Investment Casters Examine New Techniques, Products

These advances provide new ideas to improve melting, patterns and cores.

New techniques and products need to provide a metalcaster with either cost savings or better quality castings. Although these changes may initially cost a foundry in terms of production time and man-hours, they should not be dismissed immediately. If given a careful look, these technologies may show the promise of increasing production performance and quality.

These three advances in investment casting technology are adapted from papers presented at last fall's 45th Investment Casting Institute Conference. The new technologies utilize an old idea and improve upon it for today's investment caster.

PATTERN FILLER

Investment casting begins with a low temperature, thermoplastic wax material that is used to create patterns. For every pattern wax, there is a different blend of material to produce it, each delivering different results in the casting process. In 1996, M. Argüeso & Co introduced a new pattern material to investment casting – Hydro-Fill pattern compounds – s an option beyond emulsified or conventional pattern waxes.

The Pattern compound is comprised of pattern materials (waxes, resins, synthetic polymers) and purified water that have been combined with pattern was in the form of micro-sized spheres. These spheres, which are achieved through chemistry and technology, are distributed uniformly throughout the wax and give it a cellular structure. And, this structure is the base for the fillers' defining characteristic – it is hydrophilic, or in other words, it has an affinity for attracting water.

Conventional pattern waxes are hydrophobic – they resist wetting – and create surfaces that are difficult for bonding. To overcome this property, investment casters wash, scrub, dip, rinse and use aggressive etches to prepare the wax surface for shelling.

Wax surfaces that do not bond or lack adhesion with ceramic coats tend to lift off the pattern, creating a void and air space that is not visible to the naked eye. This void can cause the shell to crack or cause finning on the casting due to the expansion of the entrapped air during the heating of the shell. The addition of the new pattern filler to the wax improves the wetting and adhesion properties of the ceramic to the pattern surface.

Figure 1 demonstrates an adhesion comparison between a conventional wax pattern and a new filler pattern prepared in the same manner. Both patterns were prepared with a primary of zircon flour and a Ludox SK binder, and had no surface preparation. As shown, cracking occurred on the conventional wax pattern along the edge, while the filler pattern showed no signs of lifting or cracking.

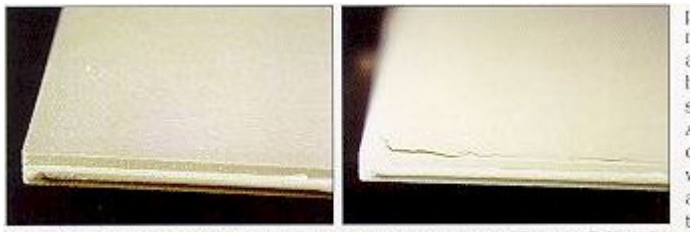

Fig. 1. This is a ceramic adhesion comparison between a pattern filler wax (left) and a conventional pattern wax prepared in the same manner. Cracking occurred on the hydrophobic conventional pattern, while the hydrophilic filler pattern remained intact.

SUPERIOR FLOW

Beyond adhesion, the hydrophilic qualities provide the filler waxes with improved flow and viscosity characteristics. The superior flow is illustrated in the improved pattern surface quality that allows for easy removal of the filler patterns from the die.

The filler's wide range of viscosity aids the pattern during another source of shell cracking – the de-watering process. As conventional waxes are heated to be removed from the shell, they can also expand and crack the coating. The addition of the filler to the pattern increases the thermal conductivity of the wax and decreases the thermal expansion properties. The filler pattern, due to its superior fluidity and the ability of the cellular structure to collapse during de-waxing, minimizes the tendency to crack shells. Figure 2 demonstrates the expansion difference between conventional pattern waxes and the pattern compound waxes.

After de-waxing a concern to investment casters is the residue left in the shell before preheat, and ash remaining in the shell after preheat and burnout. But the new pattern compound, due to the high amounts of water, is low ash filler, resulting in an improved cleanliness of shells after de-waxing.

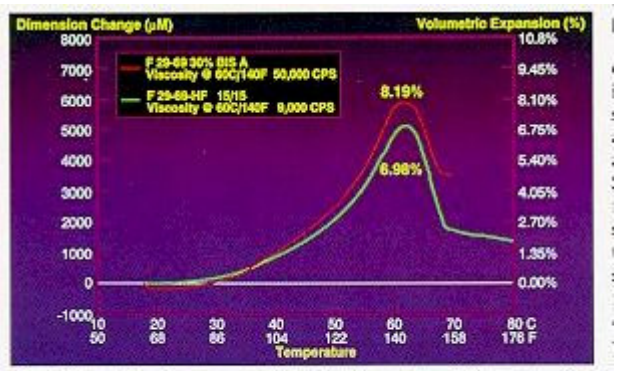

Fig. 2. Conventional waxes expand greater than pattern filler waxes when heated, resulting in more frequent shell cracks during dewaxing. The purple line represents a conventional wax while the green a pattern filled wax.