Improved Sand-Compaction Method for Lost-Foam Metal Casting

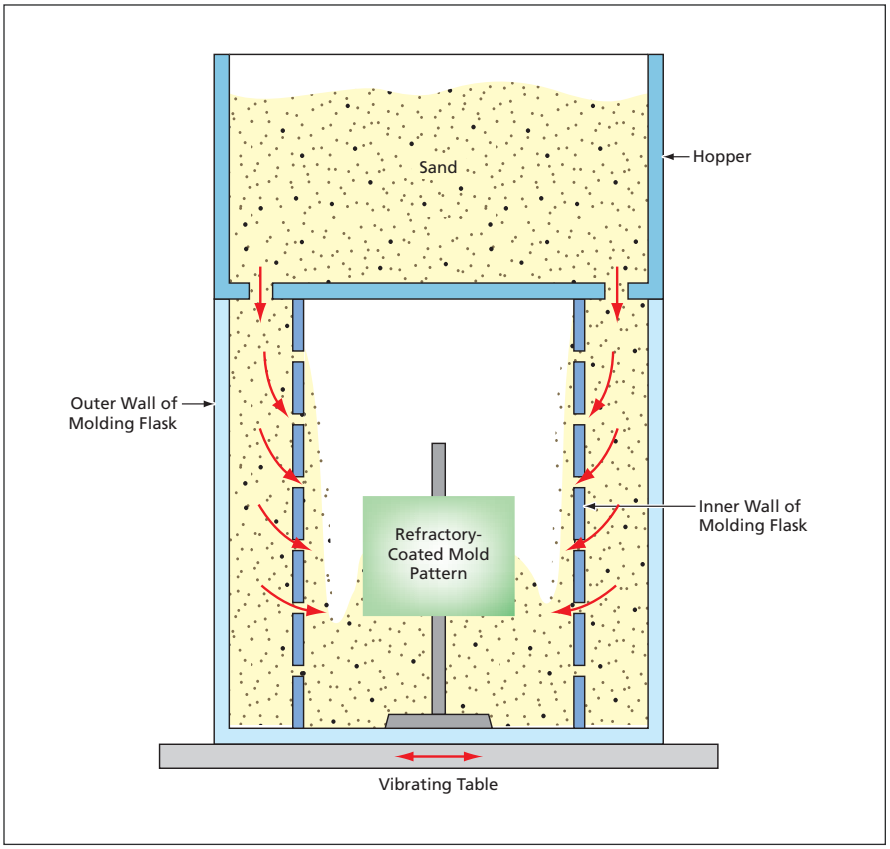
The flow of sand is redirected for better filling and compaction.

Marshall Space Flight Center, Alabama

An improved method of filling a molding flask with sand and compacting the sand around a refractory-coated foam mold pattern has been developed for incorporation into the lost-foam metal-casting process. In comparison with the conventional method of sand filling and compaction, this method affords more nearly complete filling of the space around the refractory-coated foam mold pattern and more thorough compaction of the sand. In so doing, this method enables the sand to better support the refractory coat under metallostatic pressure during filling of the mold with molten metal.

Filling of the molding flask with sand is an important stage in the lost-foam casting process. To obtain a high-quality casting, it is necessary to ensure that the foam mold pattern is surrounded by sand compacted tightly enough so that the sand can support the refractory coat during filling with molten metal. In lost-foam casting as practiced heretofore, the refractory-coated mold pattern is placed in the molding flask and sand is rained from the top until the foam cluster is entirely embedded in sand. During filling with sand, the sand is slightly fluidized, and low-density sand/air mixture is unevenly distributed around the pattern.

To compact the sand around the pattern and to deliver sand into all passages and cavities in the pattern, horizontal and/or vertical vibrations are applied to the flask. However, controlling the motion and maximizing the compaction (and thereby minimizing the permeability) of the sand is a challenging problem. Once the sand particles at lower levels of the flask become interlocked, sand from higher levels cannot be delivered into the pattern cavities at the lower levels. Motion of sand decreases toward the bottom of the sand bed, where compaction has been achieved. If motion and compaction of sand are insufficient, penetration of the refractory coat, and consequent surface defects in the casting, may occur in regions of low compaction. To maintain the desired flow and compaction of sand, some foundries make pauses in the sand rain. However, such pauses increase filling and compaction time, thereby reducing productivity. The improved method is oriented toward maintaining the desired flow and compaction of sand without introducing pauses in the sand rain.



Sand Flows Sideways into the molding flask, instead of raining down into the flask as in the conventional method.

In the improved method, sand is made to flow into the molding flask substantially horizontally instead of raining down as in the conventional method. For this method, one needs a double-wall molding flask. The outer wall of the flask is solid; the inner wall is perforated with uniformly distributed holes. From a hopper above the flask, sand is supplied to the annular volume between the inner and outer walls. From this annular volume, sand flows horizontally through the holes, into the space surrounding the refractory-coated foam mold pattern (see figure). As in the conventional method, the flask is vibrated to aid flow and compaction. The motion of sand is more normalized than it is in the conventional method, such that sand is delivered more nearly completely into all passages and cavities, including horizontal passages and inverted pockets. The fluidization of sand is less turbulent than it is in the conventional method. Moreover, compression forces exerted on the mold pattern by raining sand are eliminated — a beneficial effect in that such forces can distort the mold pattern.

This work was done by Sayavur I. Bakhtiyarov and Ruel A. Overfelt of Auburn University for Marshall Space Flight Center. For more information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov.
MFS-31679-1