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A critical analysis of typical assumptions in the theory of entangled polymer dynamics in elongational flows MARAT ANDREEV, RENAT KHALIULLIN, JAY SCHIEBER, Illinois Institute of Technology, Department of Chemical and Biological Engineering — The discrete slip-link model (DSM) was developed to describe the dynamics of entangled polymer melts of arbitrary chain architecture in arbitrary deformation. The model is able to predict linear viscoelasticity of monodisperse linear, polydisperse linear and star-branched systems. The model also shows good agreement with dielectric relaxation experiments. In this work we apply DSM to non-linear flows of monodisperse linear polystyrene and polyisoprene melts without any adjustable parameters. Model predictions for shear flow agree very well with experimental results. The DSM is able to capture the transient response as well as the steady state viscosity. However, for elongational flow, agreement is unsatisfactory at large strains. We explore a number of simplifications of the model and their effect on flow predictions, including: finite extensibility, convective constraint release and activation of dangling ends. Only after discarding all approximations and assumptions as a source of discrepancy between DSM predictions and experimental data can we conclude whether additional physics concepts are necessary to describe non-linear rheology of entangled polymer melts.

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