NUMERICAL SIMULATIONS OF VISCOELASTIC FLUIDS THROUGH DIFFERENT CONTRACTION CONFIGURATIONS FOR THE DEVELOPMENT OF A MEASURING SYSTEM FOR EXTENSIONAL VISCOSITY

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The flow behaviour of Newtonian and Boger fluids through various axisymmetric contraction configurations is studied through numerical prediction. A principal aim was to evaluate the geometry design choice of the hyperbolic contraction flow. The FENE-CR model has been used to reflect the behaviour of Boger fluids, with constant shear viscosity, finite (large) extensional viscosity and less than quadratic first normal stress difference. The numerical calculations have been performed on six different contraction configurations to optimize the geometry for measuring extensional viscosity in uniaxial flow. Additionally, the influence of a sharp or rounded corner on the nozzle has also been studied. There are currently few commercial measuring systems available for measuring extensional rheology on medium-viscosity fluids, such as foods and other biological systems. The hyperbolic contraction flow method would be a suitable alternative. The pressure drop, the velocity field, the strain rate and the extensional viscosity across the geometry have each been evaluated for both Newtonian and viscoelastic fluids. This numerical study has shown that the hyperbolic configuration was superior over the other geometry choices, measuring at constant extension rate. No vortices were formed, the measuring range was broader and the extension rate was constant throughout the geometry unlike for the other configurations. The difference between sharpened and rounded corner configurations proved to be negligible.

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