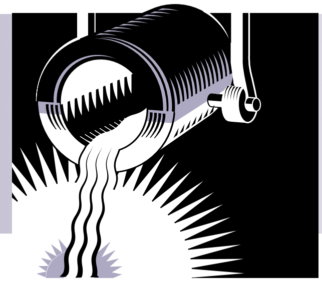
METAL CASTING

Project Fact Sheet



Prevention of Porosity in Iron Castings

Benefits

The results of this project will help metal casters to understand, predict and prevent porosity formation in iron castings. As a result, scrap will be significantly reduced. Researchers estimate that the results of this project could reduce scrap, and therefore melting requirements, by as much as seven percent.

Applications

The results of this project can be applied in casting design and foundry operations throughout the iron castings industry. In addition to improving cost competitiveness and energy efficiency by predicting and mitigating porosity formation, damages caused by unexpected failure of castings will be reduced.

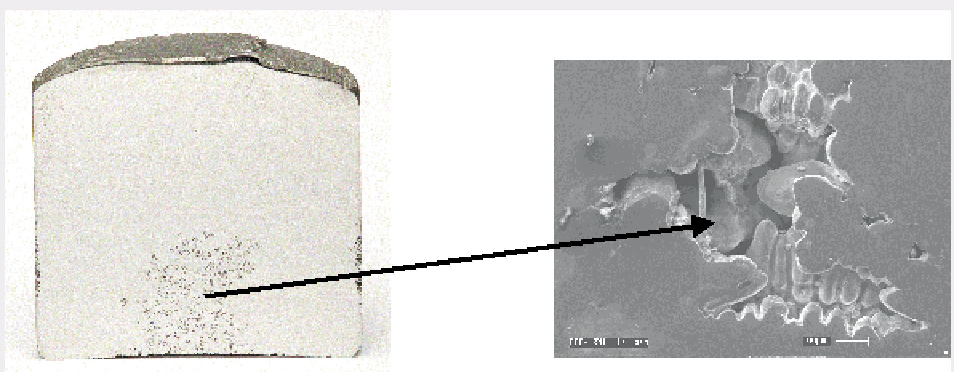
Model will teach mechanisms of porosity formation and enable foundries to implement preventive measures

For most foundries, porosity problems occur sporadically, but even occasional outbreaks can be costly. Even a small amount of porosity can significantly reduce the mechanical properties of the castings; as a result, the casting will have to be scrapped. In general, ½ to ¾ of the all-scrap castings are lost to factors related, directly or indirectly, to porosity. Despite the obvious importance of the problem, there is no consensus on how to deal with it.

Most porosity in iron castings is believed to be a result of the combination of solidification shrinkage and a decrease in the solubility of gases during solidification. Unfortunately, there are insufficient data to support this theory. Therefore, it is essential for the foundries to learn the mechanisms of porosity formation and other effects of gases in their iron castings. It is also essential to establish a quantitative relationship among the factors affecting porosity formation, in a form that can be used to predict its formation in a production environment.

In this project, researchers from Climax Research Services and Albany Research Center will develop a model to help foundries learn the mechanisms of porosity formation and other effects of gases. They will also establish the quantitative relationship among factors affecting porosity formation. The model will be commercialized for use throughout the metal casting industry.

Preventing Porosity in Iron Castings



Interdendritic porosity in a Ni-Hard I casting melted and solidified under 1 atm nitrogen pressure.

Project Description

Goal: The goal of this project is to develop a model to help foundries learn the mechanisms of porosity formation and other effects of gases in their iron castings. It will establish a quantitative relationship among the factors affecting porosity formation and better enable foundry operator to reduce/eliminate porosity formation in a production environment.

Progress and Milestones

In castings, porosity formation is generally the result of an excessive gas content of the liquid alloy, or solidification shrinkage, or a combination of both.

A number of studies have been done to understand the mechanism of gas and shrinkage porosity formation and to develop models to predict porosity formation. Most of the research conducted on porosity formation have attacked only a few sides of the problem rather than dealing with the whole picture. There is a need to generate data covering all of the variables affecting porosity formation, using the same alloy, in order to understand the problem as a whole.

In this project, the modeling work is focusing on the unbalancing of several pressure terms, such as pressure exerted by solidification shrinkage, the increasing gas concentration in the remaining liquid due to reduced solubility in the solid, the surface tension between gas and liquid, the metallostatic head on the casting, and the ambient. Each of these pressure terms can be evaluated, and conditions which favor pore formation can be determined experimentally. Thus, a model incorporating all the variables will be developed.

This three year project was awarded in August 2000. The project was formed with input from the American Foundry Society (AFS) member foundries, with the most valuable contribution being their input in the future direction of research.

Project Partners

Climax Research Services
Wixom, MI

Albany Research Center
Albany, OR

Borden Chemicals, Toledo, OH

Citation, Birmingham, AL

Columbia Steel Castings, Portland, OR

Durametal, Muncy, PA

Georgia Iron Works, Grovetown, GA

Intermet, Lynchburg, VA

Maca Supply, Springville, UT

Texaloy Foundry, Floresville, TX

United Foundries, Canton, OH

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