NUMERICAL SIMULATION OF NON-ISOTHERMAL VISCOELASTIC EXTRUDATE SWELL FROM CONVERGED 4:1 DIE

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The non-isothermal analysis of extrusion polymer processing axisymmetric flow problem is complicated not only because of the heat transfer problem, but also because of the highly temperature-sensitivity and complex rheological character of the fluid. Numerical simulation flow of viscoelastic fluid with free surface, which is realized in extrusion process, showed on fig.1. The flow of liquid is described by equations of conservation of mass,

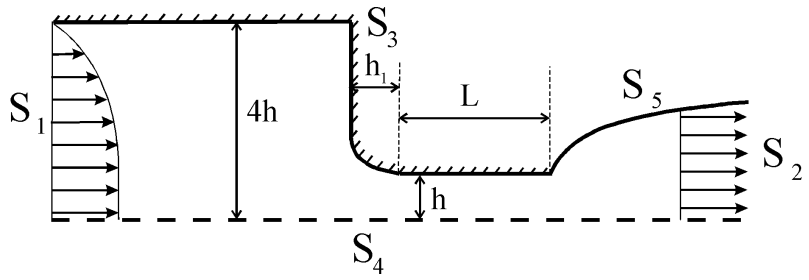

Figure 1. Flow domain for extrudate swell

momentum and thermal energy with rheological constitutive equation of Giesekus [1]. On basis of finite element method the stable numerical scheme was developed to solve this problem [2]. The main result in this work is investigation of coupled fluid mechanics and heat transfer problems dealing with elastic fluids in extrusion problems. The cross-channel upstream die and downstream jet radial velocity profiles are investigated. The velocity profile at low Weissenberg number (Newtonian limit) demonstrates considerable obvious difference compared at high Weissenberg numbers, where significant elastic effects occur. While in the case of Newtonian fluid velocity have maximum value at the axis of symmetry and then decrease monotonically to the boundary of jet, in contrast this case in elastic fluid the greatest variations in velocity profile near the free surface are found. This effect of non-monotonic velocity profile near free surface is observed in all downstream section of high elastic fluid, which have significant values of swelling ratio as well. The non-isothermal conditions show that swelling ratio is decreasing with heating the die walls. Different numerical experiments were performed to define the configuration of outflow jet in various regimes and geometries of the die. The distribution of flow velocity fields, pressure and temperature are investigated on dependence of heating the walls. The ratio of extrusion in dependence of parameters the rheological model are investigated also.

References

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