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Free Surface Flows and Extensional Rheology of Polymer Solutions JELENA DINIC, LEIDY NALLELY JIMENEZ, MADELEINE BIAGIOLI, ALEXANDRO ESTRADA, VIVEK SHARMA, Chemical Engineering, University of Illinois at Chicago — Free-surface flows – jetting, spraying, atomization during fuel injection, roller-coating, gravure printing, several microfluidic drop/particle formation techniques, and screen-printing – all involve the formation of axisymmetric fluid elements that spontaneously break into droplets by a surface-tension-driven instability. The growth of the capillary-driven instability and pinch-off dynamics are dictated by a complex interplay of inertial, viscous and capillary stresses for simple fluids. Additional contributions by elasticity, extensibility and extensional viscosity play a role for complex fluids. We show that visualization and analysis of capillary-driven thinning and pinch-off dynamics of the columnar neck in an asymmetric liquid bridge created by dripping-onto-substrate (DoS) can be used for characterizing the extensional rheology of complex fluids. Using a wide variety of complex fluids, we show the measurement of the extensional relaxation time, extensional viscosity, power-law index and shear viscosity. Lastly, we elucidate how polymer composition, flexibility, and molecular weight determine the thinning and pinch-off dynamics of polymeric complex fluids.

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