

HIGH PERFORMANCE SINGLE SCREW EXTRUSION – MODELING AND EXPERIMENTAL INVESTIGATIONS

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Single screw extruder (SSE's) are the most advantageous machine concepts for polymer plasticating extrusion due to the simple and economic but nevertheless reliable mechanical design, the appropriate conveying mechanism for particulate solids, the elegant drag-removal melting mechanism, the pumping efficiency for highly viscous fluids, the venting functionality, the passable residence time distribution, and the distributive and dispersive mixing performance.

Although SSE's have been industrially used since the 19th century, they are still the subject of current research work due to the high economic significance and the complexity of the transport phenomena. In the past 15 years considerable improvements in performance have been achieved, in particular due to the following points: a) grooved barrel design in the melting zone (like the Helibar system developed by Grünschloß), b) high speed extrusion (peripheral screw speed over 1m/s), c) specific barrier screw concepts, d) targeted use of dispersed solid melting mechanism.

This invited lecture focuses on high performance SSE and deals with i) the SPLINE polymer extruder concept, a specific grooved barrel design in the melting zone, ii) starve feeding, and iii) heuristic modeling of functional zones.

The presented SPLINE polymer extruder concept is designed with extended grooves in the feeding and melting zone without any tapered profile that is without any compression in the grooves as usual.

Starve feeding for single screw extruders has not really been industrialized, although it has been successfully shown that it provides a wider processing window. However, most of the known investigations were carried out at a very low output range. This lecture will recite extrusion experiments with starve feeding at higher output ranges.

Finally, a generalized heuristic relationship for predicting the conveying characteristics of power-law fluids in two- and three-dimensional screw channels without the need for numerical methods will be presented.