

INDUSTRIAL TECHNOLOGIES PROGRAM

Casting Porosity-Free, Grain Refined Magnesium Alloys

Recently an AFS-sponsored research project on grain refining was completed at Case Western Reserve University (CWRU). However, the improvement in mechanical properties produced by grain refining was not as significant as expected due to the existence of micro-porosity. Furthermore, micro-porosity is a major source of scrap in magnesium castings without practical and effective process remedies. This project holistically addresses improving properties in magnesium alloys through the elimination of micro-porosity and grain refinement.

Project Description

The goal of this study is to identify the root causes for micro-porosity in magnesium alloys and develop practical production remedies.

Two magnesium alloys, AZ91E and low beryllium AM50A, will be investigated. Procedures for degassing, risering, chilling and pouring of magnesium alloys that would eliminate or significantly reduce microporosity will be evaluated. ASTM B108 no-bake sand mold test bars will be initially cast. A combination of risers and chills will be utilized to establish directional solidification conditions. Computer simulation will be used to optimize the arrangement of risers and chills and to determine the pouring temperature for generating a temperature gradient.

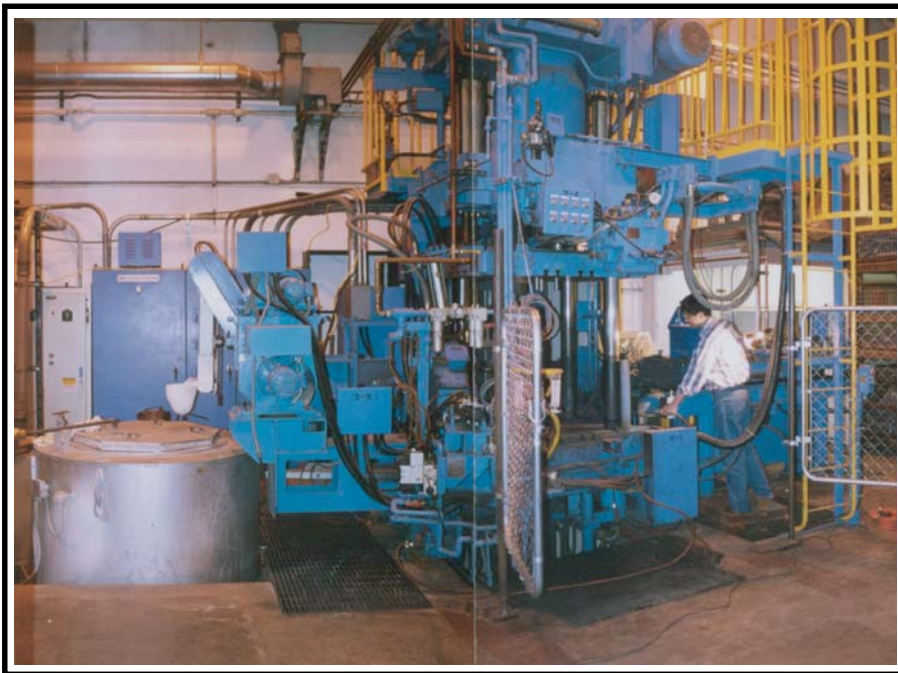


Benefits for Our Industry and Our Nation

- *Reduce scrap through elimination of micro-porosity in magnesium alloys.*
- *Improved mechanical properties of magnesium castings will increase its structural application in automobiles and reduce energy consumption.*

Applications in Our Nation's Industry

Improved mechanical properties of magnesium castings will expand the applications of magnesium in the automotive industry. This will reduce life-cycle energy consumption and the green house gasses from automobiles. Reduced scrap for metalcasters also improves the nation's energy independence.



UBE 350 ton Squeeze Casting unit used at Case for producing porosity-free castings

Milestones

Results to Date

1. Acquired magnesium alloys and developed test patterns for laboratory sand casting trials
2. Designed and conducted computer simulations of test castings for laboratory trials
3. Baseline castings without degassing or chills have been cast with AZ91D, AM50, and ZE41 and metallographic analysis was conducted to assess micro-shrinkage porosity
4. Castings with degassing and chills have been cast with AM50 and ZE41; metallographic analysis was conducted

Future Milestones

1. Integrate porosity-free casting processes with grain refining – recommended best practice
2. Compare microstructure and tensile properties of different process practices
3. Validate recommended processes during in-plant trials
4. Prepare guidelines for casting pore-free, grain refined Mg alloys

Project Partners

Case Western Reserve University
Columbus, OH

American Foundry Society
Schaumburg, IL

Cast Metals Coalition Partnership
Charleston, SC

Magma Foundry Technologies
Arlington Heights, IL

UBE Machinery
Ann Arbor, MI

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.



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Energy Efficiency
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Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

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