Refining Lost Foam Casting to Preserve American Industry

The lost-foam-casting process used to make complex metal parts is one of the most environmentally friendly casting methods. Experience has shown that it can reduce energy use by as much as 27%, compared with conventional sand casting, and can greatly reduce metal scrap.

In lost foam casting, an expanded polystyrene (EPS) foam pattern is made as a mold for casting each part. The foam pattern is covered with a thin heat-resistant coating and embedded in sand. Molten metal is poured into the pattern, the EPS decomposes, and the metal replaces it, precisely duplicating its shape. The decomposition products diffuse through the coating and enter the sand, but the coating contains the metal. After the part has cooled, the coating flakes away.

Preparing to cast an aluminum part by lost-foam casting (left, top down): securing the EPS mold in sand, pouring molten metal into the mold. At right, Ralph Dinwiddie of ORNL with an EPS mold and Dennis Nolan of FOSECO-Morval with a cast aluminum part.

Expanding the use of lost foam casting could save energy and money for U.S. industry. One obstacle to its widespread adoption is that casting defects may result from foam residues trapped within the metal during the filling process. To clarify how the EPS and its residues are displaced as molten metal fills the mold, the casting industry is using the resources of ORNL's MPLUS Facility to analyze the process. ORNL is collaborating with three companies (FOSECO-Morval, Walford Technologies, and MCT) in using infrared (IR) imaging to measure and record thermal profile variations during casting. IR imaging provides unique spatial and thermal resolution of the different casting phases.

The most recent set of experiments at ORNL tested three different foam polymers and patterns made by three different tooling methods. IR images were made of the filling process as it occurred. The cast parts will be characterized and the data correlated with the IR data. The goal is refinement and improved control of the casting process.

Refinement of lost foam casting is of strategic interest to the casting industry because it would enable U.S./Canadian companies to make complex parts that foreign competitors cannot produce. As more low-end casting moves offshore, the strategic edge offered by the high-end capability could be a key to preserving the domestic industry.

For information about the MPLUS Facility, see www.ms.ornl.gov/programs/mplus/mplus.htm

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continued from p. 4

Tests of ORNL's heat exchanger indicate that it meets or exceeds the specifications for temperature change and pressure drop for the compact fuel processor. Further tests are in progress to optimize the amount of water flow and system efficiency. Future goals of this work are to make the exchanger lighter, perhaps by changing the material in the coolant jacket or by reducing its size.

For more information, see http://www.ms.ornl.gov/researchgroups/cmt/foam/foams.htm.

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