

METAL CASTING

Project Fact Sheet



DIE LIFE EXTENSION: COMPOSITION AND HEAT TREATING OF DIE STEELS

BENEFITS

Researchers hope to achieve a 20% to 50% improvement in die life using the results of this research. This will lead to significant cost savings by reducing the frequency of die repair and replacement. It will also reduce downtime in die casting operations. Less frequent die replacement will lead to energy and waste benefits by reducing the energy and waste associated with die design, testing, and production as well as the significant savings in scrap.

APPLICATIONS

The results of this research can be applied throughout the die casting industry. The overall result will be the evaluation of the best steel and best processing methods for aluminum die castings. These and other measures for extending die life will greatly improve productivity in die casting operations. It is anticipated that once perfected, these tools will help to optimize die materials and heat treating methods in order to extend die life.

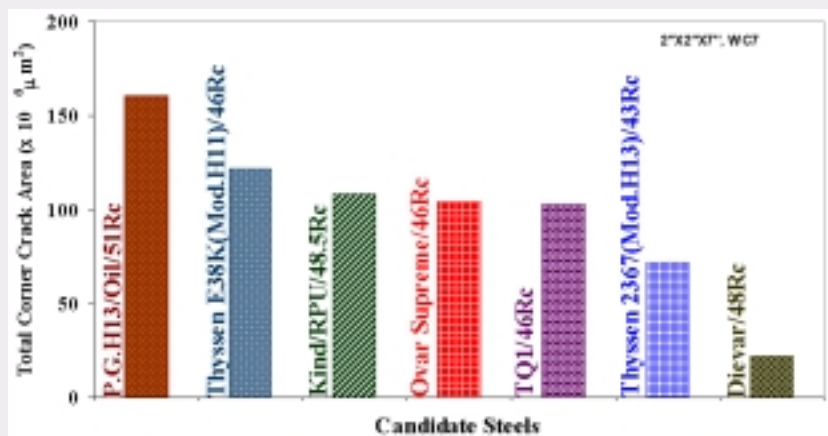
PROCESS IMPROVEMENTS TARGET 50% IMPROVEMENT IN DIE CASTING DIE LIFE

In die casting, complex parts can be manufactured in large quantity with desired mechanical properties and near net shapes at relatively low cost. The design and performance of the steel die is critical in meeting these engineering requirements. It controls the dimensions, tolerances, and surface quality of final parts. The thermal stress to the die from constant heating and cooling ultimately leads to cracks in the die and die failure. A die can sometimes cost in excess of \$1 million and take months to years to design, test, and produce. A significant amount of energy is used in each of these stages. Improvements in die life can significantly improve energy efficiency and cost competitiveness in die casting.

Case Western Reserve University has been conducting a program of research to extend the life of dies used for aluminum die castings. As part of that program, this project is studying compositional modifications and improved heat treatment procedures that will lead to a 50 percent improvement in the life of die casting dies.

Researchers will study the effect of steel composition on die life. The focus will be upon the relationship between thermal fatigue resistance and the steel chemistry. Specific elements are being evaluated in order to identify the best composition for extending the life of die steels. Researchers also will study the effect of the cooling rate for different steels. A step cooling process is being evaluated as a potential method for minimizing distortion and eliminating cracking.

THEMAL FATIGUE PERFORMANCE OF DIE STEELS



Research has shown die life improvement through proper selection of die steel.



Project Description

Goal: The goal of this research is to extend the life of die materials utilized in aluminum die casting by 50 percent. The primary objectives are to 1) further evaluate the effect of controlled changes in steel chemistry on the resistance to heat checking, 2) develop a new fast interrupted oil-quenching cycle, and 3) verify the results of the laboratory tests with in-plant trials using production die casting machines.

This project is designed to incorporate all of the important findings, resulting from earlier research, that have been shown to improve die life, including:

- Proper selection of die steel including compositions that are preferable in service to premium grade H13.
- Use of rapid cooling of the die during heat treatment to improve its resistance to loss of both strength and thermal fatigue resistance.

DCD technologies has put these items to use and increased die life from 100,000 shots to 400,000 shots per die. Ford Motor Company has used both the new composition and heat treatment to at least double their die life. GM has also used both the steel selection and thermal treatments to at least double die life.

Progress and Milestones

This project began in January 2000. Specific milestones include:

- Effect of Steel Composition - Thermal fatigue testing and impact strength will be performed on die steel samples. Results will be analyzed and the relationship between properties and structure will be assessed.
- Effect of Cooling Rate - The effect of the cooling rate on die fatigue and cracking will be assessed. Alternative cooling procedures will be identified.
- In-plant Trials - Selected components will be tested by industry participants in some of the most demanding die casting applications. The performance of these components will be monitored and recorded for dissemination to industry.
- Technology Transfer - CWRU in conjunction with the North American Die Casting Association will conduct workshops and seminars to be presented to NADCA's local chapters in various locations throughout the country. Results also will be published in industry trade journals such as *Die Casting Engineer* and presented at NADCA's annual Die Casting Congress.



PROJECT PARTNERS

Case Western Reserve University
Cleveland, OH

North American Die Casting Association
Rosemont, IL

Alloy Tool Steel
Santa Fe Springs, CA

Badger Metal Technologies
Menomonee Falls, WI

Chem-Trend
Howell, MI

DCD Technologies
Cleveland, OH

FPM Heat Treatment
Elk Grove Village, IL

Hayes Tech Center
Ferndale, MI

Latrobe Steel Company
Latrobe, PA

FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

Harvey Wong
Office of Industrial Technologies
Phone: (202) 586-9235
Fax: (202) 586-6507
Harvey.Wong@ee.doe.gov
<http://www.oit.doe.gov/IOF/metalcast/>

Please send any comments,
questions, or suggestions to
webmaster.oit@ee.doe.gov.

Visit our home page at
www.oit.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585



August 2000