resultant microstructure of the previous event, such as casting, is used as the initial condition of the following event, ensuring the tracking of the component history and maintaining a high level of accuracy across metallurgical stages. The model takes into account the relationship between the different input parameters and the link to basic metallurgical features. Such a model can be used for tailoring mechanical properties and component performance with the correct choice of chemical composition and manufacturing process parameters. The effects of cooling history during casting and heat treatment processes on aluminum alloy castings are numerically and experimentally investigated. The microstructure and mechanical properties are predicted and compared with experimental measurements.

8:30 AM
CAST IRON
Room: S320 A
Presiding: Vasko Popovski, Applied Process Inc., Livonia, MI; Kevin McMahon, Elkem, Forest Jct, WI.

Sponsored Research: Casting Skin of Compacted Graphite Iron Part I: Evaluation and Mechanism of Formation (10-067)
Sarum Boonmee, Bobby Gyesi, Doru Stefanescu, The Ohio State University, Columbus, OH.

The presence of casting skin in ductile (DI) and compacted graphite (CG) irons is an undesirable feature that lowers mechanical properties compared to the fully machined test samples. The purpose of this paper is to look into the morphology of the casting skin for CG iron and to quantify its value as a function of some casting variables including molding sand, casting thickness and metallostatic height. In the first part of a two-part paper the authors describe the methodology for the design of a test casting based on a number of requirements including: samples free of shrinkage and porosity, test castings suitable for evaluation of static mechanical properties in as-cast as well as in machined conditions, and a characteristic cooling rate of the sample less than ~10oC/s. After conducting virtual casting experiments with the selected test castings to confirm that design criteria were met, two CG iron heats (carbon equivalent 4.44 and 4.54%) were produced using the Sintercast process, and cast in sodium silicate and phenolic urethane bonded sand molds. A total of 78 test castings were produced. Samples were quantitatively measured for graphite shape factors, graphite area, percent of graphite and pearlite using image analysis. It was found that graphite shape factors varied as a function of distance from surface. After very low levels in the proximity of the surface, the nodularity increases and then gradually decreases toward the center of the plate casting. In addition, the percent pearlite increases with higher distance from the surface. These quantities were used to quantify the casting skin. Selected samples were further examined using color metallography technique. The special etching outlined the interdendritic regions through the segregation of silicon. It was possible to outline the differences in the eutectic grain of high nodularity and low nodularity CGI.

Sponsored Research: Casting Skin of Compacted Graphite Iron Part II: Influence on Tensile Mechanical Properties (10-068)
Sarum Boonmee, Doru Stefanescu, The Ohio State University, Columbus, OH.

The goal of this research was to assess the effect of casting skin on the tensile properties of CG iron. CG iron plate test castings were produced in sodium silicate and phenolic urethane no-bake molds. The thickness of the plate castings was 7.6mm (0.3in), 10.2mm (0.4in) and 15.2mm (0.6in). The visual nodularity of the plates was in the range of 5 to 20%, and the pearlite content varied from 6 to 26%. Tensile testing was performed on as-cast samples, fully machined samples, and on samples that were not machined but were shot-blasted at two different levels (1 and 5 minutes). Within the experimental range the plate thickness did not affect the tensile properties significantly. As expected, the removal of the casting skin through machining was conducive to significantly higher tensile properties (it increased from an average of 300MPa for the as-cast plates to 355MPa for the machined plates). A similar trend was observed for elongation, which increased from an average of 3.3% for the as-cast plates to 5% for the machined plates. Further improvement of the tensile properties was obtained through shot blasting. After five minutes of shot blasting the average strength increased to 392MPa. This effect is attributed to a significant decrease of the thickness of the skin and to the compressive stress induced on the surface of the plates. It was demonstrated that the casting skin decreased both the tensile strength (9% on average)and elongation. The maximum skin thickness observed in this research was of 0.4mm. For the plates with the maximum skin of 0.4mm the decrease in strength was 15.5%. The molding aggregate did affect the casting skin, and thus the mechanical properties.

Sponsored Research: Effect of Cooling Rate on the Mechanical Properties of a Fully Pearlitic Ductile Iron (10-003)
Robert Tuttle, Saginaw Valley State University , University Center, MI.

The relationship between cooling rate and mechanical properties is not completely understood in ductile iron. Previous work concentrated on ductile irons with a fully ferritic or partially pearlitic matrix. This paper examines the role cooling rate plays on the properties of a fully pearlitic ductile iron. A series of molds with different size tensile bars were poured in resin and green sand molds to vary the cooling rate. Cooling rate had no significant impact on the mechanical properties of this type of ductile iron. However, the as-cast skin and percentage of pearlite had a significant effect on properties.

8:30 AM
DIE CASTING
Creep Resistant Zinc
Room: S320 E
Presiding: Michael Bess, Metals Marketing & Technology, Putnam Valley, NY.

Keynote Presentation - Creep Properties of Die Cast Zinc Alloys (T10-081)
Karol Schrems, National Energy Technology Laboratory, Albany, OR.

Creep tests have been carried out on two zinc-based alloys: Alloy 2 (Zn-4Al-0.03Mg-2.7Cu) and Alloy 5 (Zn-4Al-0.05Mg-1.0Cu). Die-cast samples were creep tested in tension to 1% strain. Over a range of temperatures from 60 °C to 120 °C and stresses from 10 to 60 MPa, the creep data was correlated using an empirical equation of the form f(?)=A t ?^n exp (-Q?RT) from which was derived C?, a constant that incorporates composition, material structure, and strain. Null strain due to the dimensional change caused by aging of copper-rich precipitates was subtracted from the overall strain. Alloy 2, with the high copper content, exhibited improved creep properties over Alloy 5, both with and without consideration of the dimensional strain of aging.

Success Story - EZAC - New Creep Resistant, High Strength, Hot Chamber Zinc Alloy (T10-082)
Ryan Winter, Eastern Alloys, Inc., Maybrook, NY.

EZAC is a continuation of the development of the initial ZCA-9 research performed by ILZRO. Several years of continued alloy development and testing have allowed the development of a more creep resistant, high strength, hot chamber zinc based alloy. EZAC has been found to have a creep resistance over an order of magnitude improvement over Zamak 5, and yield strength similar to ZA-27 (The strongest cold chamber zinc alloy commercially available). The paper will compare resulting creep and mechanical properties of EZAC to standard zinc based alloys including ACuZinc 5.

Success Story (T10-083)

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PANEL: Panel Discussion (Karol Schrems, Frank Goodwin, Ryan Winter) (T10-084)

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8:30 AM
ENGINEERING
Plant Engineering
Room: S320 C
Presiding: Gregory Bray, Electric Controls & Systems Inc., Birmingham, AL.

PANEL: Safety, as Practiced in General Motors Powertrain (10-127)
Pete Buczek, GM Powertrain (Retired), Davisburg , MI; Chris Desautels, James Eigner, General Motors Corp. (Retired), Essexville, MI.

Panel Topics:
Buczek: Safety, as Practiced in General Motors Powertrain
Desautels: Hazard Recognition & Designed-In Safety in the Foundry
Eigner: Proven Techniques for Improving Safety Performance in a Maintenance Department

This panel will include three presentations: 1 - The first will show the importance GM places on safety, and give a short history of the safety practive in GM. It will show how uppper management gives the support and guidance for the practices at the Powertrain sites. 2 - When designing a new facility, or even a small facility change, engineers can miss some of the more subtle operational hazards. This presentation will show how one of GM's plants solved this potenttial problem. 3 - The maintenance departments of all plants frequently provide an ever-changing job scope, making safety a challenge. This presentation will show how one of Powertrain's plants improved the safety performance of its maintenance department.

8:30 AM
MOLDING METHODS & MATERIALS
Room: S320 D
Presiding: David Jablonski, Badger Mining Corp, Berlin, WI; John Serra, Carpenter Brothers Inc , Milwaukee, WI.

Sponsored Research: Measurement and Control of a Ceramic-Graphite Refractory Coating from Wet Preparation to Elevated Temperature Exposures (10-101)
Adil Abdelwahab, Abdul Aowal, Margaret Joyce, Sam Ramrattan, Western Michigan University, Kalamazoo, MI.

This is part of a multiple phase research project supported by the American Foundry Society and the American Metalcasting Consortium. Phase I of this project examined new testing techniques that can be used on chemically bonded cores and molds for refractory coating. In Phase I alternative and new methodologies to characterize the physical, flow and leveling properties of a refractory coating on phenolic urethane cold box (PUCB) sand discs were studied. The effect of the refractory coatings at different percent surfactant on was studied. Additionally, dip time was examined. To control the depth of coating penetration without altering coating solids, the level of surfactant in the coating was varied. Three different surfactant levels, 0.15, 0.25 and 0.35% were studied. Increasing the level of surfactant decreased the surface tension of the coating, increased the low shear viscosity of the coating and increased the thixotropy of the coating. The lower surface tension coatings wetted the PUCB sand samples more readily. The wet coat weight thickness was not influenced by dip time at highest level of surfactant addition, but strongly influenced at the other two levels. At the highest surfactant level, complete wetting occurs at all dip times, resulting in equal wet coat weights. Wet coat weights and dry coat weights showed the same trends. Depth of penetration increased with surfactant level. The higher the surfactant level, the greater the influence of dip time on the depth of penetration. The results indicate a relationship between capillary pressure and surface tension force. The lower the surface tension of the coating (higher surfactant level) the more readily the coating wets the sand specimen. The thickness layer of the refractory coating did relate to permeability. The refractory coating prevented sand/binder losses and expansion defects but had no effect on distortion of the

Sponsored Research: Effects of Coating Thickness on Thermal Distortion (10-047)
Sam Ramrattan, Margaret Joyce, Palak Patel, Prayag Patel, Western Michigan University, Kalamazoo, MI.

Refractory coated chemically bonded sand cores and molds are an important part of metal casting technology and their behavior in contact with molten metal is of great interest. Test methods currently employed to measure heat-induced thermo-mechanical change of coated sand composites have not specifically addressed the influence of changes in mold/metal interfacial temperatures. With today's emphasis on near-net-shape, thin wall castings, and with ever more stringent casting dimensional reproducibility requirements, there is a need for test methods that accurately measure the thermal distortions of refractory coated chemically bonded binder systems. A thermal distortion test (TDT) that uses a disc specimen offers a method to study the changes brought about by the thermo-mechanical reactions of coated chemically bonded sand binder systems. This research study examines the effects of refractory coatings thickness at different surfactant levels on various phenolic urethane cold box (PUCB) sand distributions using the TDT as opposed to the laborious and time consuming processes of molding, melting, filling, shakeout, and obtaining dimensions of actual castings. This research project focused on quantifying distortion difference found in refractory coated PUCB disc specimens at 1000°C. The thermal distortion curves (TDC) and mass change are provided and compared for all coated systems studied. The results from TDC for the different surfactant levels of refractory coating on PUCB sand systems showed a significant difference. The underlying sand distribution affected coating thickness and the thermal distortion showed significant difference. The refractory coating prevented sand/binder losses and affected expansion defects. The level of distortion depended on the coating thickness and underlying sand system.

10:30 AM
Special Events
Room: Metalcasting Technology Theatre

AFS President's Session

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AFS President Steve Reynolds and leaders of the AFS Technical Division have called this special session to discuss issues of critical importance to the sustainability of the U.S. metalcasting industry. Come hear their thoughts on the state of the industry and the AFS President's challenge for the industry in the coming year. This session is open to all Cast Expo attendees. The President's session will be held in the Metalcasting Technology Theater on the Expo floor.

11:45 AM
Special Events
Room: S310 F/G/H

NADCA Design Awards Luncheon

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NADCA will present awards for Best Congress Paper, Instructor of the Year and Technical Committee Member of the Year. NADCA will also honor the Safety Award winners and Die Casting Design contest winners.

2:00 PM
ALUMINUM
Room: S320 B
Presiding: Robert Pischel , Foseco Metallurgical Inc , Cleveland, OH.

The Effects of Non-Contact Acoustic Stimulation on the Solidification Behavior and Microstructure of Aluminum Alloy A356 (10-088)
Paul Lynch, Robert Voigt, Penn State University, University Park, PA; James Furness Jr., Paul David Paulsen, Furness-Newburge, Inc., Versailles, KY.

For over a hundred years, numerous researchers have attempted to develop the necessary tools, core principles, and quantitative foundation responsible for acoustically refining and degassing alloys during solidification. Of the acoustic vibration research conducted on aluminum alloys, most utilized contact resonators that have repeatedly failed and caused melt contamination. This paper will explore and quantify the effects that non-contact sonic and ultrasonic vibrations may have on the solidification behavior and microstructure of the Al-Si-Mg casting alloy A356. Using solidification cooling curve data and microstructures obtained from non-contact acoustic vibration experiments, this study examines the solidification behavior of the A356 alloy treated with 1.18 kHz, 1.4 kHz, and 20 kHz non-contact acoustic vibrations to evaluate how solidification and microstructure is affected by acoustic vibrations. Compared to A356 that is not acoustically stimulated, the alloy treated with 1.18 kHz, 1.4 kHz, and 20kHz non-contact acoustic vibrations in this study has an altered solidification behavior, possessing decreased initial undercooling, decreased eutectic arrest, and a lower eutectic growth temperature. The microstructure of A356 treated with acoustic vibrations in this study had partially modified eutectic silicon particles. Compared to un-treated A356, the A356 alloy treated with non-contact acoustic vibrations in this study is expected to increase in ductility, elongation, and tensile strength properties compared to un-treated A356.

Confluence Welds in Aluminum Castings – Part Two (10-053)
Ratessiea Lett, Sergio Felicelli, John Berry, Mississippi State University, Mississippi State, MS; Rafael Cuesta, Ana Rivas, Maria Estibaliz Alcalde, Fundación CIDAUT, Boecillo (Valladolid), Valladolid, Spain.

This work describes an international collaboration project that has been established between Mississippi State University (MSU) and the CIDAUT Foundation in Spain, which is funded by the National Science Foundation (NSF). The research area examines the formation of confluence welds in aluminum alloy castings. In the casting process, where there may be several opposing fronts of liquid metal, such welds can be produced by the non-adherence of the metal flow streams upon rejoining. Thus, the appearance and quality of the casting may be affected. Several thin (10 mm thick) vertically sand-cast A356 plates poured using three gating configurations are being studied in this research. A number of examples of one of the configurations, referred to as B configuration, were cast in the collaborating foundry, using varying flow rates. Of these castings, two of the plates run at a slower fill rate (average melt rising speed of 45 mm/s) contained confluence welds. In order to determine if these defects affect the mechanical properties of the casting, several four-point bend tests were conducted in their vicinity. The advantage of using this test method is the bending moment distribution produced by the application of four loading points, in particular the uniform distribution of the bending stress within the central span. Samples were tested in both the affected weld area and outside of the area in order to compare results of the fracture locations. As there is no specification for four-point testing of metallic materials, several different testing configurations were used in order to find a more standardized fixture configuration. Additionally, flow simulations are also being conducted. It is expected that the analysis of both the experimental data and the simulation results will help to determine if and to what extent casting quality is affected by confluence welds.

2:00 PM
CAST DESIGN & PURCHASING
Room: S320 F

Designing Ductile Iron Success (10-173)
Ductile Iron Society, Strongsville, OH; Jed Falgren, Dotson Iron Castings, Mankato, MN; Joe Farrar, Farrar Corp , Manhattan, KS.

The growth of cast ductile iron applications defines the success of this material for design engineers. This panel presentation will look at successful conversions to ductile iron castings. It will examine the factors that made these components ripe for conversion and then how the designer-metalcaster team made them a reality.

2:00 PM
CAST IRON
Room: S320 A
Presiding: Eugene Muratore, Rio Tinto Iron & Titanium America, Rosemont, IL; Alex Gyarmaty, Saint. Gobain Adv Ceramics Hamilton, Paris, ON, Canada.

Ductile Iron Characteristics and Impact Strength at Low Temperature (10-014)
Chantal Labrecque, Rio Tinto Iron & Titanium, Sorel-Tracy, PQ, Canada; Pierre-Marie Cabanne, Rio Tinto Iron &Titanium, Villepinte, France; Eugene Muratore, Rio Tinto Iron & Titanium, Rosemont, IL.

In the last ten year period, the global installed wind turbines capacity has increased from about 10,000 to 100,000 MW. These wind turbines require several large Ductile Iron castings. If wind mills are to be installed in a cold climate environment, the DI castings have to meet low temperature impact properties as well as static tensile, yield and elongation minimums. Generally, the impact strength requirement is 12 Joules at -20 °C. The specifications for these castings are typically DIN EN 1563 or ISO 1083 since ASTM A536 does not require any low temperature impact testing. Even if these castings are currently ferritized, the mentioned properties are achievable in the as cast state. The objective of this paper is to compare the characteristics of the D.I. having the required impact strength with the ones of D.I. that almost satisfy the impact criterion. It is shown that there are different microstructure and chemical composition combinations that could meet the requirement. A concise literature review is presented in addition to recent RTIT experimental data. The detailed description of the microstructures including computerized image analysis, scanning electron microscopy and EDS of the high impact strength D.I. are among the new information discussed.

Sponsored Research: Aging and Machinability of Irons with Compact and Spherical Graphite (10-036)
Simon Lekakh, Von Richards, Jared Teague, Kent Peaslee, Missouri University of Science and Technology, Rolla, MO.

Natural aging of irons with compact (CGI) and spherical graphite (DI) in as-cast and re-solitionized conditions was studied together with casting machinability. Machinability test articles and tensile bars from ferritic DI and pearlite CGI were cast in two industrial foundries. Natural aging in CGI and DI was statically verified by evaluation of tensile strength and hardness. CNC face machinability was studied with using two types of tool force dynamometers (averaged, low frequency and instant, high frequency), high speed video, SEM/EDS of machined surface and chips. Ferritizing above eutectoid temperature and re-solutionizing below it was also used for evaluation of repeated strengthening during natural aging. It was shown that cutting forces are sensitive to precipitation hardening taken place during natural aging. Clarification of crack formation mechanism and metal/tool edge interaction were done by comparison of measured cutting forces with ideal normal distribution. The fracture work criterion was used as an indicator of cutting forces. The results could be used for optimization of casting production and machining.

Sponsored Research: Monotonic and Cyclic Property Design Data for a 25% Cr Abrasion – Resistant Cast Iron (10-128)
Barry Hodge, Andritz Inc., Muncy, PA; John Tartaglia, Rick Gundlach, Stork Climax Research Services, Wixom, MI.

This report characterizes the monotonic and cyclic properties of an A532 Class III, Type A, Level 2 abrasion-resistant cast iron. This paper supplements earlier work published by AFS in 2003. This 25% Cr white iron is the first of the abrasion-resistant class of irons to be included in this database and, to the authors' knowledge, is the first fatigue data to be published for any of the white irons. White irons are typically selected for their excellent wear resistance properties. However, these irons are often considered too brittle for structural applications. Nevertheless, both static and dynamic structural loads are important considerations in the design of many wear-resistant machine parts. The premature replacement of these parts is often caused by structural failure rather than wear. This publication is intended to partially fill a gap in published properties data, which are required by designers to fully and efficiently utilize this material.

2:00 PM
DIE CASTING
Computer Modeling I
Room: S320 E
Presiding: Robert McInerney , Buhler Prince Inc., Holland, MI.

Optimisation of HPDC Process Using Flow Simulation - Case Studies (T10-091)
Pari Adiyapatham, CRP Group, India.

This presentation will be a continuation of the paper #102 presented at 113th Metal Casting Congress at Las Vegas, and subsequently published in the July'09 copy of the NADCA's DIE CASTING ENGINEER under the title "Optimization of HPDC Process Using Flow Simulation – Case Studies" . The presentation will highlight some of the new and more interesting case studies, where the flow simulation results helped in the HPDC optimization process by means of: Thermal Die Cycling Simulations; Flow Simulations; and, Solidification Simulations.

Autonomous Gating Design Optimization (T10-092)
Deepika Gaddam, MAGMA Foundry technologies, Inc, Schaumburg, IL.

The casting quality is highly dependent on the filling pattern, which is influenced by the gate design. In the past, the gates design and location were based on the engineer's knowledge and experience only. However, a minor change in the gate angle, might result in a significant different filling pattern, which may not be quantified with experience. For circular shaped castings, control on the filling pattern can be difficult. The gate angle is very significant in such case. If the considered casting is used for decorative purpose then a strict limitation on the quality (like blistering) would be applicable. With the available computer simulation softwares, the gate angle influence on the casting quality can be evaluated with trial and error. But that would demand effort and time. Therefore a need for an automated tool arises. This paper discusses how state of the art process simulation software autonomous changes, simulates and evaluates CAD files to find the best gating design for the required casting quality. A circular shaped casting with different orientation is evaluated with different gating scenarios. The approach involves optimization of the gates for better casting quality with modifications to the gate angles. The genetic algorithm used generates the best possible gate design with respect to the defined variables and constraints. A quantitative solution is thus obtained by the novel approach of automated optimization at the stage of design.

Optimizing the High Pressure Die Casting Process Using Computer Simulation (T10-093)

Sam Scott, ESI North America, Cincinnati, OH.

In the high part count world of high pressure die casting, maximizing production can be the difference between operating at a profit or loss. HPDC foundries currently rely on experience, trial-and-error or computer simulation to help determine working process parameters for manufacturing their cast parts. However, a "working" process is not necessarily the "ideal" process. Casting parameters such as cycle time, shot profile, cooling line temperature and flow rate, and spray thickness may be optimized to determine a robust process with maximum productivity. In this paper utilizes the casting simulation software ProCAST to demonstrate new functionality which automatically optimizes the casting process parameters. The demonstration utilizes a legacy casting design, simulates the casting process used at the foundry, and then automatically optimizes the casting process by varying fast shot speed, cycle time, cooling and spraying parameters within a given "realistic" process window, with a goal of producing a quality part in a minimum cycle time. The optimized process will then be quantitatively compared to that determined by the foundry, with the process differences highlighting time and cost savings in using the optimized result.

2:00 PM
MOLDING METHODS & MATERIALS
Room: S320 D

Presiding: Josh Werling, Prince Minerals Co., Fishers, IN; Victor LaFay, S&B Industrial Minerals NA, Cincinnati, OH.

Parametric Modeling of the Autoclave De-Waxing Process (10-066)

Edward Druschitz, Preston Scarber, Alan Druschitz, The University of Alabama at Birmingham, Birmingham, AL.

This paper describes the development of a model to predict shell cracking of simple shapes during the autoclave de-waxing process. Snow [1998] suggested that up to 90% of all investment casting shell cracking is a result of the autoclave de-waxing process. Previous predictive modeling studies of the de-waxing process for an infinite plate geometry performed at the University of Alabama at Birmingham have shown that favorable wax pattern melt profiles can be achieved by promoting low internal wax pattern temperatures when melting is complete on the wax pattern outer surface, which minimizes wax pattern bulk expansion and the stresses on the ceramic shell.

Improving Investment Casting Mold Permeability Using Graphite Particles (10-087)

Darryl Kline, Simon Lekakh, Von Richards, Missouri University of Science and Technology, Rolla, MO.

Experiments and calculations were performed to increase the permeability of an investment casting mold through the use of sacrificial pore formers. Graphite particles were added to the fused-silica-based slurry and they were incorporated throughout the shell. The resulting shells were fired to remove the graphite and produce pores within the shell. Tests were performed to measure increases in permeability using a digital permmeter. Possible reduction in strength was evaluated through flexural testing. The formation of tunnels in three-dimensional layers by connection of randomly distributed spherical pores was modeled by Monte Carlo simulation. The permeability of layers formed was modeled using Fluent CFD. The experimental data was compared to the theoretical model and practical recommendations for increasing investment shell permeability were proposed.

2:00 PM
STEEL
Room: S320 C

Presiding: Hathibelagal Roshan, Maynard Steel Casting Co., Milwaukee, WI.

Effect of Carbide Re-Precipitation on the Toughness of Hadfield Austenitic Manganese Steel (10-117)

Nelson Santos, Davi Todorov, Metso Minerals Brazil, Sorocaba, São Paulo, Brazil; Alberto Cavalcanti, Ricardo Fuoco, Institute for Technological Research -IPT, Sao Paulo, Brazil.

The solution heat treatment of Hadfield austenitic manganese steel is basically used to increase the material toughness. During this heat treatment the eutectic carbides and the carbides precipitated in the grain boundaries during the cooling of the parts in the mold were dissolved in the austenitic matrix. At the end of the solution time, the parts must be cooled in water as soon as possible to room temperature to avoid carbide re-precipitation in the grain boundaries. That final step is very critical during the production of large castings, with more than 150mm thick. Using isotherm heat treatments, the article correlates the degree of carbide re-precipitation with the fracture toughness measured by Charpy impact tests of a Hadfield austenitic manganese steel. The results show a reduction in the impact energy from 180J to 20 J since the carbide re-precipitation in grain boundaries became more continuous. At the same time, the transgranular fracture mode, with ductile characteristics, became intergranular fracture, with brittle characteristics.

Effect of Phosphorus and Silicon on the Precipitation of Kappa-Carbides in the Fe-30%Mn-9%Al-X%Si-0.9%C-0.5%Mo Alloy System (10-069)

Laura Bartlett, David Van Aken, Kent Peaslee, Missouri University of Science and Technology, Rolla, MO; Ryan Howell, Army Research Lab, Aberdeen, MD.

An investigation of the age-hardenable Fe-30%Mn-9%Al-1%Si-0.9%C-0.5%Mo cast alloy has shown that small increases of phosphorus, 0.001 to 0.043 wt%, produced an increase in hardness during age hardening in the temperature range of 530 to 600°C. As the phosphorus level increased, the time to achieve peak hardness was also found to decrease by 50% and 60% for specimens aged at 530°C and 600°C, respectively. Kinetic analysis determined that phosphorous lowers the activation energy for the precipitation of κ-carbide, (Fe,Mn)3AlC, by almost 100 kJ/mol as the phosphorous level is increased from 0.001 to 0.043 wt%. Calculated TTT diagrams and comparison with kinetic data in literature suggests that phosphorus increases enthalpy of mixing for austenite and accelerates the initial spinodal decomposition. Phosphorous was also found to segregate to interdendritic areas and promote both the precipitation and growth of the κ-carbide on grain boundaries. The effects of silicon content on the aging characteristics at 530°C were also studied. As the amount of silicon was increased from 0.59 to 1.56 wt%, hardness increased an average of 34 BHN for all aging times up to the peak aged condition. Increasing the amount of silicon is believed to increase the hardness of κ-carbide by displacing manganese from the austenite matrix into the κ-carbide.

Phosphorus Mitigation in Cast Lightweight Fe-Mn-Al-C Steel (10-057)

Angella Schulte, Simon Lekakh, David Van Aken, Von Richards, Missouri University of Science & Technology, Rolla, MO.

Notch toughness of age-hardenable Fe-Mn-Al-C alloys decreases as phosphorus increases. The study presented here shows by thermodynamic calculations and experimental work that additions of Ca and Ce can be used to mitigate the deleterious effects of phosphorus. Ca wire treatment, Ce treatment by misch metal addition, and Ar-stirring were tested for their effects on inclusion content, inclusion chemistry, and notch toughness in a nominal Fe-30wt.%Mn-9wt.%Al-1wt.%Si-0.9wt.%C-0.5wt.%Mo steel. Thermodynamic calculations were performed for melt treatment optimization. Five 80 lb heats were analyzed; the first was untreated, the second had a Ca addition, the third was treated with Ca and Ce additions, and Ar-stirring in the furnace was added at different lengths to produce the fourth and fifth heats that were treated with Ca and Ce. Inclusion analysis shows that P combines with rare earth metals Ce and La, which are the major elements in misch metal, and that the population density of AlN inclusions directly affects the impact properties. In the solution treated and aged condition (Brinell hardness 317-330), the room temperature Charpy V-notch (CVN) impact energies increase from 33 J to 92 J when comparing the untreated heat to the Ca, Ce, and Ar-treated heat. The heat with the highest concentration of AlN particles had a CVN impact energy at -40° in the solution treated and aged condition of 19 J and the heat with the lowest concentration of AlN had CVN impact energy of 38 J. The addition of Ar-stirring decreased the number of inclusions by more than 90% when compared with the untreated heat.

3:45 PM
ALUMINUM
Room: S320 B
Presiding: David Neff, Metaullics Systems-Div. Pyrotek Inc. (retired), Willoughby, OH.

PANEL: Interim Report: AFS Project on Optimization of Mechanical Properties in Cast Aluminum Alloys (Phase I A356) (10-125)
David Neff, Metaullics Systems-Div. Pyrotek Inc. (retired), Willoughby, OH; Yaou Wang, Case Western Reserve University, Cleveland, OH; Randall Oehrlein , Carley Foundry Inc , Blaine, MN ; Steve Sikorski, Magma Foundry Technologies Inc, Schaumburg, IL; Geoffrey Sigworth, Dunedin, FL.

Progress will be reported on this project which concerns the ability of best melting practice and cleaning methods to produce highest strength/elongation in A356 aluminum alloy. Evaluation is achieved by comparison of those mechanical properties obtained with testbars cast with standard Stahl testbar permanent mold, new 'Case' test bar permanent mold, an Alcoa test bar permanent mold, and a stepped test bar permanent mold. Effects of metal cleaning (degassing, fluxing) on virgin and dirty melts, continuous hydrogen (Alspek) and conventional reduced pressure test values, and PodFa analysis will also be discussed. Magma simulation studies on the various permanent mold testbar molds will be presented. Following formal presentations, panel discussion will be held with the researchers and invited industry professional from key permanent mold foundries.

3:45 PM
CAST DESIGN & PURCHASING
Room: S320 F

Identifying a Candidate for Conversion to Casting (10-172)
Robert Mueller Jr., P & H Mining Equipment, Milwaukee, WI.

Engineered metal castings can provide buyers and designers weight and cost reductions compared to weldments, fabricated assemblies and forgings. The key is to know when to convert. This presentation provides an experienced look at what makes a potential casting conversion successful and how to identify components that can be successfully converted at reduced weights and costs. Several case study examples will be examined.

Continuous Cast Ductile Iron as an Alternative to Wrought Steel (10-144)
Bob O'Rourke, Dura-Bar, Woodstock, IL.

Continuously cast iron bar stock is widely used throughout the world in a variety of parts in the fluid power industry, machine tools, oil and gas,and heavy equipment. Ductile iron bar stock is an excellent alternative to carbon steel because of it's high quality, strength, ability to heat treat, and excellent machinability. This presentation will cover: the continuous casting process, sizes and shape capabilities, properties and grades, applications, how to convert from wrought steel to ductile iron, design parameters for cast ductile iron, and the difference is machining between wrought steel and ductile iron.

3:45 PM
DIE CASTING
Computer Modeling II
Room: S320 E
Presiding: Robert McClintic, Bob McClintic & Associates, Jenison, MI.

Characterizing Flow Losses Occurring in Air Vents and Ejector Pins in High Pressure Die Castings (T10-101)
Melissa Carter, Flow Science Inc., Santa Fe, NM.

It will be demonstrated how a commercial software, FLOW-3D®, can be used to model the flow losses occurring in ejector pins and air vents in High Pressure Die Castings. The results from an ejection experiment done without melt at a commercial tool shop will be discussed. These results will then be used to compute flow loss coefficients for the air vents and ejector pins. These coefficients will be used in conjunction with the bubble model in FLOW-3D®. A 3-dimensional mold filling simulation will be done using FLOW-3D® and the resultant fill pattern/defects compared with experiments. The effect of various vent and ejector pin geometries on the loss coefficients will also be studied. These results will be compared with our results and with analytical expressions.

Mould Flashing Reduction by Strategic Cooling Line Placement (T10-102)
Ralf Kind, MAGMA FOUNDRY TECHNOLOGIES, INC., Schaumburg, IL.

Everybody working in high pressure die casting has experienced moulds flashing or even “spitting”. Normally flashing develops over time when the moulds getting

older and worn out, but can be experienced in some moulds nearly from the first casting on. Whenever it occurs the casting quality and mould live is reduced significant. Moulds that are not seal can not hold the high pressure necessary to feed melt into the solidifying casting causing porosity and rejects. Flash sticking to the mould can build up and deform or hinder components to close properly what causes more flashing and deformation. Main originators for flashing are the high impact loads after filling and/or the mould temperature profile. This presentation shows how die casting process simulation can be utilized to optimize the mould temperature profile to reduce distortion and flashing.

Using Simulation Technology to Verify the Work of Complete Venting Systems (T10-103)

Hakan Fransson, NovaCast Foundry Solutions AB, Sweden.

Newly developed software can simulate the work of complete, extremely thin-walled venting systems. This speech will describe how to simulate areas where the melt will stop due to cooling and due to high back-pressure caused by the melt passing through thin-walled sections. The machine will not be able to push the melt through these sections. The technology used is a variant of VOF, Volume of Fraction, which allows meshing of virtually any design. Casting results can be reproduced in a very reasonable time with the technology we have developed for reproducing melt flow behavior in a die casting mold.

3:45 PM

MOLDING METHODS & MATERIALS

Room: S320 D

Presiding: John Serra, Carpenter Brothers Inc , Milwaukee, WI.

Big Flask Molding Towards Automation - The Production of Big Castings for Windmill Generators (10-008)

Mauro Favini, I.M.F. Srl Impianti Macchine Fonderie Srl, LUINO (VA), Italy.

The optimisation of the production processes and the increasing requirements for safety, boost to produce automated installations moving towards the maximum flask size that can be handled. New requirements mainly coming from the “wind mill” market, but also from other applications, prove that modern no-bake installations can radically modify the traditional production procedures, by simplifying all the operations, by making them safer and reducing the personnel involved. Some recent projects with different typology and complexity are presented.

3:45 PM

STEEL

Room: S320 C

Presiding: Philip Bruno, Case New Holland, Davenport, IA.

Prediction of Aluminum Nitride Embrittlement in Heavy Section Steel Castings (10-094)

Charles Monroe, Richard Huff, Caterpillar, Champaign, IL.

Aluminum Nitride (AlN) embrittlement is a problem in heavier section (>4”) steel castings. AlN forms at higher residual Aluminum and Nitrogen levels and slow cooling rates. In load critical components, the formation of AlN will embrittle the casting, reducing the impact strength and ductility of the steel. The precipitation diagram for AlN from Hannerz is reviewed and his more accurate equation plotted. In addition, this information is matched to simulated cooling curves in slab castings to plot maximum Aluminum content against section size to avoid embrittlement. However, these rules of thumb can be misleading in analyzing geometries without final rigging or production information like the sand properties. The most important information in predicting AlN is the cooling rates in the production setting. Therefore, the equations are incorporated into casting simulation software to use the simulated cooling curves to locate embrittled volumes. Two example castings show the use of the AlN embrittlement indicator. This prediction will help to avoid AlN embrittlement in the design of heavy section steel castings and rigging.

Grain Refinement in Plain Carbon Steels (10-026)

Robert Tuttle, Saginaw Valley State University, University Center, MI.

Grain refinement has been successfully employed in aluminum, magnesium, and copper based alloys and cast irons. While there has been some work done on grain refinement in steel, there is still not a significant amount of knowledge to help develop an industrial process. The research documented by this paper attempted to produce grain refinement from selected material powders in 1010 and 1030 steel. Selected powders were placed in a shell core cup with a Type S thermocouple, which was then filled with liquid steel. Cooling curves were recorded and used to determine undercooling. Microscopy of the samples verified the amount of grain refinement attained in each sample. $CoAl_2O_4$, NiAl, TiN, and TiO_2 produced a significant reduction in undercooling in 1010. It was not possible to determine as-cast grain size in the micrographs of the 1010 samples. CeO_2, MgO, and NbC reduced the undercooling for the 1030 samples. While $CoAl_2O_4$ did not reduced undercooling, it did produce observable refinement in the 1030 samples.

Modeling for Improved Casting Quality of High Aluminum Steels (10-061)

Angella Schulte, Simon Lekakh, Von Richards, David Van Aken, Missouri University of Science and Technology, Rolla, MO.

High strength, low density precipitation hardened Fe-Mn-Al-C cast steel is a very attractive material for many weight limited transportation applications and military armor. These types of cast components typically have a high surface to volume ratio and limited wall thickness. Liquid Fe-Mn-Al-C alloys have significantly different casting characteristics when compared to regular carbon steel, in particular a strong tendency to re-oxidize and form surface films during the mold fill. These melt properties promote the formation of oxide film laps and cold shuts in thin walled castings. Modeling with MAGMASOFT (Modeler 1) and FLUENT (Modeler 2) software in conjunction with experiments was performed for the study of castability of Fe-Mn-Al-C steel P900 armor plates. The effect of superheat and venting procedures was evaluated for different molding techniques including bonded olivine sand molds tilted at both 0º and 15º from the horizontal and pre-heated investment shell molds in the vertical orientation with a bottom filled gating system. Modeling results were experimentally verified and the optimal process parameters were suggested. The best castings were produced in vertically oriented bottom-filled ceramic investment shell molds with a superheat of 300C° (540F°) and poured directly from the furnace into a preheated investment shell at 800°C (1472°F). Successful P900 castings were also obtained from the tilted bonded olivine sand molds when poured with a superheat above 300C° (540F°).

Tuesday, March 23, 2010

7:15 AM
AUTHOR/CHAIR BREAKFAST
Room: S310 E

AFS Author/Chair Breakfast

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For AFS session participants, this breakfast provides the opportunity for authors, session chairs, students and staff to meet and coordinate details for the educational sessions for the day.

8:30 AM
DIE CASTING
Machines & Equipment
Room: S320 E
Presiding: Hal Gerber, Albany Chicago Co , Pleasant Prairie, WI.

Die Evacuation: Fast, Efficient and Reliable (T10-111)
Paul Robbins, Castool Tooling Systems, Uxbridge, ON, Canada.

No one would deny that the use of vacuum in high-pressure die-casting has brought about crucial improvements in quality. Castool and VDS have devoted considerable effort to deveoping reliable high-speed vacuum shut-off valves with very high performance. For high integrity casting, where high quality castings with low porosity are required, a high-speed secure vacuum valve is the best solution.

High Tech Die Casting (Case studies of innovative Die Casting Machines (T10-112)
Alessandro Benini, Italpresse Industries, Italy.

This paper concerns the design and manufacturing of one innovative two-platen diecasting machine, together with the presentation of some case histories about the practical application. In the foundry world the high closing forces necessary to face the molten metal shot into the die cavity, are traditionally obtained through the “Toggle” mechanism with link rods: on the contrary, the two-platen machine closing force is provided by a completely hydrodynamic system. The main advantages coming from this engineering solution are represented by a far better linear relation between the involved physical quantities as well as an inner rigidity of the whole system. Nowadays, thanks to the outstanding technological progress, more and more innovative instruments and devices are available: the finite element (FE) simulations allow reliable complex structural calculations, while on the other side the evolution of electronics develops powerful and consistent instruments. All these elements represent a possible answer to the current request of machines able to meet elevated productive flexibility and repeatability, including a process simplification: a starting point to obtain structurally reliable products which also respond to elevated quality standards.

RFM Thin Wall Ladle Contributes to Enhanced Metalcasting Productivity and Quality (T10-113)
Jeffrey King, Pyrotek, Inc., Columbia City, IN.

Pyrotek, Inc. introduced RFM™ refractory composite auto ladles in 2004. Since their introduction, RFM™ ladles gained wide popularity in Squeeze Cast, Sand and Permanent Mold aluminum casting processes because of reduced oxide-induced scrap due to their non-wetting properties and longer service life compared to fiber laminate ladles. Pyrotek has now developed an RFM™ ladle designed to address the needs of the High Pressure Die Caster. Case studies show how the RFM Thin Wall Ladle has contributed to enhanced metalcasting productivity and quality for High Pressure Die Casters.

8:30 AM
Special Events
Room: S320 A

PANEL: Energy Reduction Projects for the Foundry
Robert Eppich, Eppich Technologies , Syracuse, IN; Rob Peaslee, Manitowoc Grey Iron Foundry, Manitowoc, WI; George Weed, GW Energy Solutions Inc., Pittsford, NY; Robert Lepage, BitCraft Embedded Computing Solutions, LLC, Cross Plains, WI; John Kison, Metal Mechanics Inc., Schoolcraft, MI; Thomas Meyer, Apogee Technologies, Murryville, PA.

Panel will include practical foundry case studies of energy reduction technologies. Case studies will include: Cooling electrical cabinets, aluminum melting, casting yield improvements, cast iron ladle pre-heating,core room efficiency, charge material processing.

8:30 AM
Special Events
Room: S320 B

PANEL: Metalcasting - A Global Perspective

Theodore Schorn, Enkei America Inc , Columbus, IN; David Jakstis, Spirit Aerospace, Andover, KS; Freddy Martinez, K B Alloys Inc, Robards, KY ; Rafael Gallo, Molten Metal Equipment Innovations, Middlefield, OH; Rob Bailey, BS Metallurgy Inc., Manitowoc, WI.

Panel Topics:
Schorn: Communicating Quality: East Meets West
Jakstis: Casting procurement in China
Martinez: Metalcasting industry in Mexico
Gallo: Sales and Service in Mexico
Bailey: Magnesium Production in China

This panel will focus on what it is like to do business globally. Presentations and discussion will center on doing business in China, Latin America, Mexico and India, and will include the foundry, supplier and casting buyer perspective. Among the topics discussed: Dealing with cultural differences, casting quality issues, communication with foundries, evaluating foundries and sourcing castings.

10:15 AM
HOYT MEMORIAL LECTURE
Room: S320 G/H

How Can We Become a Practical Green Foundry Industry (10-103)

Gary Gigante, ThyssenKrupp Waupaca Inc., Waupaca, WI.

Since biblical times, foundries have been the leaders in recycling materials. Today's society is looking for industry to do more than simply recycle. They want industry to be much more energy efficient, have a low impact on the environment and achieve a small carbon footprint. Our society has coined new terms to measure "greenness". The number of cars on the road, trees lost or planted, and pounds of carbon emitted to the atmosphere have become the new benchmarks. Foundries are by nature energy intensive. Not only in the fuel or power we consume to melt our metals, but also in the vast amounts of materials we transport and use to make our molds and cores. The forces we employ to clean our castings and the manner in which they reach the market also bear scrutiny. We are expected to shed the paradigm of "we are good recyclers" and move forward to becoming leaders in green technology. What are the barriers that present us from being green? What new technologies will need to be developed? What are the real costs and will government be there to assist us with becoming greener? Finally, what might the foundry of the future look like?

12:00 PM
Special Events
Room: S310 F/G/H

AFS President's Lunch and Annual Business Meeting

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The election of AFS and CMI officers and directors will follow a luncheon. In addition, Awards of Scientific Merit, Service Citation and the CMI Directors' Award will be presented, as well as the Casting of the Year and the Millionaires Safety Awards.

2:00 PM
DIE CASTING
Energy
Room: S320 E

Presiding: Daniel Twarog, North American Die Casting Assn., Wheeling, IL.

Climate Change, Greenhouse Gas, Cap and Trade, and Carbon Footprint – An Overview: (T10-121)

Alex Monroe, North American Die Casting Association, Wheeling, IL.

Many prominent groups have been warning of man-made global climate change for years. The proposed solution to climate change is to heavily regulate the emissions of CO2 and five other greenhouse gases. These warnings have been heard by many regulators, and as a result it is likely that manufacturers will be required to pay for the right to emit greenhouse gases. These costs will come largely in the form of drastically increased energy costs. Learn the basics of climate science, greenhouse gas regulations, and how to calculate your carbon footprint. Knowledge of these topics will provide important to remain profitable in light of greenhouse gas regulations.

Energy Efficient Metal Delivery and Holding in the Die Casting Plant (T10-122)

Brad Bell, Apogee Technology, Norwood, MA.

Aluminum die casting operations have utilized two general metal supply systems for decades: batch metal delivery by fork truck mounted ladles or using radiant heated launder systems . Both systems incorporate typically large holding furnaces with substantial energy consumption and molten metal inventory. Both the launder system and often the holding furnace have been heated by radiant elements in the lids. A new heating methodology based on volumetric conduction rather than surface radiation has been developed for metal delivery and holding. These systems are capable of replacing the ladle furnaces at the die casting machine with a small heated dip out well. The new system results in a substantial energy savings, improved metal quality, and lower system maintenance. This paper will describe such a system recently installed at Briggs and Stratton – Statesboro Georgia, with an emphasis on the heating system and energy savings. Preliminary information indicates that energy savings on the order of 75% have been realized, with a molten metal inventory reduction of 76%.

Using Simulation Technology to Verify the Work of Complete Venting Systems (T10-123)

Robert Wolfe, Ford Motor Company, Dearborn, MI.

Newly developed software can simulate the work of complete, extremely thin-walled venting systems. This speech will describe how to simulate areas where the melt will stop due to cooling and due to high back-pressure caused by the melt passing through thin-walled sections. The machine will not be able to push the melt through these sections. The technology used is a variant of VOF, Volume of Fraction, which allows meshing of virtually any design. Casting results can be reproduced in a very reasonable time with the technology we have developed for reproducing melt flow behavior in a die casting mold.

3:45 PM

DIE CASTING

Die Cast Management

Room: S320 E

Presiding: Daniel Twarog, North American Die Casting Assn., Wheeling, IL.

State of the Industry (T10-131)

Daniel Twarog, North American Die Casting Association, Wheeling, IL.

With the worst economic conditions in history slowly fading to the past, the die casting industry is positioning itself to look ahead and develop sustained growth into the next two to three years. Many die casting facilities, operating in a “survival mode” over the last 18 months, have begun to transition out of this mode with an up-tick in business in the fourth quarter of 2009. It’s nothing to jump up and down about, but enough to give hope to businesses that are in dire need of some good news. This presentation will cover specific industry data and forecasts that give shape to the die casting industry, present and future.

How to Make Your Website a Lead Generation Machine (T10-132)

Bob DeStefano, SVM E-Business Solutions, Somerset, NJ.

Is your Website a lead generation machine? Your Website should be your most powerful marketing tool, delivering a steady stream of new business leads filling your sales pipeline. Unfortunately, most companies do not optimize their Websites for lead generation – offering nothing more than a passive online brochure. This enlightening presentation will make online marketing understandable and provide you with actionable tips, best practices and strategies for transforming your Website into a powerful lead generation machine. Whether you are an online marketing novice or an expert, you will learn proven ways to: - Attract targeted traffic from search engines - Convert anonymous Web visitors into named leads - Measure the effectiveness of all of your marketing initiatives