Injection Molding Case Study: Washing Machine Augers

Key Issues: EDM, Gas Assisted Injection Molding and C-Mold

Agitator augers are spiral devices used to move clothes and soapy water around in washing machines. A Maytag agitator auger design (assembly) is shown in Figure 1. The auger is shown in the inset photo.

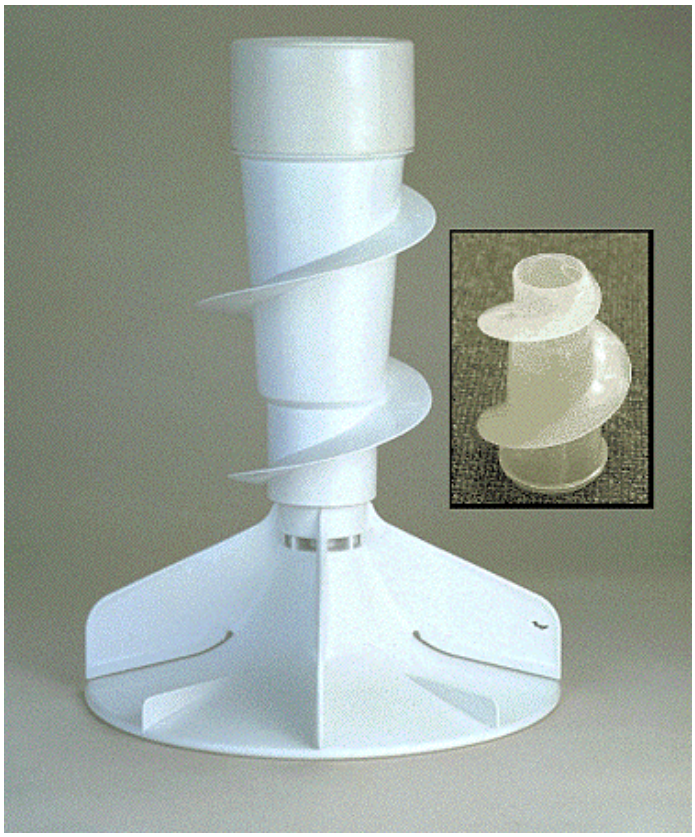

Figure 1.

These devices, which come in a variety of geometries, are designed to improve the efficiency of washing clothes. Since the 1950's they have been built by injection molding of thermoplastic resins. Building the injection mold tooling for these parts is a very specialized business. In fact most tooling for this application is built by just one toolmaker in Chicago, Illinois (Ostrom Tool Company). The process involves extensive EDM machining of a multipiece die.

The Maytag part shown in Figure 1 has a spiral fin running along its length. The thickness at the base of the fin is up to 3.5 times the nominal wall thickness. This thick base is required for structural reasons but controls the molding time due to its long cooling requirements. It was proposed to hollow out this section by using gas assisted injection molding (GAIM). The idea was tested by running C-Mold simmulations and by molding clear parts for visual inspection.

An article by Mike Nelson of Maytag states, "Since the base of the fin where it meets the cylinder is very thick, we wanted to remove some of this material to reduce the molding cycle time. Gas-assisted molding seemed like a viable option for hollowing out the section without sacrificing the structural integrity of the fin. However, knowing a bit about how gas moves through plastic, we had reservations about being able to keep the gas inside the spiral channel. We believed that, unless we got the design and process conditions just right, the gas would want to take a straight flow path down the length of the part rather than a longer spiral path around it. Hence the benefits offered by gas-assisted molding could easily be negated by the cost and time associated with tool re-work and molding trials.

"We have been using C-MOLD's Performance Solution for injection molding for a number of years, but at the time of this design we had not used C-MOLD simulation for the gas-assisted process. We began working with the engineering staff at C-MOLD in Louisville, Kentucky, on a consulting basis to perform simulation on the auger design and process setup to explore whether this design was feasible using the gas-assisted molding process. Initial results showed us that the gas pattern could be controlled enough to achieve the desired gas penetration. These early iterations gave us enough confidence to proceed with the gas-assist two-cavity tool design to be used for making production parts.

"With the help of C-MOLD Gas-Assisted Injection Molding simulation, Maytag successfully converted production of this washing machine agitator auger from conventional injection to gas-assisted injection molding. Gas-assisted injection molding technology allowed us to produce a better-designed product for less money, and to do it right the first time."

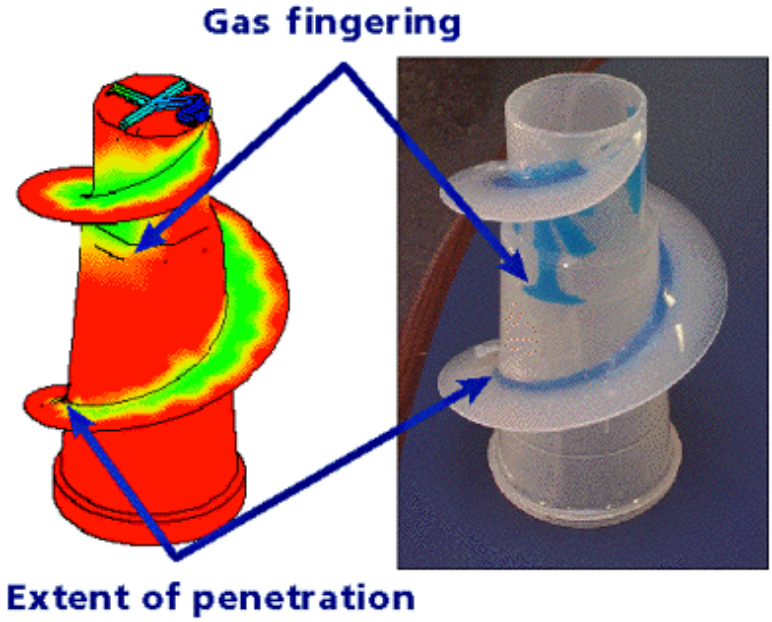

Figure 2. The gas-penetration pattern predicted by C-MOLD Gas-Assisted Injection Molding and the visual molding trial result.

Figure 2 shows the predicted gas penetration compared to the actual gas penetration in a part molded with clear polypropylene (production parts are molded in white polypropylene) with a colored liquid injected into the hollow channels to make them visible. The gas cores out the thick rib base as predicted by C-MOLD. (Some gas fingering into the thin wall areas of this part can be seen near the gas entrance.)

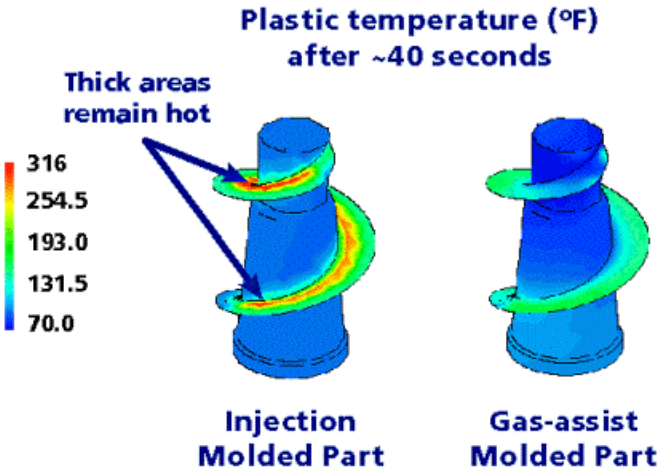

Figure 3. The decrease in plastic temperature in the gas-assist molded part lead to a 38% reduction in cycle time going from 70 seconds to 43 seconds.

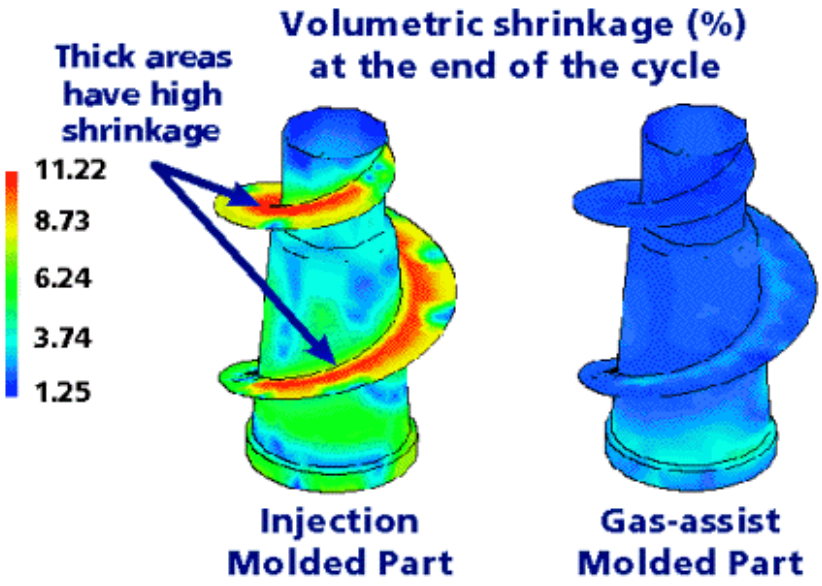

Figure 4. Significantly less volumetric shrinkage in the gas-assist molded part improved the part roundness by up to 75%.

"The benefits offered by gas-assist are now a reality for this part. Cycle time was reduced by 38% over the conventional injection molding process, weight was reduced of approximately 12%, and the part roundness improved by 50% to 75%. C-Mold also helped us design the cold runner and gas pin placement, which had to be changed late in the tooling construction. It also helped determine the starting process conditions that, when run on the actual molding machine, delivered successful parts the first time the mold was shot"