

Titima Thongpradid 2009: Prediction of High Density Polyethylene Sheet Extrusion Flow. Master of Engineering (Chemical Engineering), Major Field: Chemical Engineering, Department of Chemical Engineering. Thesis Advisor: Associate Professor Terdthai Vatanatham, Ph.D. 134 pages.

The extrusion process is used to produce many products. Polymer melt extruded from a sheet die is thicker than the die opening. It is the result of extrudate die swell. Therefore, modification the die opening to compensate the extrudate swelling is necessary to achieve the desired dimensions by adjusting the opening ratio empirically. The aims of this study are to investigate the melt rheological and to study the extrudate swelling behavior of HDPE from sheet die and simulate the swelling by using POLYFLOW program to predict the swell ratio. The melt rheological properties were measured by using a single screw extruder with capillary dies with the screw speed of 6-15 rpm at a temperature range of 423-473 K. The extrudate swell was studied in a sheet die. The experimental results showed that shear viscosity decreased with increasing temperature and wall shear rate which was the shear thinning behavior. Moreover, the results indicated that the extrudate swell ratio decreased with increasing temperature, but extrudate swell ratio increased with wall shear rate. Experiment with sheet die thicknesses in a range of 0.6-1.0 mm at a wall shear rate range of 5.4-47.4 s⁻¹ showed the extrudate swell ratios of 1.42-1.60. Numerical simulations of extrudate swell for HDPE melt were carried out using the Carreau-Yasuda law model. Numerical model using the finite element method was applied in POLYFLOW program. This model is based on clarified assumptions of generalized non-newtonian isothermal flow problem, with 2D and ½ planar geometry. The assumptions are no slip at the wall, incompressible fluid, steady state, and free surface flow after die exit. Comparisons between the experimental result and the results from POLYFLOW program using Carreau-Yasuda law showed that the simulation result gave lower swell ratio with the error of approximately 13%.

Student's signature

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