CONSTITUTIVE EQUATION FOR POLYMERIC FLUIDS AND SOME ONE DIMENSIONAL CASES OF FLOWS

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Constitutive equations for melts and concentrated solutions of linear polymers are derived as consequences of dynamics of a separate macromolecule. Realization of this approach involves consequent solution of two problems: formulation of the equations of dynamics for a macromolecule and transition from the formulated equations to RES. Further it is offered to consider only the slowest thermal movements of a macromolecule. It leads to consideration of suspension of dumbbells being in a medium formed by other similar dumbbells. The self-coordinated account of influence of movement of other dumbbells leads to specification of a kind of anisotropic friction factor that in its turn allows formulated a simple rheological equation of state. The model is investigated for viscometric flows. It was shown that the model gives a good description of non-linear effects of simple polymer flows: viscosity anomalies, first and second normal stresses, non-steady shear stresses. Two cases of steady-state flow between unlimited parallel planes under the action of a constant pressure gradient are considered and the same constitutive equations allow us to expand calculations also on the process of extension of the jet after the leaving of the die. Considering the processes of stretching, which occur at the lower temperatures, one has to take into account the possible process of crystallization of polymer.

The possibility of using modified rheological Vinogradov and Pokrovskii model is shown for the description of linear polymer melts flows in various modes of deformation. The system of the equations of dynamics is written down in one-dimensional approach, at the account heat exchange. Comparison with experimental data available in the literature for film half-width shows adequacy of the applied approach.

Comparison of results of velocity calculation with experimental data is implemented for polymer fluids moving between parallel planes. It allows drawing a conclusion, that in the considered case of Pouselle flow, the rheological model describes non parabolic profile of velocity in this case plates that does not contradict experimental data.

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