METAL CASTING

Project Fact Sheet

Thin Wall Iron Castings

Benefits

This research project will introduce new and advanced manufacturing processes and material technologies to U.S. foundry operators. It will increase opportunities for ferrous castings to meet increasingly demanding specifications for weight and strength. It will increase the range of alternatives of cast products available to the U.S. automotive industry, thereby enabling them to respond to fuel economy standards. Specific benefits will include:

- Developing production processes, and material composition and treatment, for iron castings containing walls as thin as 2.0 to 2.5 mm.
- Savings of 5% in gasoline consumption annually with the application of these castings in domestic cars and trucks.
- Increased competitiveness in export markets for light weight, high strength castings.

Applications

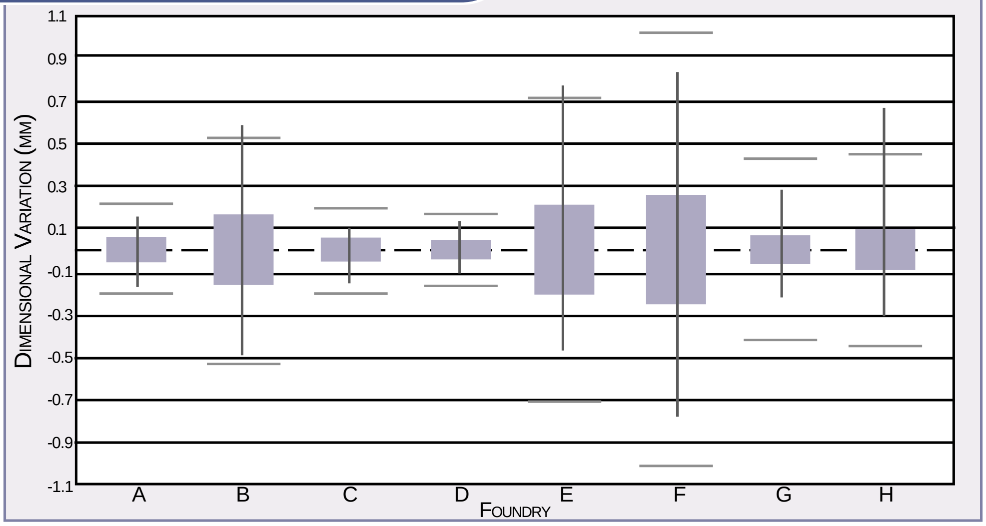
Iron castings represent about 75% of total U.S. casting shipments. Automotive castings account for about 20% of iron shipments. Project results will include manufacturing processes and material technologies which can be applied in the U.S. iron casting industry. It will help the industry to respond to increasingly demanding and competitive markets in automotive castings.

Techniques being developed to produce high strength, lighter weight automotive castings

Foundries specializing in automotive castings are confronted with the challenge of developing new processes and materials that reduce overall car weight to meet federally-mandated fuel economy standards, without sacrificing performance. In order to meet those standards, automakers have increasingly turned to lighter weight materials. The result has been the displacement of ferrous castings for automotive parts. However, ductile iron is not only less expensive than most alternative materials, it is superior in terms of relative weight per unit of yield strength, and has better fatigue properties. In addition, compacted graphite cast iron is superior for engine components because it allows engines to at higher temperatures, thus increasing their efficiency.

This project, being performed by The University of Alabama and the University of North Carolina - Charlotte, responds to the Metal Casting Industry of the Future Roadmap goals of identifying manufacturing processes and material technologies that will enable the production of higher strength, lighter weight ferrous castings. Specifically, it will develop production processes, and material composition and treatment for ductile iron castings containing walls as thin as 2.0 to 2.5 mm, and compacted graphite iron castings having walls down to 4 mm. Conventionally-treated castings with walls this thin normally form brittle carbides, making them unfit for use. Thin-wall iron castings, used in domestic cars and trucks, should result in a savings of 5% in gasoline consumption annually and will allow cast iron to compete with light metals in transportation systems. Moreover, the techniques developed through this project (control in melting, metal treatment, pouring, and mold accuracy) can be transferred throughout the foundry industry for other applications.

Molding Capability Study Results



Foundry test results. Lines represent (+, -) three sigma deviations.

Project Description

Goal: The objective of this research project is to develop the technology to produce thin-all commercial castings of gray, ductile and compacted graphite iron. The project will investigate the metallurgical treatment required for molten iron, methods of modeling solidification of thin wall iron castings, and the mold and core-making techniques needed to reproducibly make molds capable of holding 2 to 3 mm thick walls. This project addresses industry roadmap goals in the areas of Products and Markets, Manufacturing Technologies, and Materials Technologies.

Progress and Milestones

This three year project began in 1998. Progress includes:

- Molding and Core Capability Study – Green sand parameters (bond content, sand temperature, moisture content, etc., that affect casting dimensional reproducibility have been identified. The effect of casting surface finish on the accuracy of casting dimensional measurements has been established.
- Microstructural Modeling for Thin-wall Cast Iron – Researchers have completed a predictive model for inverse chill formation, hardness, and tensile strength in thin-section castings.
- Melt compositions and treatment techniques have been developed that reproducibly give 2.5 mm thick ductile iron castings having ductilities ranging from 5 to 15%.
- Metallographic procedures for evaluation of ductile iron have been established. Issues addressed have included: optimum magnification for evaluation of nodule count and shape; minimum diameter to be accepted when evaluating nodule count; and optimum quantitative metallography features for graphite shape evaluation. Relations between the different metallographic methods of establishing microstructural quality in ductile iron have been established.

Industry Partners

Industry partners include:

ABC Coke
Birmingham, AL

American Colloid
Berlin, WI

Badger Mining
Berlin, WI

Brillion Iron Works
Brillion, WI

Caterpillar, Inc.
Mapleton, IL

Carrollton Casting Center
Carrollton, KY

Chrysler Foundry
Indianapolis, IN

Citation Corp.
Birmingham, AL

Elkam Metals Co.
Ashtabula, OH

Fairmont Minerals
Chardon, OH

Ford Motor Co.
Dearborn, MI

Foseco, Inc.
Cleveland, OH

Georg Fischer DISA A/S
Denmark

GM Powertrain
Saginaw, MI

Hickman Williams & Co.
Livonia, MI

Intat Precision
Rushville, IN

Intermet Technical Service
Lynchburg, VA

K&P Agile, Inc.
Naperville, IL

Magma Corp.
Arlington Heights, IL

Miller & Co.
Rosemont, IL

Rio Tinto Iron & Titanium
Rosemont, IL

Simpson Technologies
Jackson, MI

Superior Graphite
Chicago, IL

UES Software
Annapolis, MD

Project Partners

University of Alabama
Tuscaloosa, AL

University of North Carolina - Charlotte
Charlotte, NC

American Foundry Society
Des Plaines, IL

Cast Metals Coalition and
over 20 Industry Partners

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