METAL CASTING

Project Fact Sheet

THIN SECTION STEEL CASTING

BENEFITS

- Improves foundry practices in steel foundries resulting in larger market share
- Reduces energy requirements in the foundry due to reduced melting requirements
- Improves fuel efficiency in the automotive sector through the introduction of light weight, thin wall steel cast components

APPLICATIONS

The results of this project can be applied throughout the steel foundry industry. Techniques for thin section steel casting can be implemented for an virtually any type of steel cast component, however, the strongest demand is currently for light weight cast components in the automotive industry.

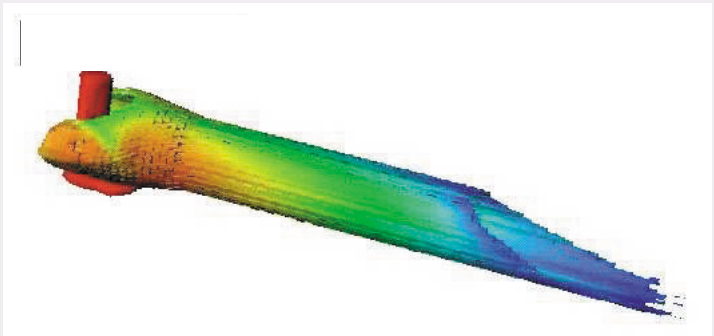
PRACTICES BEING IDENTIFIED TO DEVELOP LIGHT WEIGHT, THIN SECTION STEEL CASTINGS

Continued customer demand for lighter casting weights points to the significant market for high-strength, thin-wall steel castings in automotive applications and thinner wall castings for a wide variety of other applications.

In this project, Pennsylvania State University and industry partners are developing a comprehensive understanding of thin section steel mold filling and the influence of foundry processing variables on thin section steel capabilities. This will enable low cost light weight cast steel components.

The development of the FM (fonte mince) process in the mid-1980s and the Hitchiner process in the 1990s have been driven by opportunities to reduce wall thickness. Although these "low pressure" processes offer enhanced mold filling, the capabilities of conventional, low cost "gravity pour" sand casting to produce thin-wall steel castings has not been fully exploited. The most critical technology areas to address are techniques for enhancing and ensuring the ability of the molten steel to fill thin mold sections. The issues that must be addressed include metal fluidity enhancement, metal/mold surface tension constraints, and gating system development. No comprehensive guidelines have yet been established to permit foundries to fully embrace the critical technologies needed for successful cast thin section steel components.

THIN WALL STEEL CASTING DESIGN



Steel castings with wall thickness as thin as 4mm can be readily produced.

Project Description

Goal: The goal of this project is to develop a fundamental understanding of the key technologies needed to develop lighter weight, thinner section steel castings. The focus is directed towards an understanding of technologies and practices that will enhance mold cavity filling.

Progress and Milestones

This three year project began in October 1997. Specific tasks include:

- Plant Casting Trials - This research data was used to develop a comprehensive empirical understanding of the many factors influencing thinner section casting capabilities. To date, analysis of test castings has resulted in empirical equations to predict thin wall filling performance.

- Laboratory Trials - Laboratory trials are isolating critical thinner section casting variables. Because the influence of certain critical foundry variables cannot be readily studied at production foundries, these studies and additional fluidity and mold filling experiments are being performed in the laboratory.

- Validation Studies with Solidification Modeling Software - FLOW-3D® was chosen as the simulation package due to its flexibility in specifying the simulation inputs. The sensitivity of mold filling simulation to several inputs was evaluated including the effect of heat transfer coefficient, velocities, freezing range, and critical fraction solid. The simulation also was used to evaluate the sensitivity of foundry variables including pouring temperatures and mold materials. Wall thickness was found to be a significant factor. For the same initial metal temperature, increasing the wall thickness from 3 mm to 4 mm increases the minimum fill distances by 70 percent on average.

Project Partners

Pennsylvania State University
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Steel Founders' Society of America
Barrington, IL

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Muncy, PA

Pacific Steel Casting Co.
Berkeley, CA

Pelton Casteel
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January 2001