Symposium 4: Extrusion and Extrusion Processes

P-4-61

STUDY OF HEAT TRANSFER IN DISPERSIVE MIXERS AT HIGH SCREW SPEEDS

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High speed single screw extruders operate with peripheral screw speeds higher than 1 m/s up to 2 m/s and in selected cases 4 m/s. These developments made it possible to reach output dimensions with small scale extruders previously only possible with large extruder sizes. At these screw speeds the improvement of melt quality becomes much more important than at low ones. Solid bed breakup occurs in the melting zone of single screw extruders especially at higher screw speeds and leads to remaining solid particles in the melt.
The improvement of melt quality can be carried out by the use of axially and helically fluted dispersive mixers. Due to narrow shearing gaps dispersive mixers exhibit a high dissipated energy input at high screw speeds. In this study an analytical calculation and CFD (Computational Fluid Dynamics) simulations are carried out to determine the melt temperature rise in Maddock mixers at high screw speeds. Beside the screw speed the influence of other parameters like the viscosity function of the processed polymeric material, the thermal material properties and the geometrical design of the Maddock mixer on the temperature rise are investigated. The effect of the remaining solid particles in the melt at the inlet of the Maddock mixer on the calculated melt temperature is additionally considered in the CFD simulations. The results allow a proper design and application of Maddock mixers in high speed extrusion to improve melt quality. (oral presentation)