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3D-Simulation of Warpage for Short Fibre Reinforced Thermoplastics

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The increasing requirements in industry to reduce development time and costs by maintaining advanced quality and functionality in highly integrated polymer parts demand good prediction tools for injection moulding process.
Warpage in fibre reinforced thermoplastics is in contradiction to unfilled or isotropic materials mainly influenced by the orientation of fibres and less by cooling. The orientation is mainly affected by the gate position, part geometry and shear rates.
A mould has been developed equipped with pressure transducers and thermo-couples to produce parts specially designed to investigate warpage. 2D- fibre orientation measurements based on the surface ellipse method and 3D measurements based on x-ray computer tomography with a nano-focus beam have been performed to determine fibre orientation at different locations for short glass fibre reinforced parts. The recorded pressure, temperature and orientation data were compared with the results from different commercial 3D software Codes to simulate the injection moulding process.
3D simulation codes were chosen as real parts very often are neither flat nor consist of uniform thicknesses. The use of process relevant material data, e.g. pvT at high cooling rates will be discussed to show in which cases the use of such data is crucial in order to predict filling correctly.
It can be shown that there is still need in better prediction of fibre orientation and new models to describe warpage deformation in order to be able to get reliable quantitative predictions in this area.