Recent Projects

Ceramic Aggregate

Recycling and Reuse Technology Transfer Center (RRTTC) and Carbo Ceramics: A new ceramic aggregate having similar characteristics as silica sand has been developed by Carbo Ceramics. Casting experiments performed by the Metal Casting Center has shown this material to have an increase resistance to sand expansion related defects and enhanced durability over other natural sand aggregates. For the Iowa foundry industry, the potential reduction of 1-3% average cost on scrap and rework can be realized in using the synthetic aggregate. Because of these unique properties, research work through the RRTTC is investigating the feasibility of designing a closed-loop core and molding system. Coupled with present sand reclamation technologies, the spherical ceramic aggregate offers the potential for the Iowa Metal Casting Industry in reducing foundry wastes with lower energy costs. Higher waste landfill costs are anticipated to significantly increase in the next couple of years. The goal of the research program is to reduce the amount of spent sand being sent to the landfill. Based on government standards of spent sand, this translates to an estimated monthly decrease of 4,000 tons for an estimated saving of $800,00 per year for the Iowa foundry industry. *For more information on this project, contact Dr. Scott Giese.*

Characteristics of Cores Used in Producing Aluminum Castings

During the last five years, the sale of aluminum castings has grown at a rate of approximately three times that of iron or steel castings. The result of this growth has been lighter, more fuel efficient cars and light trucks. The MCC, working with Borden Chemical, a major supplier of sand binders to the foundry industry, has been working on improving the characteristics of cores used in producing aluminum castings. One of the major problems encountered in casting aluminum alloys is that cores used are predominately produced from phenolic urethane binders. These binders have high hot strength and, as in the case of aluminum castings, are not heated with the pouring of the castings to temperatures that break down the bonds between the sand grains. The result of this is that cores are difficult to remove from the solidified castings. Current methods used to remove the cores are both energy intensive and have the possibility of damaging fragile components. We are evaluating changes in binder formulations in an effort to reduce or eliminate these problems. Possible benefits of the research also include reduced buildup of resins

on the core equipment used to produce the cores and better dimensional stability. *For more information on this project, contact Jerry Thiel.*

Environmental Issues

Environmental issues are usually on the forefront of many metal casters concerns or at least should be. HAPS or Hazardous Air Pollutants are gasses that are produced when molds containing carbon containing materials are subjected to high temperatures as occurs in the pouring of cast metals. These include both chemically bonded and green sand molds. Of all the HAPS released from poured castings, benzene is the largest. The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit of 1 part of benzene per million parts of air (1 ppm) in the workplace during an eight-hour work day, 40 hour work week. The Department of Health and Human Services (DHHS) has determined that benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood forming organs. The Metal Casting Center is working with suppliers of bentonite and seacoal on methods to reduce the emission of harmful benzene from the pouring of molds. Continuing research will examine various propriety additives, their effect on benzene emissions and casting quality. *For more information on this project, contact Jerry Thiel.*

Environmental Protocols and Techniques

The MCC assisted the Iowa Waste Reduction Center (IWRC) by conducting three presentations on environmental protocols and techniques available for the Iowa foundry industry. The presentations discussed research work associated in reducing foundry wastes, improving energy efficiency through process mapping, and foundry materials that reduce emissions into the workplace. Regulatory compliance issues were covered and discussed by the IWRC. The Metal Casting Center illustrated that the future success and global competitiveness depends on the development of new technologies and materials to meet environmental regulations. The Iowa foundry industry now supports the collaborative research efforts with foundry suppliers in developing and promoting these environmental initiatives. *For more information on this project, contact Dr. Scott Giese.*

Bio-based Porcine Binder

Hormel Foods has commercially introduced a new bio-based procine binder for the foundry industry. The protein based binder is unique in that it is water based and uses waste materials from the pork industry. The binder is safe to use (interestingly, it can be ingested), is neither corrosive nor flammable, and does not use toxic or hazardous chemicals. Since the binder system is water based, spent sand can be easily reclaimed and reuse of the sand will significantly reduce the amount of waste generated by the foundry industry. The MCC is assisting Hormel Foods in developing expanded binder capabilities for the Iowa foundry industry. Training programs provide an opportunity to learn more about the binder material. Research work is being performed to document the processing and physical characteristics of the protein based binder and to illustrate the environmental and casting advantages for the foundry industry. *For more information, contact Jerry Thiel.*

Enhanced Molding Sands to Improve Surface Quality of Castings

The MCC has been working with Fairmount Minerals, a major supplier of silica and lake sand to the foundry industry, on enhancing molding sands to improve the surface quality of castings. Research has continued on blending various sands to improve their performance in the foundry. Previously, sand companies have relied on nature to provide molding sands in sufficient abundance to fill the needs of metal casters. Lake sands, which occur naturally as a result of erosion of rock along the shores of lakes, typically have lower expansion rates due to the inherent impurities in the sand. Round grained silica sands, which are found inland of lakes, have few impurities and yield stronger cores and molds when used in chemically bonded sand systems but have slightly higher thermal expansion rates. Typical expansion rates for lake sands are 10-30% less than that of round grain Silica sands. Recently lake sands have been increasingly more difficult to obtain because of environmental issues. In an effort to sustain the supply of quality sand to the metal casting industry, the MCC and Fairmount Minerals have been working on ways to reduce the expansion of silica sands by selectively blending the material with available lake sands. The research has resulted in several blended sands that improve the resistance to veining while minimizing the need for core or mold coatings. The research is expected to continue throughout 2001. *For information on this project, contact Jerry Thiel.*

Riser Sleeves

The overall objective of the proposed research work is to determine the thermal efficiency of a variety of riser materials and geometric shapes. The main objectives of the proposed research work are:

1: Explore computation methodology and techniques in determining an appropriate insulating factor for a variety of riser sleeve products.

2: Develop a correction factor as function of diameter for different sizes, materials, and geometries.

3: Determine appropriate feeding aid values for steel using positioned thermocouples.

4: Evaluate and explore the possibility of using modeling techniques in the design of risers, insulating thickness, and exothermic riser sleeve thickness.

For more information on this project, contact Dr. Scott Giese.

In-Mold Inoculation of Gray Iron

The objective of this project is to develop and test in-mold inoculation technique and technology for gray cast irons. We will utilize ceramic foam filter with special chemistry inoculants as back-up inoculation. The first phase will assess dissolution behavior of different inoculants and filtration capacity of ceramic foam filters. *For more information on this project, contact Dr. Yury Lerner.*

Pre-inoculation Effect of SiC in Thin Wall Ductile Iron Production

Pre-inoculation effect of SiC furnace additions on microstructure, magnesium recovery, and castability in thin wall ductile iron plates has been compared with alternative FeSi75. An obtained result showed that pre-inoculation with SiC provides higher residual magnesium and better magnesium recovery when the same amount of FeSiMg master alloy was used. When the

amount of FeSiMg master alloy for experimental heats using SiC was reduced by 11%, the residual magnesium remained higher (0.33% vs. 0.32%) than in experimental heats using FeSi75 and standard amounts of FeSiMg. Chill tendency in thin wall ductile iron plates was lower even in those experimental heats using SiC with residual magnesium higher than 4.1% in experimental heats using FeSi75 with the same carbon equivalent. *For more information on this project, contact Dr. Yury Lerner.*

Total Assessment Audits

As part of the Industrial Technology Department, the center has a diverse knowledge pool to draw from when assisting companies in Iowa. The MCC was recently involved in a total assessment audit with the responsibility of determining the viability of an Iowa based company to develop an in-house heat treatment department. After a detailed audit of their materials and requirements, comparisons were made of their current costs and projected cost if they heat treated the parts in-house. Results of the findings were presented to the company as part of a Manufacturing Extension Partnership Total Assessment Audit headed by Scott Community College. This type of collaboration assists businesses by expanding their expertise with knowledge of current or new manufacturing technologies. *For more information on this project, contact Jerry Thiel.*

Industries of the Future (IOF)

A partnership with the Center for Industrial Research and Service (CIRAS) and Iowa State University to introduce the National Industries of the Future-Metal Casting and develop an Iowa Industries of the Future-Metal Casting. This involves every metal caster in Iowa to help in developing a metal casting vision and technology roadmap. *For more information contact Dr. Scott Giese.*