

METAL CASTING

Project Fact Sheet



TITANIUM MATRIX COMPOSITE TOOLING MATERIAL FOR ENHANCED MANUFACTURE OF ALUMINUM DIE CASTINGS

INNOVATIVE MATERIAL FOR USE IN ALUMINUM DIE-CASTING COMPONENTS SAVES ENERGY AND EXTENDS PRODUCT LIFE

Benefits

- Extends sleeve life by 4 to 10 times over H-13 steel
- Reduces downtime as a result of fewer shot sleeve changeovers
- Energy savings of at least 6% achieved by reducing energy losses in holding furnaces and in die preheating during changeovers
- Better heat retention reduces the tendency towards premature metal solidification that impedes the flow of molten metal needed to feed the casting properly
- Significantly reduces the tendency for aluminum soldering wash-out opposite the pour hole and eliminates rejects from abraded steel wear particles carried into the castings
- Longer plunger tip life because of reduced friction
- Less lubrication or perhaps no lubrication needed which reduces both cost and emissions

Applications

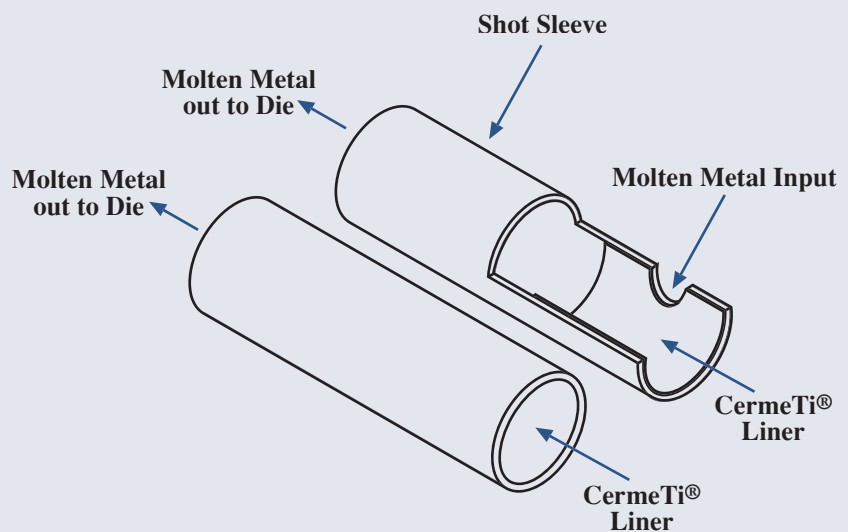
This new technology has immediate commercial potential in the metal casting industry where there is a need for improved service life over H-13 die steel. The technology can be used with any metal casting application currently using H-13 shot sleeves, including squeeze casting, conventional die-casting and semi-solid processing. Additional aluminum casting applications may include plungers, plunger tips, core pins, die inserts, etc. This technology may also apply to casting of alternate materials such as magnesium and other applications in metal processing industries where improved tool and die materials are needed.

In the aluminum die-casting process, shot sleeves force molten aluminum into a die for casting. The shot sleeve is filled with molten aluminum either by a manual or an automated ladle. The material is then forced into the die by a plunger or piston. The conventional material of choice for fabrication of shot sleeves and other aluminum die-casting components is H-13 steel.

However, the conventional H-13 shot sleeve technology wears out after 20,000 to 40,000 casting cycles, due primarily to hot corrosion which washes out the bottom of the sleeve. Additionally, the conventional technology requires a die lubricant, a major source of environmental waste.

CermeTi® is a titanium-alloy composite material recently developed by Dynamet Technology, Inc. This material can be implemented in the form of an entire shot sleeve or a partial liner inserted into an existing H-13 shot sleeve. This new technology has significant advantages over the conventional technology, especially in its resistance to aluminum soldering and erosion. The result is an extended useful life for the shot sleeve, reducing downtime and improving product quality.

SHOT SLEEVES WITH CERMETI LINER MATERIAL



A new shot sleeve liner material being developed by Dynamet Technology saves energy and waste in the die casting process.



Project Description

Goal: Validate initial prototype testing of the technology as a liner material for aluminum die-casting shot sleeves.

The newly developed metal-matrix composite is expected to reduce energy consumption during the die-casting process, while increasing the service life of shot sleeves. In particular, the reduced thermal conductivity of the titanium liner reduces heat loss during the injection phase of the casting process. This slower cooling permits either cooler shot temperatures (less preheat energy) or slower plunger-tip speeds (less turbulence or surface impingement problems within the die). In addition, improved erosion resistance decreases sleeve wear and increases sleeve life. Furthermore, CermeTi shows significant resistance to molten aluminum attack, greatly reducing soldering effects when in contact with molten aluminum.

CermeTi also offers environmental advantages over conventional H-13 tool steel. During the aluminum die-casting process, aluminum adheres to steel, requiring the use of die lubricants. CermeTi may not require a die lubricant, thereby eliminating a source of environmental waste.

Dynamet Technology is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in the Department of Energy's Office of Industrial Technologies.

Progress and Milestones

- Manufactured CermeTi bars.
- Lab test at Oak Ridge National Laboratory demonstrated a ten times longer life with baseline CermeTi composition over H-13 steel.
- Lab test at Worcester Polytechnic Institute showed CermeTi compositions virtually eliminate soldering effects in contact with molten aluminum.
- Identify specific target components (shot sleeve liner, pins).
- Conduct prototype testing in selected aluminum casting environments.
- A proposal for commercial scale demonstration of this technology has been submitted and is being considered for funding by DOE.

Economics and Commercial Potential

The die-casting industry is receptive to new technologies that improve efficiency and extend shot-sleeve durability. The considerable increase in tool life coupled with additional benefits such as reduced downtime, improved product quality, impressive energy savings, and the elimination of a die lubricant make CermeTi an attractive alternative to current industry practice. Projected annual U.S. energy productivity and waste savings from this innovative new technology ranges between \$80 and \$120 million.

The use of die-cast parts reached a record 2.1 billion pounds in 1999, and forecasts predict consumption will reach 2.2 billion pounds in 2000. Custom aluminum die-cast shipments rose 15% last year to 1.7 billion pounds. The automotive industry is responsible for the majority of this growth.



The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and to conduct early development. Ideas that have significant energy-savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

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