THE MADISON GROUP
PLASTIC CONSULTING ENGINEERS

From the TMG Solutions Archives: Warpage Reduction Analysis

Keywords - Warpage, Moldflow, Acetal, Cooling

Problem

An injection-molded acetal shroud used in a medical device assembly was experiencing excessive warpage of the sidewalls that prevented it from being assembled to the mating component.

Evaluation

An evaluation of the current cooling line layout and process parameters used to manufacture the shroud was performed using Autodesk Moldflow Insight. The simulation revealed that the current cooling line layout allowed the core to run 30 – 40 °F hotter than the cavity side of the mold. As a result of the differential cooling from the cavity to core-side of the mold the internal corners of the sidewalls cooled at a slower rate than the cavity-side and caused the sidewalls to deflect inward. This non-uniform cooling at the corners of "box-like" structures is common and is often referred to as "corner effects" or "spring-forward effect."

Due to the small dimensions of the core steel there was minimal opportunity to add additional cooling circuits to reduce the surface temperature of the core. Therefore, the mold design was changed to incorporate Moldmax HH (BeCu) inserts that have a higher thermal conductivity into the core. Additionally, two new cooling circuits that used bubblers to cool the new cores were integrated into the mold design. The design modifications were designed around the current ejection system, and allowed the part to cool more uniformly. The new cooling line layout helped reduce the mold temperatures and the sidewall deflection by 50%.

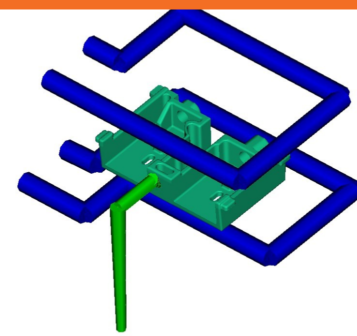

Figure 1: Isometric view of original cooling line layout for acetal shroud.

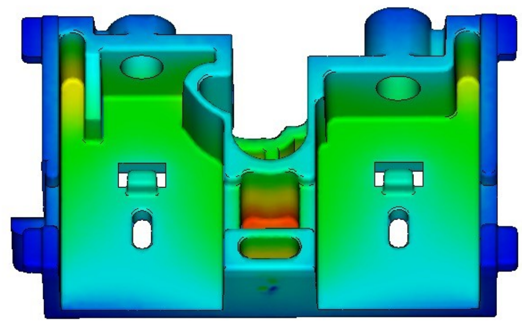

Figure 2: Original cooling line layout resulted in elevated mold temperatures on the core-side of the mold.

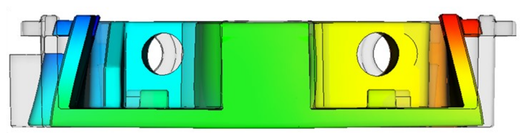

Figure 3: The hotter core mold temperatures caused the sidewalls to deflect inward.

Conclusion

It was the conclusion of the evaluation that the part warpage was the result of insufficient cooling on the core-side of the part. This led to elevated mold temperatures that caused the sidewalls to deflect inward. Using injection molding simulation alternative mold and cooling line layouts were evaluated to reduce the sidewall deflection by 50%.

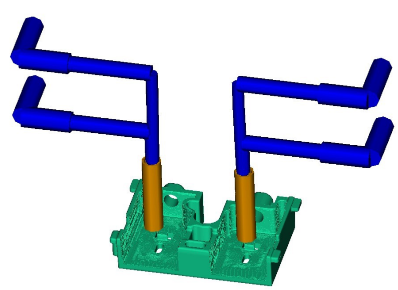

Figure 4: Incorporating high conductivity inserts and adding bubblers to the core-side of the mold helped reduce the predicted deflection of the sidewall.

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