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Simulation of the Flow in Bilayer Coextrusion Dies with Gradually Changing Calibrator Profiles

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Abstract : The main goal in the design of a die for extrusion of a complex profile is to obtain a uniform velocity at the die exit. If the velocity at the exit of an extrusion die is not uniform, the shape of the extrudate profile can change significantly after the polymer exits the die. To rectify the extrudate distortion caused by non-uniform exit velocity, calibrators and sizers are often installed along the extrudate cooling system. Furthermore, the profile shape in calibrators and sizers is sometimes gradually changed to intentionally deform the extrudate to the required final product shape. This is exploited to simplify extrusion die design, because a relatively simple profile at the die exit can be modified to obtain a more complex profile by deforming it in calibrators or sizers. The gradual change in the shape of calibrator or sizer profiles can also be used to extrude slightly different profiles from the same die. In the present work, a combined flow, thermal and structural analysis is used to accurately predict distortion of extrudate profile after the polymer leaves a die. Simulations of the flow and extrudate deformation in two different bilayer coextrusion dies with gradually changing profile shape in successive calibrators and sizers will be presented. The effect of non-uniform exit velocity, cooling shrinkage and shape of sizer profiles on extrudate deformation is included in the simulation. The predicted extrudate shape and layer structure is found to match accurately with those in a coextruded product.

Keywords : coextrusion, extrusion die design, finite element method, polymers
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