METAL CASTING

Project Fact Sheet

METALLIC REINFORCEMENT IN DIRECT SQUEEZE DIE CASTING

BENEFITS

This project will result in a number of important benefits. Higher yield associated with improvements in the squeeze casting process will reduce melting requirements thereby saving energy. In addition, the ability to switch from ferrous to non-ferrous castings will also reduce energy associated with melting due to the lower melt temperature of aluminum. Finally, the ability to produce low weight, high strength components for applications in the automotive sector will help to reduce vehicle weight and improve fuel economy.

APPLICATIONS

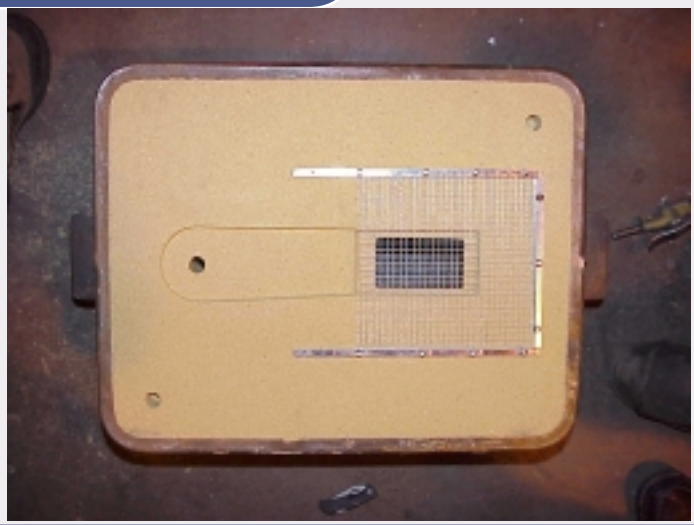
The squeeze casting process is capable of producing high strength, high ductility aluminum castings for load bearing components in vehicles such as knuckles, brake calipers, wheels, and other components. The results of this project can be applied towards increasing the strength of these structural parts through enhanced reinforcement. In addition, it will enable improved toughness and fracture resistance of housing for rotating parts within engines and other critical components.

METALLIC INSERTS PROVIDE GREATER STRENGTH, IMPROVED RESISTANCE, AND REDUCED TEARING

At the present time, aluminum die castings frequently do not have sufficient impact strength and resistance to shattering to be employed in many applications. Cast aluminum structures are frequently required to withstand possible splitting or a fragmenting type of fracture of the casting where a supercharger flies apart, or a clutch or stabilizing wheel cracks in service. It is necessary to be dependent of the shock resistance of the cast alloy. This investigation has been designed to incorporate a mesh of considerably higher impact and shock resistant materials within the die casting when produced so that it will provide a stable part that will avoid particles from these components being driven outside of the casting. The preliminary work has shown that the shatter resistance can be increased by a factor of about 3 times based on Charpy V-notch measurements.

Inserts are used in conventional die castings to improve strength but they are generally relatively small and are not well bonded to the aluminum die casting. Previous work has evaluated ceramic inserts. For instance, the introduction of alumina-based fibers or silicon carbide whiskers up to 20% in volume can increase the strength and modulus of elasticity significantly. However, this large a quantity of fiber reinforcement makes filling a die very difficult except for squeeze casting. None of the previous work has dealt with the use of a metallic mesh or interconnected metallic reinforcement that is bonded to the aluminum casting to provide improvements in impact and fracture resistance of the whole part. In this project Case Western Reserve University and industry partners will study both the aluminum alloy employed for the parts and the type of reinforcement. The reinforcement will be solely metallic materials.

METALLIC INSERTS INCREASE STRENGTH IN DIRECT SQUEEZE CASTING



Sand Mold with reinforcing wire mesh ready for casting.

Showcase Description

Goal: The goal of this project is to develop feasible methods of reinforcing aluminum die casting components with large size metallic inserts that will provide greater strength, improved impact resistance, and reduced tendency to shatter.

Progress and Milestones

This three year project was awarded in August 2000. It is a follow-on to earlier research performed by Case Western on direct squeeze casting of aluminum alloys. Planned activities in the current project include:

- **Reinforced Casting Experiments** – Aluminum alloys will be selected for the matrix. Lab scale casting experiments with sand molds and squeeze parts will be conducted with simple cast shapes representative of the applications. Plate-like, cylindrical and spherical shapes will be cast initially.
- **Bonding Technique** – Interfacial coatings that provide the desired metallurgical bond between the insert and the aluminum alloy matrix will be selected and evaluated.
- **Mechanical Testing** – The strength of the bond between the matrix and the reinforcing insert will be evaluated by tensile and bending tests.
- **In-plant Implementation** – After it has been demonstrated that a satisfactory means of holding the reinforcing insert in the die and a strong metallurgical bond has been established for different metallic inserts and aluminum alloys, the industrial partners will use this information to produce actual components for the applications.

Project Partners

Case Western Reserve University
Cleveland, OH

North American Die Casting Association
Rosemont, IL

Black and Decker
Baltimore, MD

Briggs Die Casting
Wauwatosa, WI

Cummins Engine
Columbus, IN

Kowalski Heat Treating
Cleveland, OH

Lester Precision Die Casting
Solon, OH

Los Alamos National Laboratory
Los Alamos, NM

ZMD Mold and Die
Mentor, OH

Zoller
Ann Arbor, MI

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