INDUSTRIAL TECHNOLOGIES PROGRAM

E–SMARRT: Energy Saving Melting and Revert Reduction Technology

A Balanced Portfolio of Tasks to Address Energy Saving Opportunities in Metal Casting

Metalcasting is one of the most energy intensive industries. The industry is critical to the U.S. economy, because 90% of all manufactured goods contain one or more cast metal components. These castings are integral to U.S. transportation, energy, aerospace, manufacturing, and national defense. The industry is diverse and employs a variety of casting processes and alloys to make a myriad of products. R&D is needed to address a wide range of issues that can target the largest energy savings opportunities, with appropriate crosscutting technologies for the various metalcasting processes and alloys. Unfortunately, because the majority of metal casters are small businesses, many lack the resources to perform R&D on their own.

The Advanced Technology Institute (ATI) has developed Energy-Saving Melting and Revert Reduction Technology (E-SMARRT) program, a balanced portfolio of projects to address energy-saving opportunities in the metalcasting industry. E-SMARRT R&D projects focus on energy efficiency and environmental impact improvements in melting technologies and casting processes that do not require major capital investment from industrial end-users. This strategy avoids the risk of pursuing only a single technology, which even if technically and commercially successful, would only impact a single point of the industry's multifaceted energy requirements. The E-SMARRT program has created partnerships with researchers in over 100 industrial companies and national laboratories to develop a research strategy that could reduce the metalcasting industry's energy requirements by 14 percent within ten years.

E-SMARRT R&D tasks feature low-threshold energy efficiency improvements that do not require major capital investments and offer significant energy, economic, and environmental benefits.

Benefits for Our Industry and Our Nation

- Reduce energy consumption by 14% over ten years
- Reduce scrap rate and improve yield rate in the metal casting industry
- Improve existing melting processes
- Reduce overall greenhouse gas emissions and airborne particulates

Applications in Our Nation's Industry

The E-SMARRT program will significantly reduce energy consumption in metal casting processes and improve important capabilities of castings. More than 100 metal casters, engineering firms, and suppliers will benefit from rapid adoption and broad application of newly developed technologies.

Project Description

E-SMARRT is a balanced portfolio of tasks to address energy-saving opportunities in the metalcasting industry. The goal of the E-SMARRT program is to improve metal casting processes to achieve an average annual reduction in energy use. The portfolio includes: improvements in melting efficiency; innovative casting processes for yield improvement/revert reduction; instrumentation and control improvement; and material properties for casting or tooling design improvement.

Barriers

- Improve understanding of governing relationships that have crosscutting effects in casting applications

- Lack of cost-effective functional prototypes

- Insufficient understanding of the geometry/alloy/process relationship to variability in material properties

- Lack of software models

Pathways

The project targets both melting and casting processes through a balanced portfolio of R&D tasks. This approach will identify processes and technology advances capable of delivering enhancements in energy efficiency and economic benefits. The portfolio is representative of the needs expressed by the metal casting industry and the metal casting industry associations.

By collaborating with the Cast Metal Coalition (CMC) and various researchers, E-SMARRT addresses research needs identified by the metal casting industry. The E-SMARRT project focuses on melting efficiency and innovative casting processes in the area of metal transfer heat loss, scrap/rework reduction, mold yield improvement, simulation tools for design, improved properties data, and castability process geometry.

Milestones

The E-SMARRT portfolio is comprised of a number of major tasks and subtasks. To date, none of the major tasks or subtasks are fully complete, but several milestones for each task have been completed. The following are the major tasks and some example subtasks of the E-SMARRT portfolio:

- Improve melt efficiency:
  - Improvements in efficiency of melting for die casting
  - Melting efficiency improvement

- Innovative casting processes for yield improvement/revert reduction:
  - Clean steel casting production
  - Production of lost foam castings in aluminum and magnesium based alloys
  - Design support for tooling optimization
  - Prediction of wax pattern tooling and final investment casting dimensions

- Instrumentation and control improvement:
  - Energy efficiency instrumentation

- Material properties for casting or tooling design improvement:
  - Development of surface engineered coating systems for aluminum pressure die casting dies
  - Casting porosity-free, grain refined magnesium alloys
  - Aging of graphitic cast irons and machinability

Commercialization

Technology transfer is one of the major tasks of the E-SMARRT program. AFS, NADCA and SFSA will work to link E-SMARRT-sponsored research with industry and to maximize the impact of the emerging metalcasting technologies. The team will leverage their knowledge, expertise, and broad membership to monitor project progress and promote knowledge transfer of the tools, technology, and processes developed. Project participants will also expand and deepen existing industrial partnerships to enhance the impact of R&D results in the US metalcasting industry. Technology transfer of emerging tools, processes, and systems will focus on potential energy savings and carbon footprint reduction.

Project Partners

Cast Metals Coalition
- Advanced Technology Institute Charleston, SC
- American Foundry Society, Schaumburg, IL
- North American Die Casting Association Wheeling, IL
- Steel Founders Society of America Crystal Lake, IL

CANMET, Ottawa, Canada

Case Western Reserve University Cleveland, OH

Colorado School of Mines, Golden, CO

Eck Industries, Inc., Manitowoc, WI

Edison Materials Technology Center Kettering, OH

INEEL, Idaho Falls, ID

Iowa State University, Ames, IA

ILZRO, Research Triangle Park, NC

Lehigh University, Bethlehem, PA

ORNL, Oak Ridge, TN

Ohio State University, Columbus, OH

University of Alabama at Birmingham Birmingham, AL

University of Iowa, Iowa City, IA

University of Missouri-Rolla, Rolla, MO Worcester

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Energy Efficiency & Renewable Energy

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