Industrial Technologies Program

Precision Castings

The ability to develop near net shape steel castings, utilizing the investment casting and lost foam casting process could reduce energy use associated with molding, machining, and tooling operations in steel castings and expand market opportunities. However, some barriers have prevented widespread application of these casting methods for steel castings. For instance, shell cracking has been the main problem for steel investment castings and cooling cracks (or quench cracks) for steel lost foam casting.

Researchers from the University of Missouri at Rolla are developing methodologies to improve metal casting processes. These new methodologies will reduce scrap , which also leads to reduced production costs. Better scrap reduction can be realized from the investment casting process, and better yield improvement is offered by lost foam casting, especially as compared to the no-bake or green sand molding processes. Theses new methodologies also impact the goal of attracting a new technical work force and potential technical management since the program involves both graduate and undergraduate students working with technical managers at industrial match sponsor organizations.

Students pouring lost foam castings with fill velocity data acquisition

Benefits for Our Industry and Our Nation

- *Higher yield savings and lower casting weight per function due to elimination of draft and parting lines for the larger lost foam castings.*
- *Reduced scrap losses due to shell cracking for smaller investment castings.*
- *Reduction of the metal melted per good ton of castings.*
- *Less machine stock required per casting which is a yield savings and a small additional energy-savings in machining.*

Applications in Our Nation's Industry

This research will establish new markets for near net shape steel castings that will be produced using the investment and lost foam process. It would also increase the application of steel castings in heavy-duty truck fleets and reduce the weight of these fleets.

Project Description

The goal of this project is to improve metal casting processes by reducing scrap and therefore reducing the cost of production. Detailed process improvements will be investigated for both the Investment Casting and Steel Lost Foam processes.

The objectives for the investment casting portion of the subtask are:

- Improve knowledge of fracture toughness of mold shells and the sources of strength limiting flaws.
- Understand the effects of wax reclamation procedures on wax properties.
- Develop an instrumentation package to determine what really happens in an autoclave and develop a predictive model.
- Apply "clean steel" approaches to pouring technology and cleanliness in investment casting of steel.
- mprove incoming materials inspection procedures as they affect the microstructure and toughness of the shell.

The objectives for the lost foam steel casting portions of the subtask are:

- Develop an understanding of the relationship of fill patterns to high carbon hard spot occurrence.
- Evaluate the effects of alternate foams on the occurrence of high carbon hard spots.
- Evaluate the trade-off between coating permeability and steel surface cleanliness in lost foam casting of steel.

Milestones

The milestones for this project are:

1. Literature survey on lost foam fill in all alloy systems
2. Survey foundry sponsors for design issue related hard spots
3. Design and build tooling for test article
4. Screening study on available commercial foams
5. Design experimental matrix for modified foams
6. Modified foam experiments and evaluation
7. Commercial coatings matrix (designed experiment) testing
8. Experimental coating matrix development
9. Experimental coating tests
10. In-plant confirmation trials of best effort combination
11. Develop atlas of strength limiting flaws and sources for shell failures
12. Study effects of wax reclamation procedures
13. Shell Instrumentation package design and construction
14. Instrumented shell tests at production foundries
15. Modeling of shell wax interaction
16. Pouring technique and cleanliness effects in investment cast steel
17. Evaluation of improved incoming material inspection techniques

Project Partners

University of Missouri at Rolla
Rolla, MO

Steel Founders Society of America
Crystal Lake, IL

Cast Metals Coalition Partnership
Charleston, SC

American Centrifugal
Birmingham, AL

CMT-Hitchener, Milford, NH

Conbraco, Conway, SC

Matrix Metals, Richmond, TX,

Mercury Marine, Fond du Lac, WI

Precision Metalsmiths
Cleveland, OH

Sawbrook Steel, Cincinnati, OH

Stainless Foundry and Engineering
Milwaukee, WI

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

U.S. Department of Energy
Energy Efficiency
and Renewable Energy

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