

Intercomparison of slip flow velocity measurements of filled polymers by capillary extrusion rheometry

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Abstract

Slip flow can complicate both the measurement of the shear flow behaviour of polymers and the modelling of moulding processes. However, the understanding of the reliability of methods for measuring slip flow behaviour is limited. The results of an intercomparison on the measurement of slip flow behaviour by capillary extrusion rheometry of two polymer melts - a filled high-density polyethylene and a filled ethylene-vinyl acetate copolymer - are reported. Slip velocities were calculated, following the Mooney method, from the dependence of the shear stress - shear rate behaviour on the extrusion die diameter. Both compounds exhibited wall slip: in one case the slip velocity accounted for $\approx 80\%$ of the total flow rate. Slip velocity results were typically within $\approx \pm 20\%$ of the average values for the materials, although scatter up to $\approx \pm 40\%$ was obtained for one material at high shear stresses. An analysis of slip velocity measurements indicated that uncertainties of 40% to 50% are typical (95% confidence level) although significantly higher uncertainties could result if testing conditions (primarily die diameters) are not optimised.

Keywords: Slip flow; Slip; Capillary rheometry; Polymers; Plastics: Intercomparison