THE MESOSCOPIC CONSTITUTIVE EQUATIONS FOR POLYMERIC FLUIDS AND SOME EXAMPLES 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. 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. In this paper the case of weakly entangled systems are considered and formulated a rheological equation of state (RES) that establishes a relationship between the stress tensor, kinetic characteristics, and internal dynamic parameters. A simple rheological model which can be chosen as an initial approximation in formulating such a sequence of RES are obtained and studied. In this work, RES is extended to the case of allowance for the additional corrections caused by intrinsic viscosity and the delayed interaction of a macromolecule with its environment. 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. The resulting equations can be recommended as a first approximation in constructing a sequence of RES. Comparison this approach with another authors are given. 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.