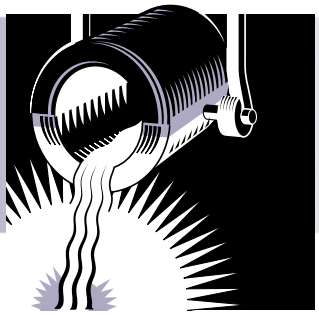
# METAL CASTING

Project Fact Sheet



## SEMI-SOLID METAL PROCESSING

### BENEFITS

- Potential for better control of flow, final porosity and microstructure of cast parts
- Cast products with near-net-shape complex geometries
- Reduced energy consumption due to lower temperature processing of billets
- Increased productivity due to shorter solidification times, reduced shrinkage, and longer die life
- Improved ductility and dimensional repeatability compared to conventional cast products

### APPLICATIONS

Semi-solid processing is ideally suited for the production of large volume die casting components, including light weight, high strength components for automobiles. The successful completion of this project will provide the needed knowledge base required to help U.S. metal casting industry in the development and implementation of the semi-solid process.

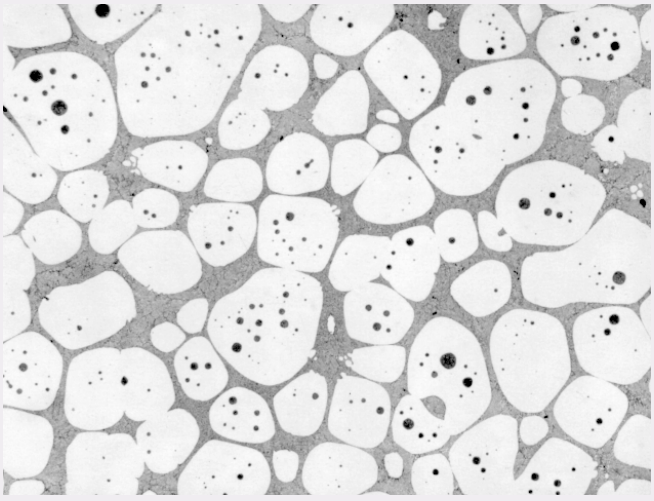
## RESEARCH ADVANCES APPLICATION OF SEMI-SOLID METAL PROCESSING, ENABLES HIGH QUALITY DIE CAST PARTS

Semisolid metal (SSM) processing is a relatively new technology which offers distinct advantages over other near-net shape manufacturing processes. This process is ideally suited for die casting. In this process, cast parts are produced from a slurry kept at a temperature between the solidus and the liquidus isotherms. This process produces complex parts with better quality when compared to parts made by similar processes. It also allows net-shape forming, reducing further machining operations. The process combines the advantages of both liquid metal casting and solid metal forging.

In this process, the raw material is melted and allowed to cool and solidify, while the dendrites formed during solidification are broken-up. The morphology of the dendrites is altered using mechanical, electromagnetic or other forces. Subsequently, the specially prepared raw material is remelted to its mushy state, and, while the temperature is kept between the liquidus and solidus isotherms, it is processed to its final shape.

Research being performed at the Worcester Polytechnic Institute is focused on developing a better understanding of the process in order to optimize the operation. It is gaining a deeper insight into the underlying theoretical and physical concepts associated with this novel family of thixotropic materials.

### SEMI-SOLID ALUMINUM ALLOYS



**This special microstructure gives semi-solid metal its unique advantage. When heated to the "mushy" state, the material flows as a fluid, but retains other solid-like behaviors.**

## Project Description

**Goal:** This research will address fundamental technical issues of semi-solid metal processing and contribute to the development of a knowledge base for the commercial sector.

The flow of these rheologically complex fluids in shape making operations in a rapid cycle mode is highly unsteady, which significantly influences the overall quality of the final product. In order to develop a better understanding of the process and to optimize the operation, it is important to gain a deeper insight into the underlying theoretical and physical concepts associated with this novel family of thixotropic materials. Process control needs to be based on process understanding; moreover, there is a need for material characterization of SSM processed materials.

## Progress and Milestones

This three year project began in 1998. It is jointly funded by the Office of Industrial Technologies Aluminum Industry of the Future. Work will be conducted under three main tasks:

(1) Material Characterization
(2) Modeling and Simulation of Die Filling
(3) Die Design.

## Additional Consortium Members

Primary and Secondary Producers
Alcan International Limited, Montreal, Quebec
Alcoa Incorporated, Alcoa Technical Center, PA
Aluminum Pechiney, Paris, France
Kaiser Aluminum and Chemical Corporation, Spokane, WA
Northwest Aluminum Company, The Dalles, OR
Ormet Corporation, Wheeling, WV
VAW, Inc., Pittsburgh, PA
Wabash Alloys, Wabash, IN

Suppliers/Equipment Users
Buhler, Inc., Minneapolis, MN
Chem-Trend, Inc., Howell, MI
Foseco, Inc., Bessemer, AL
Heraeus Electro-Nite Company, Philadelphia, PA
Metallurg Aluminum, Newfield, NJ
SPX Contech Division, Portage, MI
Selee Corporation, Hendersonville, NC
Thixomat, Ann Arbor, MI

End Users
Briggs & Stratton Corporation, West Allis, MI
Daimler Chrysler Corporation, Indianapolis, IN
Ford Motor Company, Dearborn, MI
General Motors Corporation, Pontiac, MI
Harley-Davidson Motor Company, Milwaukee, WI
Mercury Marine, Fond Du Lac, WI

### Project Partners

Worcester Polytechnic Institute, Worcester, MA
North American Die Casting Association, Rosemont, IL

Consortium Members: Metal Casters
AEMP Corporation, Jackson, TN
Amcast Industrial Corporation, Southfield, MI
Cambridge Tool and Manufacturing Company, Inc., North Billerica, MA
Citation Corporation, Birmingham, AL
Consolidated Metco, Clackamas, OR
Hayes Lemmerz International, Inc., Ferndale, MI
Hitchcock Industries, Inc., Minneapolis, MN
Intermet Corporation, Lynchburg, VA
J.L. French International, Sheboygan, WI
Kennedy Die Castings, Inc., Worcester, MA
Madison-Kipp Corporation, Madison, WI
Palmer Foundry, Inc., Palmer, MA
Prince Machine, Holland, MI
Stahl Specialty Company, Kingsville, MO
Superior Industries International, Inc., Morris, MN
Teksid Aluminum Foundry, Inc., Dickson, TN
Wyman Gordan Investment Castings, North Grafton, MA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