MPI's Advanced Casting Research Center Celebrating 30 Years of Industry—University Collaboration to Advance the Casting Industry

Diran Apelian, Alcoa-Howmet Professor of Engineering at Worcester Polytechnic Institute (WPI), founded the Metal Processing Institute (MPI) with the vision of building the premier educational and research institute serving the metal processing industries. Today, it is setting new trends and standards as a leading industry-university alliance. With more than 90 corporate partners, it is the largest such institute in North America.

The key to MPI's success is industry leaders and university researchers working together to solve business challenges and improve manufacturing processes through its three centers: Advanced Casting Research Center (ACRC), Center for Heat Treating Excellence (CHTE), and Center for Resource Recovery and Recycling (CR^3). The work of these collaboratives has improved productivity and enhanced the competitiveness of their industrial members. The centers also have pushed the envelope in the development of new alloys, new processes, and novel manufacturing technologies, as well as the associated stewardship of natural material resources.

MPI's first center, ACRC, celebrates its 30th anniversary this year with a gala event at its spring meeting, June 2-3, 2015, on WPI's campus. CHTE will observe its 15th anniversary and CR^3, the youngest of the three centers, will celebrate its 5th birthday at the same time. Put it all together, and that adds up to 50 years of fundamental research, with many significant achievements, carried out through industrial support.

"This is a way for us to honor the work of our members, research staff, students, and faculty members," explains Apelian. "It is through their efforts that we have impacted the technology supply chain in a powerful way. Our greatest asset is the combined experience of these people all working together, and of course the knowledge base that we have developed and the students we have graduated who are now leaders in industry."

The event will pull together the best and the brightest in the industry from all over the world. Primary and secondary producers of aluminum and light metals, equipment manufacturers, foundry suppliers, end users, casters, and trade associations will come together to celebrate past breakthroughs and identify global trends as they also establish a roadmap for future efforts.

ACRC's current members are:

- Aerojet Rocketdyne
- AFS
- Aluminum Rheinfelden Gmbh
- Atek Precision Castings
- Boeing
- Can-Eng
- Chem-Trend, Inc.
- CPS Technologies
- Cummins
- ECK Industries
- Elkem
- Fiat Chrysler Automotive
- Foseco
- General Motors Corp
- General Aluminum Manufacturing Co.
- Harley-Davidson Motor Co.
- Hazelett
- Lawrence Livermore National Laboratory
- Los Alamos National Laboratory
- Magna Cosma International
- Mercury Marine
- MAGMA Foundry Technologies
- Montupet
- NADCA
- NEMAK
- Noranda Aluminum
- Oshkosh Corp.
- Palmer Foundry, Inc.
- PSA Peugeot Citroen
- Rio Tinto Alcan Inc.
- Sakthi Group
- Shiloh
- Viridis 3D

Herb Doty (GM), Ray Donahue (Mercury Marine), Diran Apelian of (MPI) and Christof Heisser of (MAGMA Foundry Technologies) at the happy hour at the 2014 annual dinner.

The Metal Processing Institute conducts two meetings a year for its consortia members. ACRC and CHTE members gathered at the opening of the Fall 2014 meeting at the WPI campus.

Research Protocol:

- Research projects are member-driven. Members submit and vote on proposed projects.
- Oversight by an industry steering committee and focus group on each project assures project relevance.
- Four projects are initiated each year.
- Members have royalty-free IP rights to pre-competitive research.
- Members have the option of paying to sponsor proprietary projects.
- ACRC also does large-scale projects funded by the federal government and foundations. These projects keep members informed about leading edge technology.
- Members are trained on all research technology and software updates.

Research Projects

ACRC takes on four member-funded projects per year; it will focus on the following projects in 2015:

- **Aluminum Nano-Composites for Elevated Temperature Applications**
  Investigate and optimize a scalable economical process for manufacturing Al alloy-AIN nano-particle, and Al-TiC nano-particle composite materials as well as characterize their microstructure and properties.
- **Clean Aluminum: Processing Methodologies and Performance on Mechanical Properties**
  Explore new methods of measurement and mitigation of quality detractors in aluminum melts via laser-induced breakdown spectroscopy (LIBS) and chemical and centrifugal filtration.
- **Alternate Eutectic Systems for Aluminum Casting Alloys**
  Explore other eutectic systems (Al-Fe and Al-Ni) for use in aluminum casting alloys. Al-Fe and Al-Ni were selected because they melt at 650°C and 640°C, respectively, and because they form a stable intermetallic phase with eutectic aluminum.
- **Casting of Dissimilar Metals**
  The scope of this project is to develop a ferrous insert that promotes the growth of a strong metallurgical bond with the aluminum during the casting process. This would improve interface properties such as load and heat transfer.

ACRC is also working on projects funded by the federal government. One of its most exciting initiatives is its involvement in Lightweight Innovations for Tomorrow (LIFT). A year ago, the White House announced the establishment of this critical hub for light metals under the leadership of Professor Alan Taub of the University of Michigan (UM).The $148 million initiative is aimed at helping to revitalize the nation's manufacturing capabilities and competitiveness. LIFT is expected to create more than 10,000 new metals manufacturing jobs, spur innovative research and development of lightweight metals processing and manufacturing, and help train hundreds of engineering professionals and skilled trade workers in the most advanced skills. Its founding partners are the University of Michigan (UM), the Ohio State University (OSU), and the manufacturing nonprofit EWI.

Seven process pillars have been designated as critical to the success of the initiative. Under Apelian's leadership, MPI is the lead for the casting pillar, with Alan Luo of OSU as co-lead. Three key projects in metal casting are being launched in 2015: at Michigan Technological Institute (Paul Sanders); OSU (Luo), and at WPI (Apelian).

Professor and MPI Director Diran Apelian (center) and Professor Dawn Tilbury, Associate Dean of the College of Engineering at the University of Michigan (red scarf), attend the ribbon-cutting ceremony for LIFT's new Detroit headquarters earlier this year.

Other government-supported research projects that MPI and ACRC are working on include:

- Department of Energy –ARPA-E project on Aluminum Mini Mill ($3 million)
- ARL-supported major initiative in REE and Magnesium Alloys ($14 million)
- ARL center for cold spray technology ($8 million)
- Aluminum scrap and recycling –through ACRC sister center CR[3]

ACRC Leadership—Steering Committee

- Kevin Anderson, Mercury Marine (Chair)
- Yong-Ching Chen, Cummins
- Denis Massinon, Montupet S.A.
- Jim Onders, General Aluminum
- Mark Osmanski, ATEK Precision Castings, LLC
- Jose Talamantes-Silva, NEMAK, S.A.
- David Weiss, Eck Industries

Directors at Large

- David Weiss, Eck Industries
- John L. Jorstad, JLJ Technologies, Inc. (Emeritus)

David Weiss, Director-at Large of ACRC discussing with Randy Beals of Magna Cosma International.

Industrial Internships

The strength of MPI and its centers isn't just in the area of research. It also plays a key role in training future talent. Combined with the proven theory and practice philosophy that is at the heart of WPI's approach to education, the MPI internship program gives students hands-on application experience.

Here are some of the exciting current internships:

- Crystal growth for space applications at NASA Glenn Research Center in Cleveland, Ohio –PhD candidate Joel Kearns.
- Mo electrodes for glass melting in collaboration with H. C. Starck Corp. in Newton Mass.–Ph.D candidate Wen Di Liu.
- Laser cold spray processing at IPG Photonics in Oxford, Mass. –Ph.D. candidate Aaron Birt.

For more information on how the institute coordinates the process of bringing students and employers together visit: http://wp.wpi.edu/mpi/internships/industry-opportunities/

MPI and ACRC are located in Worcester, Mass., on WPI's beautiful New England campus. The university was founded 150 years ago this year. The third oldest technological university in the nation, it was founded by two metals manufacturers: John Boynton and Ichabod Washburn. For more information about MPI and ACRC visit: www.wpi.edu/+mpi or www.wpi.edu/+acrc.

Metalcasting Industry Research

Support of research is critical for North America to maintain a strong, vibrant, healthy and continually advancing metalcasting industry. Part of the AFS mission is to promote these activities for the betterment of our membership, our industry and our society.

AFS directly funds research projects from allocation of a portion of the annual dues paid by AFS Corporate Membership. The current AFS Funded Research Projects are described below. The other projects are funded through research partnerships, government funding and industry contributions. AFS participates in these projects by securing industry partners and providing technical management and oversight. Current research funding partnerships include: the U.S. Department of Defense (DOD), Defense Logistics Agency (DLA) Castings Solutions for Readiness (CSR) Program funded through the American Metalcasting Consortium (AMC), the National Network for Manufacturing Innovation and the three current consortium (America Makes—National Additive Manufacturing Innovation Institute, Lightweight and Modern Metals Manufacturing Innovation-LM3I and Digital Manufacturing and Design Innovation–DMDI), the National Institute of Standards and Technology (NIST) AMTech award for advanced manufacturing technology planning grant "The Pathway to Improved Metalcasting Manufacturing Technology and Processes−Taking Metal Casting Beyond 2020"and the New Generation Sand Casting Consortium (NewGen), which is a partnership between AFS and the National Industrial Sand Association (NISA) investing in metalcasting research relating to improving and advancing sand casting.

AFS Funded & Monitored Research

Eight active projects are currently being funded through the allocation of a portion of the AFS Corporate Member Dues in FY2014-2015

Helium-Enhanced Semi-Permanent Mold Aluminum Casting (12-13#05)

Coordinator: Prof. Paul Sanders, Michigan Tech University; Prof. Kyle Metzloff, UW-Platteville and AFS Aluminum Permanent Mold Committee (2-E)

The effect of helium injection in aluminum permanent mold casting has been investigated by Doutre (2000), Wan and Pehlke (2004), and Metzloff (2009). Filling the air gap that forms between the solidifying metal and permanent mold with helium increases the heat transfer coefficient and casting cooling rate. Higher cooling rates decrease the time to ejection resulting in throughput improvements. Doutre measured the effect of helium on the cooling rate of several aluminum alloys using cylindrical and plate molds and found a 30-50% reduction in time to ejection temperature. Doutre found that helium-enhanced cooling improved commercial semi-permanent mold intake manifold casting productivity by 29%, but the details of the helium injection process (injection time, location related to cores, etc.) and the resulting microstructure and mechanical properties were not discussed.

Wan and Pehlke performed both modeling and experiments on helium injection on permanent molds. They found that injection of helium (as compared to air) improved cooling times to 400°C by 37% with conductive mold coatings and 48% with insulating coatings. Metzloff examined the effects of helium-enhanced cooling in a production environment with conductive and insulating mold coatings and the effect of external mold cooling. The helium injection was most beneficial with a standard insulating coating and external cooling, yielding a 33% reduction in cycle time over the baseline production practice and a 10% reduction over an optimized cycle without helium injection. The die in this study had a large internal metal core through which helium was injected. The benefit of helium was likely minimized as the casting shrunk onto the metal core, decreasing the air gap in the core area. It was thought that the helium injection would have a greater effect if the air gap was larger, especially in semi-permanent mold castings that have poor thermal conductivity in the sand core regions.

Saleem (2012) studied the effect of helium on the cooling rate and resulting properties of sand castings. This study found a 43-100% increase in cooling rate with a corresponding decrease in SDAS leading to a 34% increase in yield strength and a 22% increase in ultimate strength with no significant loss in ductility or increase in cost. Argyropoulos (2008) found that helium injection into a refractory mold made the gap develop up to 34% faster compared to air injection, but the heat transfer rate was higher by up to 48%.

The cost of helium would suggest that gas mixtures should be investigated. A 1992 U.S. Patent by Air Products (5,173,124) provides evidence that a 80%He-20%Ar gas mixture has a 12% higher convective heat transfer coefficient in turbulent flow. It was also noted that a 59%He-41%Ar mixture had the same convective heat transfer coefficient in turbulent flow. However, helium injection into the mold-casting shrinkage gap is not thought to provide turbulent flow (Wan and Pehlke). In this case, the more relevant parameter is likely thermal diffusivity. Sevast'yanov (1985) showed a quadratic decrease (decaying faster than a linear rate) in thermal diffusivity as argon was substituted for helium in the range of 20-80% at 27°C. Additionally, Purohit (1979) has shown a quadratic decrease in thermal conductivity with argon additions to helium at 727°C.

The objective of the project is to develop and demonstrate a method for improved productivity and properties of semi-permanent mold aluminum castings using helium-assisted cooling. A semi-permanent mold will be designed to produce a pipe with three section thicknesses using a cylindrical sand core. This simple casting geometry will be used to evaluate the effect of helium injection through a core, and allow for the characterization of a sand core and permanent mold within the same casting. A proposed CAD model has been completed by Carley Foundry. Andrei Starobin at Mold Dynamics will model core outgassing due to binder loss and the pressure head required for helium gas delivery. MAGMA modeling of the mold design will be done as a cost-share in collaboration with MAGMA. MAGMA will be used to optimize the feeding system to produce a sound casting and provide an initial estimate of cooling rates based on literature heat transfer coefficients. The deliverable will be a CAD model and process gas flow (Starobin) and casting parameters (MAGMA).

During mold design, consideration will be given to the requirements necessary for a proposed semi-permanent mold core dimensional study. This research mold is expected to be utilized in several AFS-sponsored projects.

The experience gained during the 2009 Metzloff work for helium injection and temperature collection will be utilized. Co-PI Metzloff will lead the helium injection system and temperature data collection specifications. Thermocouples (1/16 in. diameter to improve response time) will be placed in the mold, core, and casting cavity. The mold thermocouples will be placed as near to the cavity surface as possible and spring loaded to maintain contact with the casting. The helium injection port will be placed in the core print to allow helium flow through the core and into the air gap between the solidifying metal and mold in the remainder of the casting. The mold will be fabricated in the Michigan Tech School of Technology Machine Shop and assembled for casting on a permanent mold machine at a participating member foundry. The temperature data collection and helium injection system will be assembled and tested prior to the casting trials.

A Six-Sigma approach will be used to optimize the process parameters for helium-enhanced semi-permanent mold casting. A full factorial designed experiment will be run to characterize the helium injection process. A center point (run 5) will be used to check for non-linearity in the parameter settings, and an extra run will assess the effect of argon gas mixtures on the cooling rate and properties. Replicates may be run depending on observed experimental variation. Microstructure evaluation to characterize the grain size, SDAS, and porosity and property evaluation of the castings will be conducted. Finally, the projected cost savings from reduced cycle time and reduced part volume (based on strength improvements) will be calculated. The additional costs associated with setup time and gas usage will be accounted for in the total cost analysis. The 2009 study showed a projected cost reduction of ~7% for permanent mold casting.

Status Update: The project is now complete and the final report is being written. Updates are given at AFS Div. 2 Aluminum 2E committee meetings. The final results will be published as an IJMC paper and presented at the AFS Casting Congress. Those wishing more information about the project should contact the Steering Committee chair Brian Began at Brian.Began@foseco.com or Prof. Paul Sanders at sanders@mtu.edu.

High Strength Cast Iron Castings Produced by Engineered Cooling (14-15#03) Phase 2

Coordinator: Dr. Simon Lekakh and AFS Ductile Iron, CG Iron & Gray Iron Research Committee (5-R)

The majority of industrially produced cast iron castings have a microstructure consisting of graphite phase in ferrite/pearlite metal matrix which were developed directly in metal casting processing (as-cast) without needing an additional heat treatment. The "as-cast" cast iron structure was formed during: (i) solidification (prime structure) and (ii) eutectoid reaction (final structure). The current state-of-the-art cast iron industrial processes mainly control the mechanical and thermo-physical properties through the prime solidification structure by:

- carbon equivalent variation for controlling prime austenite/graphite eutectic ratio
- inoculation treatment for graphite nucleation and decreasing chill tendency
- magnesium treatment for controlling graphite shape (flake in GI, vermicular in CGI, and spherical in SGI)
- melt refining from dissolved impurities (S, O, N), and
- melt filtration for improving casting cleanliness.

Practically speaking, only one method—an additional alloying by Cu, Mo, Ni and other elements, is used for direct control of the structure of metal matrix formed during eutectoid reaction. The all described above methods could be called "chemical" methods because they control the microstructure through changes in the cast iron composition. However "chemical" methods have some serious limitations: (i) high cost of alloying additions, (ii) limited increase strength in as-cast condition, and (iii) need an additional austempering heat treatment for achievement a higher strength of cast iron castings.

Analysis of the performance of standard cast irons with different graphite shape and targeted properties are included in this project. The mechanical properties data are represented by, so called "Quality index", which is a strength/hardness ratio. For example, standard SGI is significantly stronger than CGI; however SGI has lower thermal conductivity which is a limiting factor for application for cast components of intensively thermo/mechanically loaded heavy-duty engines. The targeted properties for CGI produced by a novel process in "as-cast" are shown in Figure 1. The targeted strength of GI will be near the level of current CGI, and targeted strength of SGI in "as-cast" condition will be matched to the strength of heat treated castings.

The objective of this project is to develop a novel metal casting process for production of high strength cast iron castings in "as-cast" condition applying engineered cooling. The goals include:

- increase "quality index" (UTS/HB ratio)
- increase strength without sacrificing toughness
- decrease casting cost by eliminating alloying elements
- decrease energy consumption for heat treatment

Status Update: The Phase 1 project is now complete and a paper based upon that work was published in the Winter 2015 issue. Testing is now being conducted on simulated production shapes in a lab setting on a Phase II effort to continue this work towards commercialization of the technology. The project is being monitored by the AFS Ductile Iron, CG Iron & Gray Iron Research Committee (5-R). Those wishing more information about the project or how to participate as a sponsor should contact the PI Simon Lekakh at lekakhs@mst.edu.

Development of Ultra-High Strength Light Weight Al-Si Alloys (13-14#01)

Coordinator: Dr. M. Shamsuzzoha and AFS Aluminum Division 2

This proposal deals with the development of shape castings that produce high strength hypo- and hyper-eutectic aluminum (Al)-silicon (Si) alloys with silicon content in the range of 6-9% and that possess nano-sized fibrous silicon morphology in the microstructure. In an Al-Si binary system, hypo-eutectic is formed with a silicon composition lower than 12.7% of silicon. In the microstructure of hypo-eutectic Al-Si alloys, two major components coexist, the primary and the eutectic phase. The primary phase consists of Al containing about 1.67% Si as solid solution that exists in the form of dendrites, while the eutectic structure consists of an aluminum-rich solid solution of silicon and virtually pure silicon and that is found in between the arms of the primary Al dendrites.

Typical hypo- and hyper-eutectic alloys grown by impurity-modified conventional casting exhibit a microstructure comprising of primary Si that assumes sizes on the order of 10^{-4} m and eutectic silicon with a rather course fibrous morphology of sizes on the order of 10^{-6} m. These properties of the microstructure have not provided ultra-high strength and fracture toughness for such as cast alloys. Recently a new procedure based upon the concept of the solubility of barium (Ba) in the silicon phase has demonstrated that a hypereutectic Al-17wt%-Si alloy can be produced without a primary Si phase being present.

This work will establish the capability of the present process of refinement with respect to the required Ba additions, Si content, and refined microstructure in hypo-eutectic Al-Si alloys. In such pursuits using permanent mold casting techniques, the freezing parameters for an alloy that requires the optimum amount of Ba and that reveals nano-sized microstructure will be determined. Thus determined freezing parameters and Ba content will be subjected to another round of permanent mold castings in which various commercially available light weight Al-Si hypo-eutectic alloys will be used as starting materials. All such cast alloys will be subjected to T6 heat treatment conditions whereupon mechanical properties of the resulting tempered alloys will be determined. It is expected that a comparison of the mechanical properties of these alloys with those known for the commercially available light weight alloys may reveal the scale of improvement in the mechanical properties of the alloys grown by the proposed method. In establishing this capability some concentration will also be given to the related freezing parameters such as under-cooling (ΔT), growth velocity (R), and the inter-lamellar spacing (λ) with the microstructure of the resulting alloys. Such determination is of importance with respect to the application of this technology to foundry castings of Al-Si alloys of improved mechanical properties.

Status Update: The project is underway with the first portion of the design of experiment matrix of silicon ranges and Ba alloy additions having been tested demonstrating the refinement to the silicon morphology. The work is being monitored by the AFS Aluminum Division 2 and will be reviewed at the meeting on July 7th at AFS and a presentation at 119th Metalcasting Congress. Those wishing more information about the project or how to participate as a sponsor should contact the Steering Committee Chair Dave Weiss at david.weiss@eckindustries.com or the PI Dr. Shamsuzzoha, at shamsuz@aalan.ua.edu.

New Measurement for Active Clay in Green Sand-Phase 3 (14-15#01)

Coordinator: Dr. Sam Ramrattan, Western Michigan University and AFS Green Sand Molding Committee (4-M)

Measurement of live clay in molding sand is critical to control of foundry green sand. Live clay levels must be controlled to develop and maintain proper strength levels and mechanical properties of the molding sand. Control of the live clay level is also critical in monitoring of moisture and compactability because clay is the primary moisture absorber in molding sand. If clay level could be better understood, the moisture and compactability could be more closely controlled. Inadequate control of compactability is the leading cause of green sand casting defects, and the associated costs of scrap, rework, labor, and energy to individual foundries and the industry as whole warrant investigations into alternative methods of control. The foundry industry needs a faster, more accurate, and low cost alternative to properly measure active clay in green sand. The Methylene Blue Clay techniques employed by the foundry industry for measuring active clay suffer poor reproducibility and are thus incapable of maintaining accuracy. Casting defects are consistently attributed to variations in green sand systems and limitations of the clay control methods for green sand. A better clay measurement technique is necessary to improve green sand systems.

With research support from AFS, Western Michigan University (WMU) has developed a new methodology based on dye absorption for measuring active clays in green sand. The new procedure provides a direct instrument read that requires minimal operator training. However, there is concern regarding test-to-test variability using a particular anionic type dye (orange). Any new cationic dye consumable must be environmentally friendly, of lower cost and with easier clean-up compared to the current procedure (Phase II). The AFS 4-M Green Sand Additives and Testing Committee remains interested in finding a replacement for the Methylene Blue Clay Test. The AFS 4-M Committee has endorsed the Phase II approach but 'questioned' the selection of an anionic type dye (orange) and felt that test-to-test variability of results were not demonstrated to the satisfaction of the Steering Committee.

The purpose of this Phase III research is to identify a cationic dye for the absorption technique developed in Phase II. Another purpose will be to refine the procedure and conduct industrial trials using clay standards. Phase III research will be conducted according to specified tasks that are reviewed by a 4M Steering Committee.

Status Update: The cationic dye has been identified and now activity to investigate of how it performs against various sand mixtures and foundry plant trials will be conducted at five foundries and WMU. The work is being monitored by the AFS Green Sand Molding Committee (4-M). Continued training and verification of the test is being done by the working group, including 1-day workshops at WMU. Once this activity is complete the intent would be to create a standardized and validated test approach to be included in the AFS Core and Molding Handbook. Those wishing more information about the project, or participation should contact the Steering Committee chair Mike Slaydon at mslaydon@rochestermetals.com or Dr. Sam Ramrattan at sam.ramrattan@wmich.edu.

Application of DSC Coupled with TGA and MS to Assess Sand Binder Emission (14-15#02)

Coordinator: Dr. Scott Giese, University of Northern Iowa and the AFS 4F, 4K and 10E Committees

Emissions of hazardous air pollutants and organic volatile components have been a major concern for the foundry industry in providing a safe work environment for their employees. Emission studies have evolved from the emission compound identification work performed during the 1990's to the correlation of emission amounts per ton of metal poured conducted in the 2000's, most notably, the extensive emission study performed by the defunct Casting Emission Reduction Program. Data collected and presented to the foundry by CERP provided critical information for developing binder technologies to address emission reductions in HAP's and VOC's.

The major concern in conducting emission studies is the research expense to pour actual castings and measuring the emissions during the pouring, cooling, and shakeout segments of the metal casting process. For each casting segment, emission products need to be captured for each casting segment and analyzed. Variability in emission components is introduced when different casting alloys are used to simulate various segment heating rates. Additionally, continuous sampling over the casting regime only provides the total emission amount over that particular time reference and fails to illuminate the peak production of certain emission products. From the applied research approach, it is unclear if the components of emission production are a product of complex chemical reactions occurring between the coated sand grains in a soup of VOC's, HAP's, and light gases as the casting cools or are from the rapid exposure of the heated molding sand and core binder to an oxygenated environment during the shakeout of the mold.

Research by the University of Northern Iowa Metal Casting Center on emission modeling collected supporting data using DSC-TGA-MS techniques. Significant findings from the research program identified mold atmosphere, heating rate, and isothermal heating as major factors in emission generation. The DSC-TGA-MS capabilities permitted the use of different atmosphere blends, simulating neutral, reducing, and oxidizing conditions. Interestingly, the emission characteristics for a reducing and neutral environment were identical, but oxidizing conditions significantly altered the decomposition behavior. Higher heating rates showed some early suppression of emission products, particularly at lower temperatures, and some evidence of higher emission generation when heated to elevated temperatures. At the conclusion of the research work, several research questions were recommended warranting further investigation in developing a low cost testing procedure to assess the emission generation and characteristics for green sand and resin bonded cores. These research inquiries were

- What are the kinetic rates of HAP's and VOC's generation?
- How can the DSC-TGA-MS be utilized to replicate actual emission generation?
- Do volatilized HAP's and VOC's affect the emission generation by altering the mold atmosphere?

The proposed research project will greatly contribute to develop a low cost emission protocol to assess HAP and VOC release into the workplace environment. The proposed research approach hopes to support several research areas where emission analysis is critical; particularly for gas evolution in molds and cores to reduce gas related casting defects.

Status Update: The project and initial testing is now underway. Those wishing more information about the project should contact the Steering Committee chair, Mitchell Patterson, at mitch.patterson@ha-international.com or Dr. Scott Giese at scott.giese@uni.edu.

Reclamation of Investment Casting Shell Materials (14-15#04)

Coordinator: Dr. Victor Okhuysen, California State Polytechnic University-Pomona and the AFS 4L Investment Casting Research Committee

Investment casting shell materials are used once and then disposed. This has economic, environmental, and logistical costs. Investment casting shell materials consist largely of stucco, flour, binder and additives. Of these, the most costly ingredients are the stucco, flour and binder. During processing the binder, usually colloidal silica, undergoes an irreversible reaction to form silica gel. Thus, it is not feasible to reclaim the binder. The stucco and flour are used as aggregates with the binder to produce the shell. These are the materials that this project will focus on.

The typical materials include mullite, fused silica and zircon. The zircon is a minor ingredient by volume, but due to its high cost, it is of great interest. The fused silica and mullite are used in much higher quantities and they also constitute a significant expense. The first step in the reclamation process would consist of the separation of stucco and flour particles ideally to their initial size distributions from the spent shell material. There are multiple mechanical methods that are currently used for the separation of sand and binder in sand casting. In addition, there is significant expertise on particle grinding in the ceramics and mining industry. It is anticipated that some of these methods will be applicable to the existing project. Once this is attained, then the possibility of separating the zircon from the mullite and/or fused silica can be contemplated. For the purposes of this project that separation is not being considered but this would be a likely follow up project in the future.

Phase transformations in the ceramic can occur during the thermal cycle of the investment casting shell. Zircon and pure mullite are not anticipated to have phase transformations. On the other hand, fused silica is known to transform to crystalline silica in the form of cristobalite. The transformation of amorphous phases of silica begins at around 900 C, and as the temperature increases, the amount and rate of transformation increases. The highest rates occur between 1100 and 1200 C, and nearly complete transformation is reached by 1400 C. Lower grades of mullite (47% alumina) report having some silica, though it is not specified if crystalline or amorphous.

An additional variable in fused silica consists of the alloys produced. In the production of steel pouring temperatures of 1600 C are used. These are clearly beyond the formation temperature into cristobalite. Aluminum pouring temperatures, though, are usually around 700 C, below the transformation temperature to cristobalite. Thus, a goal of this project is to investigate if fused silica can be reused for lower temperature alloys even if it can't be reused in high temperature alloys.

There are regulatory trends to have foundries reduce their solid waste streams and spent ceramics constitute the largest waste stream for investment casters. The reclamation would help foundries meet the regulatory targets. Lastly, if investment casters reclaim their ceramics, this would also simplify their supply chain. They would be able to better control their inventories and depend less on the vagaries of the market and potential supply disruptions. Work performed in Poland showed that the use of mechanically reclaimed shell materials used in superalloy casting can produce shells with equal or better green strength by the use of reclaimed flours and stucco, but for high temperature strengths, only the shells without reclaimed flour matched hot strengths.

Reclamation of the ceramic materials would save in both the purchase of new raw materials and in the disposal of the spent materials. A survey of investment casters was conducted by the AFS where 89% of the respondents indicated interest in reclaiming ceramics. The average consumption of non-zircon ceramics by these facilities was 601,000 lbs per year. An average price per pound was obtained based on available data at $0.57/lb. The average benefit for a foundry would be $342,000/year. There are 22 AFS members for whom the impact would be $7.5 million per year. A survey of the broader U.S. investment casting industry yielded at least 76 investment casters, and the extended benefit would be $26 million/year. This assumes 100% reclamation of non-zircon flours and stuccoes. Thus, even if partial reclamation was successful it would still be in the millions of dollars. Furthermore, once the ceramics are ground, it would be possible to look at zircon separation and zircon specific reuse would greatly increase the economic impact. Furthermore, this value also excludes shipping and disposal savings.

The project will produce a set of instructions and guidelines as to how to approach the reclamation of ceramic shell materials. Among these instructions there will be: Recommended equipment (based on that used in the successful results in the project), detailed procedures, and detailed notes on any changes on standard procedures currently in place. The target dissemination will include reclamation and use instructions such as:

- How to grind the spent shells including do's and don'ts.
- The equipment used
- The amount of reclaimed material that can be added
- Detailed information on what changes the facility may experience in the production characteristics of the slurry/stucco (i.e. different viscosity, higher/lower slurry life, pH changes, greater/less need for wetting agents, antifoams, etc.)

These materials will be the basis of any papers presented at the Casting Congress or published in journals, the materials to be generated for CMI training and for the poster presentations. Results on milestones will be published at the earliest opportunity mainly through AFS channels.

Status Update: The project and initial testing is now underway, with an active steering committee determining slurry formulations to be tested. Those wishing more information about the project should contact the Steering Committee chair, Matt Cavins, at mcavins@ofalloncasting.com or Dr. Victor Okhuysen at vfokhuysen@csupomona.edu.

Influence of Mn and S on the Properties of Cast Iron—Phase 2 (14-15#05)

Coordinator: Richard (Rick) B. Gundlach, Element Materials and AFS Ductile Iron, CG Iron & Gray Iron Research Committee (5-R)

Sulfur is generally considered a tramp element in cast iron, and its level must be controlled. When manganese is not present at sufficient concentrations, sulfur reacts with iron to produce a low-melting phase that can produce hot-shortness in iron castings. Consequently, the industry has always added manganese to control sulfur in cast iron. Various formulae have been promulgated in the industry for balancing Mn and S in cast iron. Many employ a stoichiometric relationship between Mn and S, requiring an excess Mn content to avoid FeS formation. Some simply employ a Mn to S ratio (such as 5 – 7) to assure that no FeS forms. Others advocate that the sulfur content must simply be at or above 0.04%S to obtain adequate inoculation response. With the exception of a few investigators, none has considered the solubility of MnS from thermodynamic principles.

Recent research conducted for the AFS 5R Committee under Research Contract Project 12-13#04 "Influence of Mn & S on the Properties of Cast Iron" has demonstrated that, through balancing Mn and S according to the solubility limit of MnS inclusions at the eutectic temperature, the strength of gray cast iron can be optimized. Based on the literature review and the experimental work, it was possible to define what Mn and S concentrations might produce the best properties with regard to strength. The experimental work focused on Class 35 iron cast in sections up to 3-inches and showed that at optimum Mn and S levels, the strength can be 6 to 10 ksi higher than in poorly balanced chemistries.

The results of the research on Mn and S in gray iron raises many questions and, also, new ideas for future research. Several of those ideas were discussed at the Spring 2014 5R Committee meeting. The one that was selected for this phase included the following activity to develop a better understanding of the strengthening effects at the optimum Mn:S balancing. While the current study showed that maximum strength occurs at compositions close to the solubility limit of MnS, it is not clear what microstructural features were optimized. The numerous metallographic samples that are available from the previous study are suitable for the proposed research. The samples will be used to determine the microhardness of the pearlitic matrix. These data will be compared with the bulk hardness of the samples and correlated with the tensile strength of the alloys in order to determine whether changes in the pearlitic matrix contributed to the loss in strength in alloys with poorer Mn-S balancing. The same metallographic samples will also be used to perform a broader characterization of the graphite structure, since the several observations from the previous study strongly suggest that the variations in strength are tied to changes in the graphite structure. Features such as cell count, mixed graphite structures (flake distribution types), and the occurrence of spiky graphite morphology will be investigated as a function of Mn and S concentrations and section size.

Status Update: This second phase of the project is starting. The work is being monitored by the AFS Ductile Iron, CG Iron & Gray Iron Research Committee (5-R) plus a group of sponsoring companies. Those wishing more information about the project or how to participate as a sponsor should contact the Steering Committee chair Leonard Winardi at LWinardi@charlottepipe.com or Rick Gundlach at rick.gundlach@element.com.

NDT & Microstructure Correlations to Gray Iron Aging (14-15#06)

Coordinator: Greg Miskinis, Waupaca and AFS Ductile Iron, CG Iron & Gray Iron Research Committee (5-R)

Gray iron cast components are well known to age or "cure" after casting, resulting in strength and resonant frequency (RF) increases over time. Previous research has shown this aging effect to be logarithmic with most of the effect (70% or so) coming in the first 15 days after casting. There are multiple theories, however, regarding how best to account for and benefit from this aging process. One benefit may be a reduction in machining tool wear. Improved tool life has been found to occur in aged castings in multiple machining trials over the years.

Literature review provides two theories regarding the mechanism of gray cast iron aging, precipitation of submicroscopic nitrides, and residual stress relief. The case for nitride precipitation rests ultimately on limited tensile data, which, with its large variation, needs a larger study to properly validate. The case for stress relief relies on primarily on the aging effect found in the resonant frequency (RF) of gray cast iron and the effect of stress inducing processing (shot blasting and machining) to the RF and tensile strength.

Ultimately, the testing protocol documented here will need to be repeated with ductile iron. This study will attempt to determine the optimal balance of aging, part and NVH (noise, vibration, harshness) performance, and also secondary operations versus processing limitations and inventory requirements or work in process (WIP) costs. The project objective is the determination of the "ultimate" cause of the aging response, leading to determination of the full aging time for gray iron castings, allowing for more precise non-destructive testing and more successful secondary operations.

Status Update: This project is just starting. The work is being monitored by the AFS Ductile Iron, CG Iron & Gray Iron Research Committee (5-R). Those wishing more information about the project or how to participate as a sponsor should contact the Steering Committee chair Matt Meyer at Matthew.Meyer@kohler.com or Greg Miskinis at Gregory.Miskinis@waupacafoundry.com.

Metalcasting Industry Funded & Monitored Research

American Metalcasting Consortium/U.S. Dept. of Defense/ Defense Logistics Agency Funded Projects/ National Institute of Standards/AMTech Program

Castings Solutions for Readiness (CSR) Program

AFS, as part of its efforts in the American Metalcasting Consortium (AMC), has recently secured contracts funded through the U.S. Department of Defense, Defense Logistics Agency, Defense Supply Center Philadelphia and the Defense Logistics Agency, Ft. Belvoir, VA. The group of projects is under an AMC program entitled Castings Solutions for Readiness (CSR). The two new projects are continuations of previous AFS AMC efforts, including one project called Cast High-Integrity Alloy Mechanical Property Standards (CHAMPS) and the other Casting Standards and Specifications.

CHAMPS Project— Additional Alloy Design Data

The CHAMPS Statistical Properties Project goal is incorporation of material property design data for additional cast alloys, A206-T4 and T7 in the initial phase and then investment cast 17-4-PH and 15-5PH in a second phase, into MMPDS (Metallic Materials Properties Development and Standardization) handbook, which replaced Mil-Handbook 5, so that this material can be specified and used to design and manufacture flight critical components in military and civilian aircraft. This builds on the original just completed E357 effort of establishing a framework to design a series of test specimens that encompass the various section thicknesses used in these applications utilizing process simulation software, validate the approach metallographically, coordinate collection of required samples from a consortium of qualified foundries and submit the data for statistical analysis and approval by MMPDS board for incorporation into the MMPDS standards. The benefit to DLA is that the development of statistical based property data will permit the use of castings across a broader range of applications and will provide the following benefits. The Engineering Support Activities at the DLA will be able to make cast alloy conversion / replacement decisions with assurance using statistical data on tensile, compressive, shear, and bearing properties from the FAA recognized source, MMPDS Handbook. Also reduced lead times with cast components competing on an equal basis with forging and assemblies from sheet, plate, and extruded mill products.

As with the E357 project, the intended outcome will be cast A&B design property allowables for the alloys selected for inclusion in the MMPDS (old Mil Spec Handbook 5) to meet FAA requirements. This will allow aerospace design engineers to specify castings without using design safety factors. Various working groups will be actively looking at melt practices, test casting gating and filling, heat treatment parameters, testing protocol and weld repair standards. The initial casting trials will follow the approach taken for E357 and conducted for 1.5 x 2.5-in. plate cast in both horizontal and vertical gating approaches, and a heat treat study was conducted at various participating foundries. These plates will be tested for tensile properties and undergo microstructural evaluation. The project is now starting with the initial activity investigating modeling the gating and rigging used for a previous E357 project followed by some casting verification trials. Those wishing to participate or wanting more information should contact Steve Robison, AFS, at stever@afsinc.org.

Casting Standards and Specifications

Accessing state-of-the-market technical, specification and training materials for castings is challenging. AFS is working to provide current and qualified information in a network friendly form to users of castings via the Casting Standards and Specifications project. The effort includes both archival and recent technical information in searchable databases. Specifications and standards are summarized, and the user is guided in their application. Tutorials covering the fundamental design concerns are also presented. The development of an online material design property database will greatly enhance the ability for the next generation of component designer to create the lightest weight and most efficient parts quicker and at lower cost. These tools facilitate more effective and efficient procurement to both DoD and industry in the support of weapon systems. Along with data from various AFS research projects, like the recently completed 08-09#01 & 08-09#03 projects for the Development of Fatigue Properties Database, AFS has also incorporated the USAMP Light Metals Materials Database properties and recently strain life fatigue data for CGI Grade 400 and a hi-alloy Class 40 Gray Iron into the AFS Casting Alloy Data Search (CADS) onto the AFS design website: www.metalcastingvirtuallibrary.com/cads/cads.aspx. This completes this phase of the project and AFS is working with various groups, including design software providers, the design departments of OEMs and ASM to create Cast Alloy Material Property Datasheets to be put on the ASM Material Selector and AFS websites. This work has been compiled into an updated DVD that is available from the AFS bookstore. This is an outstanding resource for those needing validated mechanical properties that design engineers need to make the most efficient components. The work planned under this project will add design properties for 4-5 additional cast metal alloys per year, while continuing to upgrade the CADS online database. During the first two years work was completed on Class 25E Gray Iron, Ductile Iron EN-GJS500-07 (lower hardness version of 80-55-06) for 1 and 3 inch section thickness, HiSiMo Ductile Iron, and 1 and 2 inch section Aluminum E357, with specimens coming from the previously completed CHAMPS E357 project. Work is completed for an aluminum Al4Si with samples produced in both sand and permanent mold and additional work is currently underway for 535 and planned for A206. The project would like to secure additional cast materials, including common grades of steel and copper-based alloy.

For more information, contact Thomas Prucha, AFS, at tprucha@afsinc.org or AFS technical and library services, Katie Matticks at katie@afsinc.org.

National Institute of Standards (NIST) AMTech Program

Pathway to Improved Metalcasting Manufacturing Technology & Processes–Taking Metalcasting Beyond 2020

The National Institute of Standards and Technology (NIST) awarded an advanced manufacturing technology planning grant to a metalcasting project submitted by the American Foundry Society (AFS). The Pathway to Improved Metalcasting Manufacturing Technology and Processes –Taking Metalcasting Beyond 2020 project is one of 19 initiatives that were awarded a total of $9 million to develop technology roadmaps aimed at strengthening U.S. manufacturing and innovation performance across industries.

AFS is the lead organization in the project that will be launched by the American Metalcasting Consortium, which is composed of four industry associations that represent 95% of the nation's 2,000 foundries. The goal is to conduct an industrywide roadmapping effort to identify research and related actions aimed at achieving significant improvements in processing capabilities and productivity. Specific objectives are to:

- Reach industry consensus on metalcasting capability gaps, solution priorities, and investment recommendations.
- Identify potentially transformative technologies requiring collaborative research.
- Establish clear problem definitions and a common framework for parallel work by multiple organizations.
- Chart a transition path to facilitate interoperability of developed solutions with existing systems.
- Build a collaborative infrastructure tailored to the roadmap's targeted outcomes.
- Initiate development of an infrastructure that supports an advanced U.S. metalcasting industry.

Castings are in every sector of the economy including transportation, energy, mining, construction, maritime, fluid power, instrumentation, computers, defense, and household products. A strong U.S. metalcasting industry is needed to maintain global competitiveness. To improve the domestic metalcasting industry, there are significant challenges needed to improve productivity, manufacturing practices, advanced alloy and component performance, and attract employees and students needed for energy efficiency, and environmental compatibility. The vast majority of metalcasters are small businesses that do not have the resources to perform the advanced research and development necessary to remain competitive and maintain sustainable enterprises.

The American Metalcasting Consortium (AMC) roadmapping planning process will identify, select, and develop technological alternatives to ensure a competitive U.S. metalcasting industry. AMC integrates the nation's top academic metalcasting researchers with the four leading metalcasting industry associations (American Foundry Society, Non-Ferrous Founders' Society, North American Die Casting Association, and the Steel Founders' Society of America) and their members to identify new technologies and processes to enhance the global competitiveness of the U.S. metalcasting industry. AMC will develop a roadmap with an integrated, prioritized and readily executable plan of action based on mapping capability gaps to solution paths with the greatest potential to meet goals of the industry. This initial survey was very successful, with 258 responding and then 65 in a follow-up survey-interview process which is being used to help prepare for the workshop planned for May 12-13, 2015.

National Network for Manufacturing Innovation

America Makes—National Additive Manufacturing Innovation Institute

America Makes is the National Additive Manufacturing Innovation Institute. As the national accelerator for additive manufacturing (AM) and 3D printing (3DP), America Makes is the nation's leading and collaborative partner in AM and 3DP technology research, discovery, creation, and innovation. Structured as a public-private partnership with member organizations from industry, academia, government, non-government agencies, and workforce and economic development resources, its mission is to innovate and accelerate AM and 3DP to increase our nation's global manufacturing competitiveness. AFS is partnering with Youngstown Business Incubator (YBI) who has been named a recipient of funds from America Makes for the research project "Accelerated Adoption of AM Technology in the American Foundry Industry." Along with YBI, Youngstown State University (YSU), ExOne, Humtown Products, and the University of Northern Iowa (UNI), the project team for "Accelerated Adoption of AM Technology in the American Foundry Industry" will support the transition of binder jet AM to the small business casting industry by allowing increased access to the use of binder jet equipment and the development of design guidelines and process specifications. For those attending the 119th Metalcasting Congress, the AFS and the America Makes Consortium would like to invite the attendees to a free Pre-Congress workshop, being held at the Greater Columbus Convention Center, Columbus, Ohio, from 1:00 pm-4:30 pm on April 20, 2015. During this workshop speakers will present the key aspects of the technology, latest research and advancements, how the technology can promote and enhance design freedom and product improvement and highlighted by presentations and a panel discussion by several foundries on how they are using the technology to expand markets, reduce lead time and improve cost. At the end of the workshop, discussion will be held to help form the first AFS ad-hoc committee on Additive Manufacturing.

Lightweight Innovations For Tomorrow—LIFT

The Lightweight and Modern Metals Manufacturing Innovation – LM3I – has been renamed LIFT (Lightweight Innovations For Tomorrow) and is headquartered in downtown Detroit. LIFT is led by Ohio-based EWI (Edison Welding Institute), a company that develops and applies manufacturing technology innovation within the manufacturing industry. AFS is part of a 60-member consortium that will pair leading aluminum, titanium, and high strength steel manufacturers with universities and laboratories pioneering new technology development and research. "The long-term goal of the LIFT LM3I Institute will be to expand the market for and create new consumers of products and systems that utilize new, lightweight, high performing metals and alloys by removing technological barriers to their manufacture," the White House said. The Institute will seek to achieve this through leadership in pre-competitive advanced research and partnerships across defense, aerospace, automotive, energy, and consumer products industries. The White House noted that lightweight and modern metals are utilized in a vast array of commercial products, from automobiles, to machinery and equipment, to marine craft and aircraft. "These ultra-light and ultra-strong materials improve the performance, enhance the safety, and boost the energy and fuel efficiency of vehicles and machines," the White House said. The Institute will advance the state of processing and fabrication technologies for lightweight and modern metals by facilitating the transition between basic/early research and full-scale production of associated materials, components and systems. AFS will champion the role of the metalcasting industry as a key metals manufacturing sector in this effort.

Digital Manufacturing and Design Innovation—DMDI

The idea behind the Institute is that manufacturing is being transformed by digital design, which replaces the draftsman's table with the capacity to work and create in a virtual environment. AFS feels the establishment of a Digital Manufacturing and Design Innovation (DMDI) Institute will increase the successful transition of digital manufacturing and innovative design technologies through advanced manufacturing, create an adaptive workforce capable of meeting industry needs, further increasing domestic competitiveness, and meet participating defense and civilian agency requirements. This project will benefit the U.S. manufacturing industry by providing resource, focal point and network for resolving technical barriers currently limiting the application and integration of digital manufacturing and innovative design technologies. As it relates to the metalcasting industry, the use of these technologies will assist in the more rapid development and production of lighter weight metal cast components for military, energy, transportation and commercial applications. This can allow for design innovation via part consolidation and near net shape capabilities of metalcasting, the weight reduction potential of such materials as magnesium, aluminum, titanium and next generation ferrous metals, and the improved quality and productivity of advanced casting processes, this unique program can make significant strides toward production of high integrity, complex cast components and advance our manufacturing base. The Institute will also be a resource for training our workforce from manual labor to more highly skilled and technical jobs.

AFS Information Services

Casting Process and Alloy Assistance

The AFS website offers assistance for casting design engineers in selecting the best casting process for a potential component, and also provides casting alloy design and property data on many commonly used alloys. The website provides casting users, design engineers and purchasers with relevant and accurate information on casting capabilities and properties, providing easily accessible and retrievable information from a single site. The alloy data can be quickly exported to a spreadsheet or FEA tools. The comprehensive site includes assistance for selection of alloys, casting process, alloy property data for many common alloys and a metalcaster directory to locate potential casting sources. The Casting Alloy & Process Selector, the Casting Alloy Data Search and the Metalcaster Directory are located online at www.metalcastingvirtuallibrary.com.

Technical Resource

Technical department staff and technical committee members provide regular contributions to *MODERN CASTING* and *Metal Casting Design & Purchasing* magazines. The columns, Cast-TIP and Testing 1-2-3, documents the best practices for various procedures and tests used in the metalcasting industry and various casting defects, including potential causes and solutions. AFS technical staff associates continue to support AFS members and casting users through telephone and email requests for technical help, casting problems and metalcasting information.

Library

The AFS online library database serves the needs of the metalcasting industry for current and historic metalcasting information. AFS is continuing to electronically archive the full *AFS Transactions* series using non-destructive scanning technologies. The project is nearing completion, with all *AFS Transactions* fully electronically archived and web searchable, from the very first edition (published in 1896) to the present.

The updated and advanced AFS library website with almost 40,000 papers and articles about metalcasting are available for purchase. Located at www.afslibrary.com, the website houses the world's largest collection of metalcasting reference material. The online AFS library is powered by a Google search engine, providing state-of-the-art functionality to help users find articles quickly. Reference services by phone and email assist users in refining their search or locating a specific article. The site provides the option to purchase AFS copyrighted papers and articles by automatic download or email.

For more information on the library website, contact AFS technical and library services, Katie Matticks at 847/824-0181, ext. 294, kmatticks@afsinc.org.

AFS Technology Transfer

119th Metalcasting Congress

Sponsored by the American Foundry Society (AFS), the 119th AFS Metalcasting Congress is scheduled for April 21-23, 2015 at the Greater Columbus Convention Center, Columbus, OH. The Congress will provide metalcasters, suppliers, casting buyers and designers with the opportunity to connect and learn about the latest metalcasting innovations and procedures. The Metalcasting Congress will feature exhibitors displaying the latest in metalcasting technology, and technical education sessions covering all metalcasting and die casting processes and all cast metals. The Metalcasting Congress provides a venue to learn and network with other foundry and die casting personnel. Also, immediately preceding the Congress on Monday afternoon April 20th will be an Additive Manufacturing for Metalcasting Workshop conducted by America Makes Consortium members and will be available at no cost to all Congress attendees.

For more information, contact Pam Lassila at 800/537-4237 x240 or plassila@afsinc.org.

Conferences, Workshops and Webinars

AFS Practical Cupola Seminar covers all elements of cupola melting and maintenance. The seminar, hosted by ACIPCo, Birmingham AL, and scheduled for May 5-6, 2015 will discuss charge material, refractories, chemistry and metallurgy as well as basic principles of cupola start-up and operation.

AFS Conference on High Integrity Aluminum Castings is scheduled for October 5-7, 2015 at the Sheraton Music City Hotel, Nashville, TN. AFS is seeking papers and/or presentations on topics relating to the production of high integrity aluminum castings including, but not limited to, design and structural integrity aluminum components, melt treatment, gating, feeding and simulation, inspection and quality, and current and future research in light metals casting.

AFS International Ferrous Melting Conference is scheduled for October 7-9, 2015 at the Sheraton Music City Hotel, Nashville, TN. The conference is issuing a call for papers and/or presentations on all topics of concern in ferrous alloy melting. All submissions under the following topics, refractory, induction melting, induction holding, cupola melting, slag, charge materials, metallurgy and chemistry control, casting defects from melting practices, energy conservation, pouring systems, furnace startups and shutdowns, emergency procedures and safety will be considered for publication and presentation.

For more information on all AFS conferences and workshops, contact Laura Kasch, AFS technical assistant, 800/537-4237 x246, technicalassistant@afsinc.org.

Technology Transfer Thursdays

The American Foundry Society conducts a monthly webinar program highlighting the latest research in the metalcasting industry. Technology Transfer Thursdays presents the research and findings from AFS Funded Research projects and how these new developments can benefit the metalcasting industry.

Recent webinars featured the results of a recently completed AFS research projects on the quenched cupola and veining reduction - a thermo-mechanical approach by Dr. Sam Ramrattan, WMU, which had over 115 participants on the webinar. The most recent one conducted March 4, 2015, "Magnesium Melt Cleanliness" was presented by Prof. C. (Ravi) Ravindran, Ryerson University. A continuing full slate of webinars is planned for 2015. Technology Transfer webinars are offered to the metalcasting industry at no cost. To register for these webinars contact Laura Kasch, AFS technical assistant, 800/537-4237 x246, technicalassistant@afsinc.org.