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Numerical Simulation of Ear-flow: The Faster Advance of the Flow Front at the Edge of a Cavity

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Numerous cases have been observed in industrial injection molding practise of amorphous materials of a race-track for "Ear-Flow" effect. This is the more rapid advance of the flow front at the edges than in the centre of the cavity. This flow-leading effect at the edge cannot be explained by differences in cavity wall section thickness. In the worst cases, this race-tracking leads to air-traps and visual defects in the molded part.

Murata et al.[2002] demonstrated this effect in carefully controlled molding experiments and through the use of detailed temperature measurements in the polymer melt, showed that a temperature difference existed between the polymer melt at the edge and centre of the molding.

In this work, we show that this temperature gradient can be predicted by the use of a three-dimensional FEM simulation which include an accurate representation of the melt convection from the feed system into the cavity. It is this convection pattern which leads to the in-plane temperature differential and this in turn causes the more rapid advance of polymer at the edge of the cavity.

Comparison is made between numerical simulation and actual moldings for the cases reported by Murata et al.[2002] and for other industrial cases.

Reference:
Murata et al.[2002]: Murata Y., Abe S. & Yokoi H., "Experimental Analysis of Faster Advance of Flow-Front at Both Sides of Cavity Than Center". Asian Workshop on Polymer Processing in Singapore 2002.