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Analysis of the formation of drops of a Herschel-Bulkley fluid
PATRICK MCGOUGH, SANTOSH APPATHURAI, HAIJING GAO, OSMAN BASARAN, Purdue University — Although viscoplastic liquids are widely used in technological applications, study of dynamics of drops of such liquids has received little attention to date. In this talk, the dynamics of formation of drops of a Herschel-Bulkley fluid from a tube into a gas are studied computationally and experimentally. The dynamics are governed by five dimensionless groups: Ohnesorge number, Oh (dimensionless drop viscosity), Weber number, We (square root of dimensionless flow rate), Bond number, G (ratio of gravitational to surface tension force), power-law exponent, n, and yield stress parameter, Y (ratio of yield stress to capillary pressure). Computational results are matched against experimental results. Tracking (computationally) the evolution in time of yielded and unyielded regions in the drop is shown to be crucial for developing a good understanding of the fluid dynamics of the process. The effects of the governing dimensionless groups on the volumes of the primary drops that are formed and whether small satellites as well as large primary drops are produced are investigated. Similarities and differences between the dynamics of formation of drops of Herschel-Bulkley fluids and those of Newtonian fluids are also elucidated.

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