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Transient Displacement of Viscoelastic Liquids by Air

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We examine the transient displacement by air of viscoelastic liquids, which occupy axisymmetric tubes either completely or partially, as it arises in the Gas-Assisted Injection Molding (GAIM) Process. For the simulations we combine our recently advanced quasi-elliptic grid generation scheme for computing the highly deforming liquid boundaries, the mixed finite element technique and the Discontinuous Galerkin method for computing the viscoelastic stresses. In our parametric study we examine the effects of the elastic and inertia forces, and the solvent to polymer viscosity ratio. Results using the PTT and Giesekus constitutive models show that the thickness of the remaining film increases as the Deborah number increases and remaining fluid fractions greater than 0.60 (the Newtonian limit) arise, in agreement with experiments. Increasing the viscosity ratio decreases the effects of elasticity. Similar is the effect of the Reynolds number which may also result in variable film thickness and a tip splitting instability.

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