METAL CASTING

Project Fact Sheet

CFD Modeling for Lost Foam White Side

Benefits

This project is taking another step in improving the industry's understanding and control over the lost foam process. The computational fluid dynamics model will assist in the design of EPS patterns for defect-free castings. It also will assist in optimizing the overall lost foam process. The results of this research will help to reduce defects and rejections in lost foam foundries. These improvements in yield, and reductions in scrap, will result in important energy savings for lost foam foundries.

Applications

The CFD tool can be applied throughout the lost foam casting industry. It will aid casting designers in developing a casting design which will move successfully into production. For instance, the engineer of the metal part will be able to visualize potential problems in the blowing of the mold and make the necessary adjustments prior to machining the mold. A mold designer can use the model to optimally locate vents and blowtubes prior to mold construction.

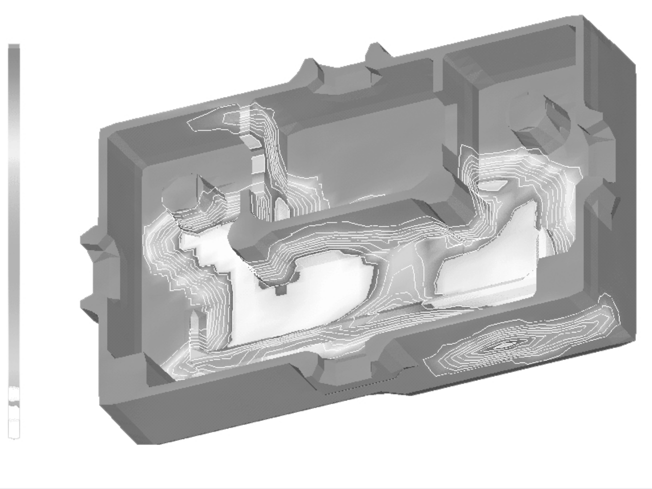
Computational fluid dynamics model to enable higher quality lost foam molds

The lost foam casting process produces clean, high quality castings with close tolerances. The most important advantage is that no cores (with binders) are required. One challenge in lost foam casting is maintaining the uniformity and quality of the expandable polystyrene (EPS) pattern. This has often been the cause of defects in casting. It is estimated that 60% of lost foam defects can be attributed to the pattern, or the so-called "white-side." Foam molds are complex and beads must flow through complex passages to completely fill the mold. The process is further complicated by the expansion of the beads.

General Motors Powertrain and others in the metal casting industry have successfully utilized advanced Computational Fluid Dynamics (CFD) tools to enable foundry process improvements. These efforts have yielded significant cost savings and improvements in the casting processes. The industry has recognized that mathematics based tools are needed to design and build consistent, quality EPS patterns for lost foam casting.

In this project, Flow Simulation Sciences in conjunction with the American Foundry Society and the metal casting industry will extend existing flow modeling software to simulate the air-driven blowing of pre-expanded beads into a mold, and the subsequent steaming (expansion) of beads as they form a lost foam pattern. They will develop a CFD Tool for improving design and development of expandable polystyrene patterns for lost foam castings.

GM Test Box



EPS volume fraction during filling of GM test box. Red is close pack and blue is empty.

Project Description

Goal: The goal of this research project is to develop a computer-based model to simulate air-driven blowing of pre-expanded beads into a mold, and the subsequent steaming (expansion) of beads to form a lost foam pattern. It will improve the ability to design EPS patterns for defect-free castings.

Progress and Milestones

This two-year project was awarded in August 2000. Planned activities include:

- **Numerical Methodology** – The numerical calculation for granular flow is currently in place and has been and is being tested against sand core blowing. Much of the fundamental nature of blowing foam beads will be the same as that for blowing other types of particles. Work includes study of boundary conditions, enhancement of grid generators, heat structurals, heat and particle flow sub-models. Testing of algorithms and models against measured data and analytical solutions will be conducted throughout the development.

- **Prepuff Particle Physics Models** - EPS particles have unique characteristics and behavior, which need to be identified and modeled. Work will include the modeling of interfacial momentum transfer in dense phase flow, dominant forces, particle normal stress, wall restitution, and thermal expansion of beads.

- **Assessment of Calculations** – The software will be used to simulate experiments that have been run or are planned to be run by GM. The final project task will be a calculation of a complex production pattern.

Project Partners

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