TPE TIPS

ISSUE 2

Designing Molds for Styrenic Block Copolymers (SBC)

Compounds made from styrenic block copolymers (SBC) such as Kraton® D or G Polymers have special properties that can enhance the success of a finished part. For best results manufacturers should understand the material's processing benefits and limitations before designing a mold.

One advantage to a SBC based compound is the amount of strength, elasticity and recovery exhibited when the part is ejected from a mold. If there is room for the material to deflect, a high degree of undercut may be pulled from the mold upon ejection.

For a bulb-type product that hasa maximum diameter to neck diameter of 2-to-1, air ejection is possible with a minimum permanent deflection of the neck. This is done by placing an air valve in the core. There may be a 3 percent to 7 percent tensile offset. This should be considered when sizing the tools.

Here are a few points to consider when designing part molds for styrene-ethylene/butylenestyrene polymer based compounds (SEBS compounds), or styrene-butadiene-styrene polymer based compounds (SBS compounds):

FLOW DIRECTION VS. CROSS-FLOW DIRECTION

Many SBC based compounds are anisotropic; that is, they have different properties in the flow direction than in the crossflow direction (90 degrees to the flow direction).

Directional variations of as much as 50 percent have been observed in the tensile modulus of the material. Tensile modulus is usually lower – and the ultimate elongation usually higher – in the cross-flow direction.

Consider these modulus differences when designing the tool and its gate locations. You may be able to determine the direction of flow by eye, or you could use a more sophisticated 'Mold Flow' analysis program.

SHRINK RATES VARY

Some compounds may also have different shrink rates in the two directions. The shrinkage in the flow direction is usually higher than in the cross-flow direction. Also, SEBS compounds shrink more than SBS compounds, soft compounds shrink more than harder compounds, and unfilled compounds shrink more than filled compounds.

SBC based compounds with high mold shrinkage may exhibit sinks and shrink voids in tools with large variations in wall section thickness. To minimize these sinks and voids, gates should be large, they should be located in the thicker sections of the part, and pack pressure should be held a little longer than usual. Be careful at this point; too much pressure held for too long can cause the gates to bulge. In very thick parts, sinks can be minimized by using a small amount (0.2 percent) of a blowing agent. If you do use blowing agents, remember that parts must stay in the tool longer to prevent the foaming agent from bulging the part when ejected. Designing Molds for Styrenic Block Copolymers (SBC)

In parts that fill from a thin wall to a thick section, the polymer may break away from the wall as it enters the thick section. This will create a back filling flow and result in a surface knit line. Flow and shadow marks may also show if the flow is

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interrupted by a pin or a sharp dimple in or on the surface. To avoid these types of defects, radius the transition zones and corners in your mold. Defects like these may be minimized by using a textured or matte surfaced tool.

SEBS COMPOUNDS ARE HIGHLY ELASTIC

SEBS compounds can have elongation as high as 1,200 percent. This property may allow you to have some unique features and product performance, but it may create a number of headaches if you are using automatic degating molds, especially those using subgates or three plate tools with self-degating drops. The gates on these types of molds should have as short a land length as possible to create high stress concentrations.This will cause the gates to break at the desired location without leaving a gate vestige.

To make sure the degating process does not pull a hole in the part, the cross sectional size of the gate should be between 1/10 and ¼ the thickness of the part wall section where the gate is located. If a large knock-out pin can be placed just below a subgate, it may shear the gate during ejection.

Lower elongation grades are easier to run in automatic degating tools. For high elongation SEBS grades, hot runner tools with valve gates can be used. Hot tip, hot runner molds are also possible for SEBS compounds, but may leave some gate vestige.

PREVENT PHASE SEPARATION

SBC based compounds contain multiple ingredients. Under some circumstances, too high shear rates may cause phase separation. To prevent this, gate size and fill rate must be right. The gate size may need to be increased or its location moved to eliminate the problem.

SURFACE FINISH

Clear, unfilled SEBS or SBS grades form intimate contact with the tool and replicate the surface very well. This, plus the high coefficient of friction of SBC based compounds, can make ejection difficult, especially with higher shrink grades that may shrink onto the core. The best way to solve this problem is to use air ejection, although a high draft may also be helpful. Another suggestion is to use a mold surface that has been treated with a release coating or has been sand blasted to trap air next to the mold surface. GLS can provide special grades with internal mold release agents to min imize the problem.

HOT RUNNER TOOLS

SBS compounds that are held at high temperature for long times are capable of crosslinking. If these materials are used in hot runner tools with dead zones or selfinsulating runner systems, gels of crosslinked compound may be sloughed into the flow path, partially blocking thin areas such as gates or part walls.

SEBS compounds are more heat stable and have been used successfully in well-designed hot runner tools. However, we do not recommend the use of self-insulating runner systems for SBS or SEBS compounds, due to the dead zones and potential for polymer degradation.

Unique products benefit from unique materials and require special considerations when designing the tools. Keep this in mind when you think of a new part mold for SBCbased compounds. This way you can avoid the traps that can lead to difficult production start-up.

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