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Dynamics of Contracting Asymmetric Viscoelastic Filaments CHRISTOPHER ANTHONY, SUMEET THETE, School of Chemical Engineering, Purdue University, SANTOSH APPATHURAI, Chevron, PRADEEP BHAT, 3M, OSMAN BASARAN, MICHAEL HARRIS, School of Chemical Engineering, Purdue University — In ink-jet printing and atomization, slender filaments are routinely formed. Such filaments either contract to form a single drop or breakup into multiple drops, e.g. by end pinching. Beginning with papers by Schulkes (1996) and Notz & Basaran (2004), past studies have focused exclusively on the contraction dynamics of Newtonian filaments. Also in these studies, initial filament shapes are taken to be long cylinders terminated by two identical spherical caps (symmetric filaments). In emerging applications, e.g. ink-jet printing of complex fluids, the filaments are viscoelastic (VE) fluids. Moreover, older experiments by Notz et al. (2001) and more recent ones by Castrejón-Pita et al. (2012) show that initial filament shapes resemble long, tapered cylinders terminated by hemispherical caps of unequal radii (asymmetric filaments). Therefore, we analyze the contraction dynamics of both asymmetric and symmetric filaments of VE fluids using the Giesekus model. Rather than solving the full set of equations governing the problem, we take advantage of filament slenderness and solve a much simpler set of 1D equations (Eggers, 1997). We then use a finite element method with Streamline Upwind/Petrov Galerkin (SUPG) formulation (Brooks & Hughes, 1982) to solve the reduced equations.

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