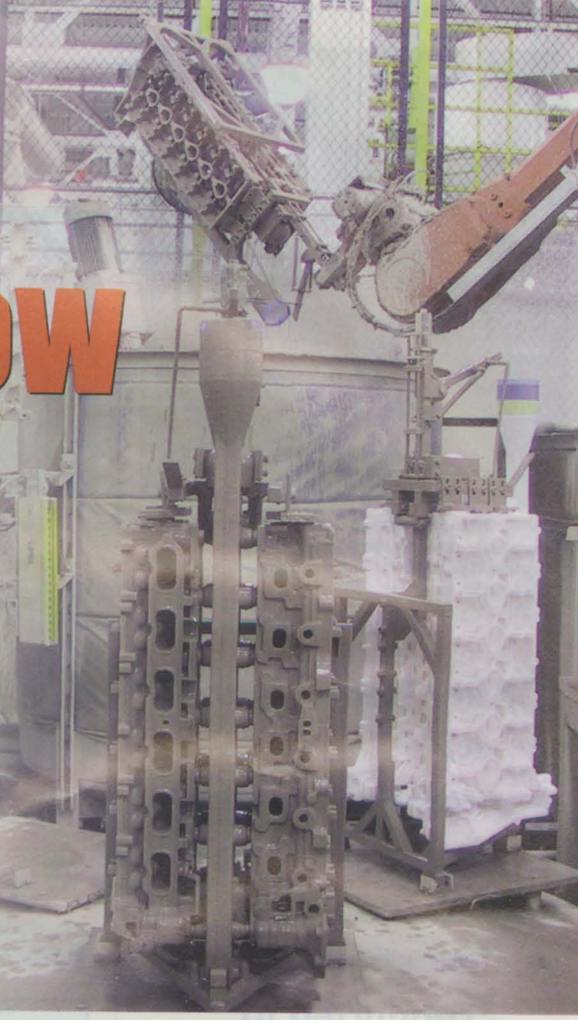
Lost Foam: Then and Now



Many early lost foam facilities ecountered failure, but the remaining firms improved their processes to achieve high-quality castings more efficiently. This article details those improvements.

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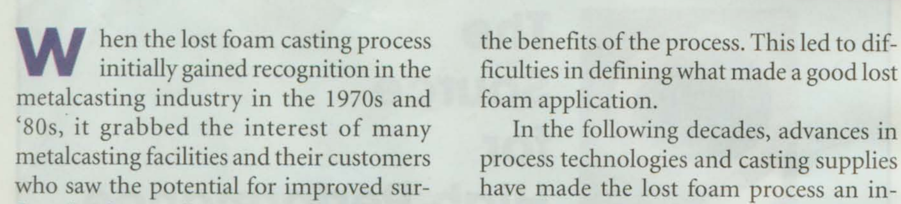
When the lost foam casting process initially gained recognition in the metalcasting industry in the 1970s and '80s, it grabbed the interest of many metalcasting facilities and their customers who saw the potential for improved surface finish, excellent dimensional tolerances and weight reductions. But the manufacturing technology at that time was far outpaced by the interest and motivation of the industry, resulting in the failures of many lost foam startups.

At the time, lost foam casting also was hindered by a potential customer base that had little knowledge or understanding of the benefits of the process. This led to difficulties in defining what made a good lost foam application.

In the following decades, advances in process technologies and casting supplies have made the lost foam process an increasingly beneficial and successful casting method. Manufacturing technology has caught up with the applications and interest in lost foam, and a better-refined definition of what makes a good lost foam casting candidate, particularly for ferrous applications, has emerged.

Still, most casting designers and purchasers have only a rudimentary understanding of the process and its benefits. And because there are fewer metalcasting facilities exploring lost foam today, casting customers lack options when shopping for a lost foam plant. There are thousands of casting facilities, but few possess lost foam capabilities, and this remains one of the biggest obstacles for lost foam to grab a larger share of the manufacturing market.



This wrench extender made of manganese-bronze and cast-in via lost foam required no draft between the ears, included a cast hole and required no risers.

Automating Clustering and Coating

Nearly every aspect of lost foam casting has seen large strides in manufacturing technology, from the foam clusters to shakeout. Much of the improvements have resulted from the automation of what was once done manually, but some steps have been taken to make lost foam equipment more efficient. Plus, suppliers to lost foam operations are providing better materials, which aid in consistently casting high-quality components.

One of the areas that has been most improved by automation is building the lost foam clusters. Traditionally, the foam patterns for a particular component would be glued by hand to an assembly tree, which then would be dipped in the refractory coating mixture. Manual

Fig. 1. For many years, the assembly trees were manually dipped into the coating mixture, as seen above, but advances in manufacturing processes have led to the automation of both clustering and dipping.

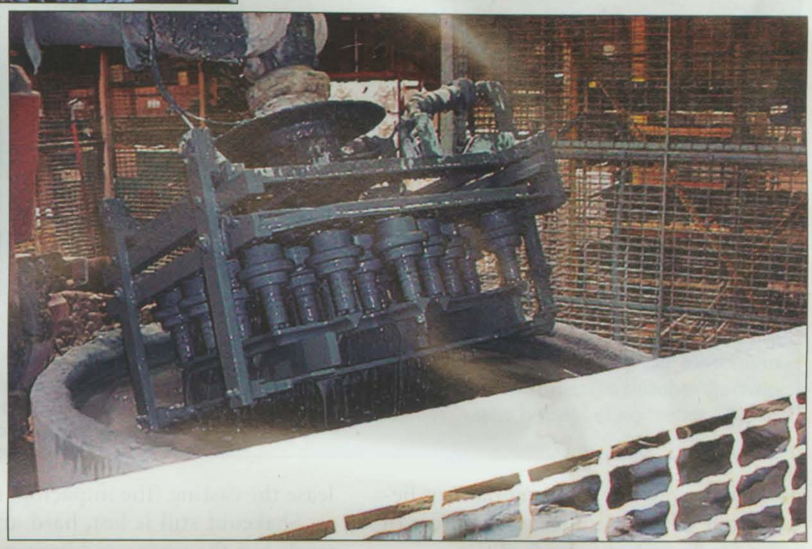


Fig. 2. Automated dipping, shown below, brought enormous advances in coating controls and results in consistent application of the coating.

clustering, however, can lead to dimensional variation, internal casting defects, complete mold failures and low manufacturing efficiency.

Lost foam facilities still perform some manual clustering, but the trend now is to use automated clustering operations. With automation, clusters can be built faster, and the consistency of the glue application and the location of each part on the assembly are much more consistent. The level of repeatability also is much better than what typically can be achieved by hand.

The coating process also has benefited from automation. The refractory coating helps control the heat transfer characteristics and the microstructure in the casting and prevents defects. Manual coating often requires individuals to make very precise actions in order to achieve proper coating (Fig. 1). This repetitive, strict motion can be taxing, and questions often arise on how consistent coating is applied day to day.

Robotic technology has caught up with the need for better control of the coating process. The use of robots ensures the glued assembly will survive the dipping, ensures consistent application and requires minimal training (Fig. 2).

Honing Compaction

An important step in casting with lost foam occurs at the compaction table, where compaction and vibratory forces cause the sand to flow around the pattern and into the internal passageways of the pattern and become rigid. As molten metal is poured into the mold, the foam pattern evaporates and the sand stays in place.

For many years, compaction tables gave minimal measurement of variables, which was generally limited to the speed of the motor and the estimated energy output. Newer compaction tables, however, monitor nearly every variable that exists during compaction in real-time. This affords better prediction of equipment failures and lets the metalcaster know when a faulty flask has been made.

In addition, the newest generation of compaction tables is opening new doors for casting design. Getting the sand to flow uphill during compaction traditionally has been difficult and required large amounts of energy, which limited designing for lost foam. Compaction tables using a vector flow system, however, make moving sand uphill much easier while requiring less energy and have the potential to open up casting design parameters.

Shaping Up Shakeout

Shakeout, one of the most problematic areas of lost foam casting, also has been improved over the years. In order to remove the castings from the assembly trees, metalcasting laborers would swing away at the runner with a sledge hammer. Of course, swinging a sledge hammer over time was quite fatiguing, and correctly hitting the runners to free the castings became an ominous job

Understanding the Lost Foam Casting Process

In the lost foam process, the pattern is made of expendable polystyrene (EPS) beads and the internal passageways in the casting are not formed by conventional cores but are part of the mold itself. The pattern is coated with a refractory wash that covers the external and internal passages. After the wash is applied and dried, the pattern assembly—with attached gating and risering system—is assembled in a flask, and loose, unbonded sand is vibrated and compacted around and into the internal passageways of the pattern.

The EPS pattern remains in the flask and, as molten metal enters the mold, the EPS pattern vaporizes. The sand stays in place due to its rigidity. The molten metal displaces the pattern to form the metalcasting.

Shakeout consists of dumping the mold after the casting has solidified. The unbonded sand then is drained out of the cored passageways.

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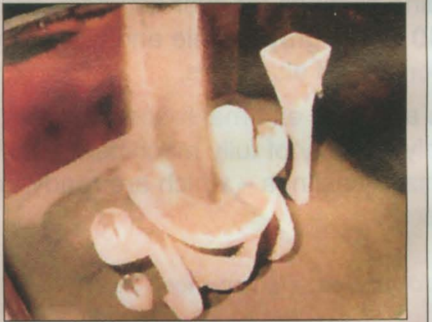

In lost foam casting, the foam pattern is placed in a flask and loose, unbonded sand is poured in and around it, as shown above. Vibrations compact the sand into the internal passageways, and after compaction, molten metal is poured into the mold.

Gaining Ground Through Component Integration

Component integration is the primary benefit to lost foam casting in ferrous applications. Citation Corp., Columbiana, Ala., used its lost foam capabilities to produce a single-piece casting that was originally designed as three components machined and fastened together.

The lost foam casting process allowed Citation to cast holes and passages that were previously created by the combination of the three parts into this one-piece direct coast clutch housing. At 8 lbs. (3.63 kg), the automotive transmission component features dimensional consistency across multiple tool cavities, reduced machine stock and achieved a 70% reduction in landed cost. **ECS**

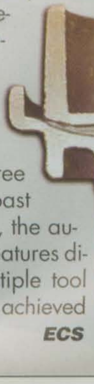

Fig. 3. During shakeout, the pneumatic wedge, which replaced a manually-swung sledge hammer, separates the casting from the runner.

as the day wore on. Shakeout damage became one of the number one sources of scrap for many lost foam facilities.

Two pieces of equipment have entered the process to make shakeout a more efficient step. The wedge and impactor are pneumatic devices that either separate the casting from the runner like the jaws of life (the wedge) or act like a mechanical sledgehammer hitting the runner to release the casting (the impactor) (Fig. 3).

Shakeout still is hot, hard and heavy work, but the wedge and impactor aid in reducing fatigue levels, injury rates and the amount of shakeout-related scrap.

Defining the Benefits

Along with tighter process controls and advances in manufacturing technology, the lost foam industry requires a better understanding of the process and its benefits by potential casting customers. To achieve this, lost foam metalcasters had to gain a better handle on these benefits themselves.

The lost foam process was known to provide weight reduction, eliminate or reduce machining and offer the freedom to make more complex castings with less scrap. But components that could benefit from these characteristics still were being cast in other processes.

Eventually, it was found that a fourth overlooked benefit—component integration—is the key to defining a good lost foam application, particularly for ferrous components. Because of the design freedom of lost foam and the ability to cast a part with complex core passages, multiple parts can be cast as a single component (see the sidebar, Gaining Ground Through Component Integration, for an example).

Now, rather than a drawing for a single part, lost foam facilities ask to view a layout for the entire assembly. The casting designers then can pinpoint which parts can be incorporated as a single, complex lost foam casting. **ECS**

This article is adapted from the presentation, "Past vs. Future Manufacture and Marketing of Lost Foam Castings," by Mike Johnston, Citation Corp., for the AFS International Lost Foam Casting Conference, October 2004.

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For More Information

***"Finding Value with Lost Foam Casting,"** AFS Technical Dept. Engineered Casting Solutions, Fall 2004, p. 49-50.*