BMC takes AIM at the FAIM GAIM

Contributed by Administrator
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Not even thermosets are exempt from the expanding presence of fluid-assisted injection molding. One company discovered how to do it by accident.Some look for the appearance of a robin as the first sign of spring. IMM, however, looks for the appearance of Jack Avery, GE Plastics? operational assets manager, presenting his yearly summary of news in assisted injection molding (AIM), as a sure sign of the changing seasons. At Molding 2003 (Feb. 24-26, New Orleans, LA), Avery?s talk was titled, ?Sorting Out Fluid-assist Injection Molding.?He used the term ?fluid-assist injection molding? (FAIM), rather than AIM, which was popularized last year, or gas-assist injection molding (GAIM), believing FAIM to be more all-inclusive. Avery reminds us that gas is a fluid, too.

Conventional GAIM and web molding are the most widely used methods, Avery says. Though WAIM is without a doubt presently the hottest new FAIM technology in terms of developmental activity, Avery stresses it is just that?a developmental technology that has yet to become a true commercial alternative.

Among molders, GAIM growth has been out of gas for many years when it comes to newcomers. Avery reports that only one injection molder joined the 102 existing GAIM molders in North America in 2002. And, as in the past, the overwhelming majority of GAIM activity remains in the playground of the top 50 injection molders?top in terms of sales volume, that is.

Still, those using GAIM reportedly are using it more than ever. Avery discussed some of the latest commercial and developmental applications in his presentation, those involving both gas and water, as did other speakers in the FAIM session. Technological developments also were covered. We?ll review those later. Right now, though, one notable presentation deserves special mention: Gas assist may breathe new life into injection molded thermosets.

Why Pay More for Less?

Len Nunnery, corporate director of quality at materials supplier Bulk Molding Compounds Inc. (BMCI, West Chicago, IL) and a Six Sigma black belt, stunned the Molding 2003 attendees with news of successful experiments his company had conducted in developing GAIM technologies for use with fiber-reinforced thermoset polyester BMC.

Why were they stunned? Volumetrically, BMC costs significantly less than the high-performance ETPs that have replaced it in many applications, particularly in parts with thick cross sections that require high-performance properties, like rigidity, at very high temperatures. But a solid BMC component uses a greater volume of material, thereby sacrificing its low-cost advantage.

GAIM reduces the volume of material required to manufacture parts with thick cross sections. It also helps eliminate molded-in stress and sinks and reduces cycle time, subsequently reducing tooling investment.

If GAIM can work with BMC, molders and their customers could gain all of the gas-assisted benefits, plus the superior performance properties of a lower-cost material. Nunnery made a point of reminding all that, contrary to popular opinion, BMC can be injection molded in high volumes, comes in colors, and can be recycled. All in all, it was stunning news.

Pop Goes the Purging

BMCI?s tests involved a mold designed to manufacture 30-by-1.25-by-.75-inch cooking range handles. It was equipped with a nitrogen gas delivery pin inside the cavity very close to the gate. The original idea was to do a short shot and then finish off packing with gas channeled through the part?s center. Bad idea.

?After many efforts it became apparent that BMC would not provide the flow properties necessary to be ?inflated? and pressurized against the cavity walls,? Nunnery says. ?Whenever possible, the gas would escape from the molten BMC, releasing to atmosphere through the mold vents.?

Quite unexpectedly, fate played its hand. Nunnery says, ?As the 30? handle mold was pressurized with nitrogen gas, an incorrect setting in the injection molding machine?s program caused the injection unit to reverse itself, discontinuing contact between the machine?s nozzle tip and the mold?s sprue bushing.?

About 2 seconds later a loud ?pop? was heard. A small amount of raw BMC shot out of the sprue bushing. When the mold was opened, they saw that the sprue and runner had perfectly cored themselves out.

Though BMC lacks the flow characteristics for short-shot filling with gas assist, the company found that gas pressure could move molten BMC away from the center of a full shot?s curing mass. They hurriedly refitted the mold with the gas pin as far as possible from the gate, runner, and sprue.

The cavity was filled solid and placed under pressure. After a 15-second delay, the injection unit was reversed?contact was broken between the nozzle tip and the sprue bushing?and the gas charge was applied. Then, after about 5 seconds, material from the handle?s center was ejected through the sprue bushing, resulting in a BMC range handle with a hollow core and a nominal wall.

Success?
Not quite. What were they to do with the uncured BMC purging? The purging was still warm, about 120F, but it was still moldable. Don?t forget, BMC?s a thermoset. Heat doesn?t melt it, it sets it. It would have a short shelf life if it was stored, and it could become contaminated when ejected. Direct reclamation was the only viable option. But how?

In a followup trial the fully filled part was injected and only the outer layer of BMC was solidly cured. The machine was programmed to prepare the next material charge, minus the volume of BMC being driven through the part by the gas, during this brief curing phase.

Gas was applied to the part after the screw finished reciprocating. After about 5 seconds, the 1000-psi gas pressure forced the nonrevolving screw backward. The gas-ejected BMC was deposited in front of the gas-subtracted charge. The purge was then metered in with virgin and the process was repeated. The part exhibited no signs of heat- or shear-related problems.

Since thermoset BMC cures rather than cools, part surfaces were unaffected by the gas-driven evacuation of the excess material. Fingering, bubbling, and other problems commonly encountered with some thermoplastic GAIM methods were nonexistent.

The appliance-grade BMC used in the tests costs about $1.00/lb. With a 39 percent GAIM weight reduction, the materials cost of a solid BMC handle, $1.46, was reduced to $.85. What?s more, the GAIM BMC handles were molded with a 65 percent reduction in cycle time when compared to molding solid handles?nearly a 3:1 gain in part yield.

Nunnery says development work is continuing, but he is confident that the added advantages provided by GAIM will help propel cost-effective thermoset BMC into a number of high-volume applications now exclusively done in thermoplastics, especially room-temperature applications requiring rigidity and durability, like refrigerator handles. In fact, this gas evacuation process was recently granted a patent. Nunnery will present a paper on this topic again next month at NPE, and will exhibit the part at the show in BMCI?s booth