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Numerical Simulation of the Effect of Processing Parameters on the Flow Behavior and Breakthrough Phenomenon in Co-Injection Molding

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In this work, a three-dimensional finite element flow analysis code is used to study the flow behavior during sequential co-injection molding. Non-Newtonian, non-isothermal flow solutions are obtained by solving the momentum, continuity and energy equations. Two additional transport equations are solved for tracking polymer/air and skin/core polymers interfaces. Solutions are presented for the filling of a spiral-flow mould for which experimental measurements are available. The numerical approach is shown to predict the core advance stage during which the core flow front catches up on the skin flow front and the core expansion phase when the flow fronts of core and skin materials advance together without breakthrough. The breakthrough phenomenon is also predicted and the numerical solution is in good agreement with the experiment. Those phenomena are hard to predict numerically and to our knowledge this is the first attempt at simulating the three-dimensional melt behavior during core expansion and core breakthrough. The predicted flow front behavior is compared to the experimental observations for various skin/core melt temperature, skin/core viscosity ratio, and core injection delay. Simulation results are in good agreement with experimental data and indicate correctly the trends in solution change when processing parameters are changing.