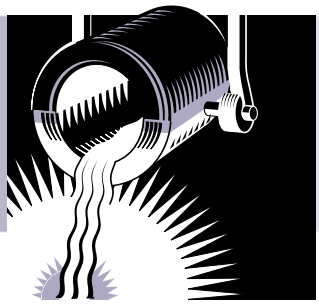
METAL CASTING

Project Fact Sheet



SENSORS FOR DIE CASTING

VIBRATION SENSORS ALLOW PROBLEMS TO BE DETECTED AND SOLVED DURING CASTING CYCLE

Sensors will improve the quality and consistency of aluminum die castings. Die casters manufacture a large and diverse array of products. Using machines to rapidly inject molten alloys into metal molds, die casters produce near-net-shape parts at high production rates. Typical part cycle times range from 30 to 120 seconds, and metal injection is completed in times as low as 50 milliseconds. Improper filling of the die cavity can result in entrapped gases and a poor quality casting. Proper performance in die casting depends on a combination of effective die design; robust mechanical operation and control of the die casting machine; the delivery of molten metal at the right temperature and cleanliness; controlled thermal management of the die; and metal pressure intensification at the end of the injection cycle to feed shrinkage. Typically, die casters monitor machine variables at only discreet points. Increasingly though, sensor technologies are available to directly measure critical process variables. If critical variables are continuously monitored and controlled, problems can be detected and solved during the casting cycle. This will lead to less scrap, improved surface finish, higher dimensional repeatability, and improved internal integrity.

This project is developing the use of vibration sensors (accelerometers) for machine diagnostics, allowing problems to be detected and solved during the casting cycle. Vibration diagnostics often provide insight into both normal and anomalous operational characteristics of equipment. In addition, they provide monitoring of the operational characteristics over their normal ranges. Vibration sensors also can be used to measure plunger characteristics due to normal or off-normal operations such as "sticking". After development, the technology will be validated in a production environment with industrial partners.

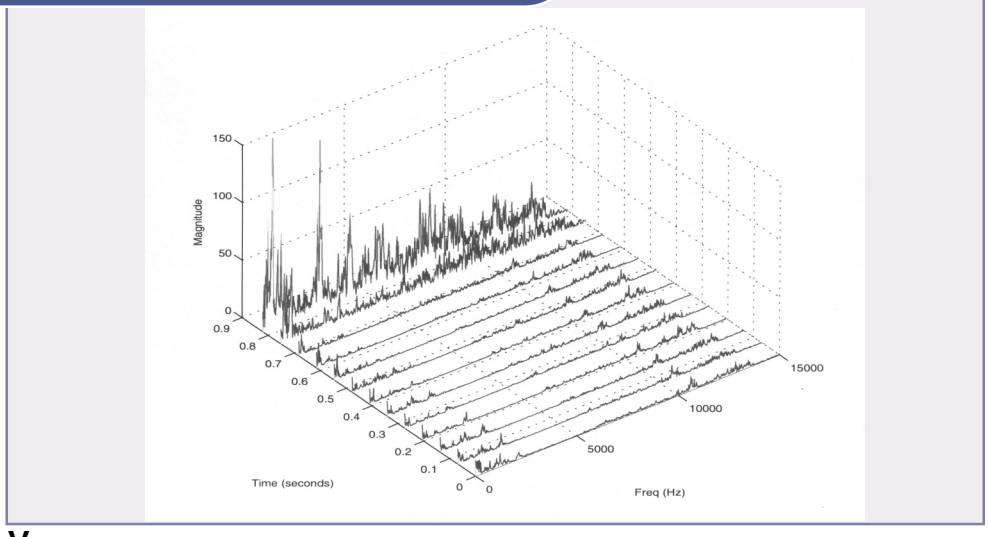
BENEFITS

- Improves dimensional repeatability.
- Improves internal integrity.
- Improves surface finish.
- Reduces scrap and reduced remelting requirements.
- Estimated energy savings of 0.24 Trillion Btu in 2010.

APPLICATIONS

The results of this project will be disseminated throughout the die casting industry. In addition, the results of this project apply in related casting techniques including squeeze casting and semi-solid metal forming. The results of this project will enable the casting industry to respond to the increasing demand for aluminum cast components in automobiles to reduce weight, fuel consumption, and emissions.

VIBRATIONAL CHANGES DURING DIE CASTING INSPECTION



Vibrational signatures illustrative of metal flow through the die gate and metal compression as the die is completely filled.

Project Description

Goal: The goal of this project is to develop a sensor to improve the quality and consistency of aluminum die castings. A vibration sensor (accelerometer) for machine diagnostics will be used to allow problems to be detected and solved during the casting cycle, leading to less scrap, improved surface finish, higher dimensional repeatability, and improved internal integrity.

Progress and Milestones

This three year project began in October 1999. Specific tasks include:

- Phase I - In Phase I, a survey was conducted of existing sensor research and applications in die casting. Following the survey, three vibration sensors were placed on a die on the Oak Ridge National Laboratory (ORNL) die casting machine. Signals were collected from all three sensors and a vibration signature of the die casting cycle was obtained. The vibration data clearly shows the sequence and various steps of operation of the die casting machine, such as safety door closing, platen closing, shot profile, platen opening, and part extraction.

- Phase II - Once the individual sensors have been implemented, tested and evaluated, all of the sensors, transmission techniques, and data acquisition techniques will be implemented on the ORNL die casting machine. This will be done to correlate process parameters and diagnostic measurements with product quality.

- Phase III - The practical and cost effective measurements and measurement techniques which have shown the greatest correlation with product quality, or have been shown to give the most insight into the die casting process, will be duplicated in a production environment. The data collected will be correlated with product quality to quantify the benefit of the instrumentation.

Commercialization Plan

Tutorials will be developed to document the knowledge and findings gained from this project. These will provide guidelines and methodologies for the implementation and use of vibration sensors for die casting. Results also will be made available in trade press and through North American Die Casting Association (NADCA) conferences.

Project Partners

Oak Ridge National Laboratory
Oak Ridge, TN

North American Die Casting Association
Rosemont, IL

Briggs & Stratton
West Allis, WI

Chem-Trend
Howell, MI

Hayes Lemmerz International Inc.
Ferndale, MI

Kennedy Die Castings, Inc.
Worcester, MA

Littler Diecast Corp.
Albany, IN

The Newton-New Haven Co.
North Haven, CT

Prince Machine Corp.
Holland, MI

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