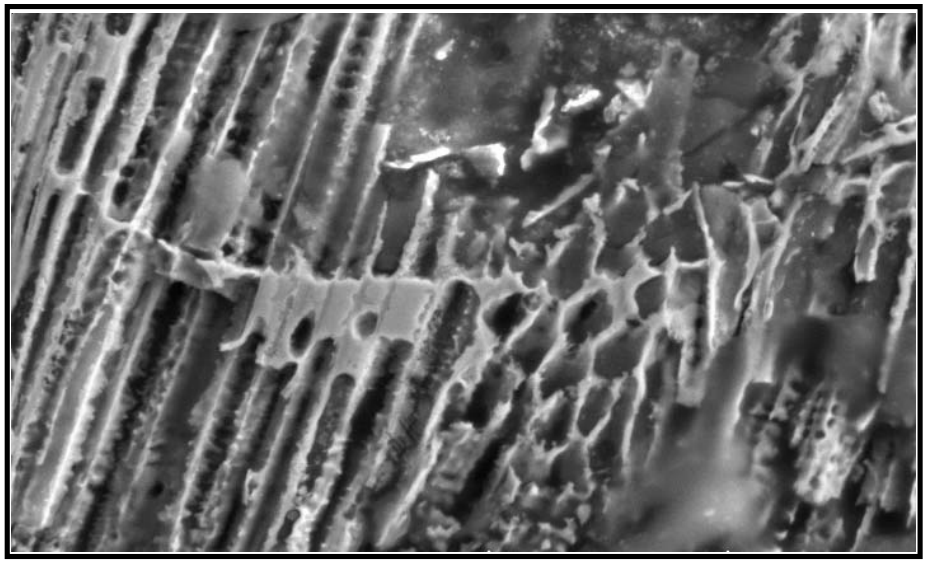
Industrial Technologies Program

Corrosion Testing Practices – High Alloy Corrosion Program

This subtask under ESMARRT Material properties for Casting or Tooling Design Improvement supports the industry objectives of Designings for New Markets and Improved Metal Casting Processes. Recent work conducted on high alloy castings has shown that the shrinkage behavior can be linked to the cooling rate and temperature gradient. The variation in cooling rate within a given casting can also affect the microsegregation potential and concomitant corrosion resistance. A research team led by Lehigh University is investigating the influence of ASTM corrosion test variables in order to improve the reproducibility of these test results.

Various ASTM documents describe laboratory test methods for determining the relative pitting, crevice, and intergranular corrosion resistance of engineering alloys. These test methods were developed primarily to determine the relative resistance of engineering alloys within a single laboratory. The results of the test method are often used as material acceptance criteria. However, the tests were not originally developed for this purpose, and control of important test variables are not described in enough detail to provide the high level of reproducibility needed for purposes of material acceptance criteria. As a result, it is possible for two different casting vendors to offer an alloy with equivalent corrosion performance, but obtain different acceptance results due to variations within the test method.



Localized corrosion in a high alloy casting due to microsegregation of alloying elements

Benefits for Our Industry and Our Nation

- *Better corrosion test standards*
- *Increased reproducibility among corrosion tests*

Applications in Our Nation's Industry

This research will provide suggestions for changing the ASTM test procedure to improve the reproducibility of the test results for alloy acceptance purposes. This research will also establish the influence of thermal conditions on microsegregation and corrosion resistance of high alloy castings for the steel industry.

Project Description

Goals: First, the influence of ASTM corrosion test variables requires further investigation in order to improve the reproducibility of these tests for alloy acceptance purposes. The research team will suggest changes to the ASTM corrosion methods that will permit accurate use of these test procedures as a material acceptance standard. The influence of thermal conditions, microsegregation potential, and resultant corrosion performance of high alloy castings will be investigated in order to improve the overall performance of these materials.

The tasks for this project are:

1. Determine the influence of corrosion test variables on reproducibility.
2. Determine the influence of thermal conditions on microsegregation.
3. Suggest changes to the ASTM corrosion methods that will permit accurate use of these test procedures as a material acceptance standard.
4. Determine the influence of thermal conditions on the microsegregation potential and concomitant corrosion resistance of high alloy castings.

Milestones

1. Influence of Corrosion Test Variables on Reproducibility.
2. Select Test Alloys.
3. Pitting Testing of Both Alloys in Accordance with Current ASTM Guidelines.
4. Crevice Corrosion Testing in Accordance with Current ASTM Guidelines.
5. Analyze Test Results.
6. Develop Recommendations / Guidelines for Improved Alloy Acceptance Testing.
7. Influence of Thermal Conditions on Microsegregation and Corrosion Resistance.
8. Prepare Samples Under Various Thermal Conditions.
9. Evaluate Microstructure and Degree of Microsegregation.
10. Conduct Corrosion Tests Using Methods Developed in Task 1.
11. Determine Influence of Microsegregation and Microstructure on Corrosion Behavior.
12. Develop Guidelines on the Influence of Thermal Conditions on Microsegregation, Shrinkage and Corrosion Resistance.

Project Partners

Lehigh University
Bethlehem, PA

Steel Founders Society of America
Crystal Lake, IL

Cast Metals Coalition Partnership
Charleston, SC

American Centrifugal
Birmingham, AL

Atlas Casting & Technology
Tacoma, WA

Southern Alloy Corp.
Sylacauga, AL

Stainless Foundry & Eng.
Milwaukee, WI

Wollaston Alloys
Braintree, MA

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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