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Viscous filament coiling: viscoelastic effects YUNXING SU, Brown University, BERNARDO PALACIOS , University of Twente, ROBERTO ZENIT, Brown University — A viscous filament falling from a certain height onto itself on a horizontal surface can form coils. This phenomenon has been extensively studied for the case of Newtonian fluids (Ribe 2004, Maleki et al. 2004). Although viscoelastic liquid properties are prominent in many biological and industrial flows, their effects on filament coiling have not yet been studied in depth. Here, we present experimental measurements of the coiling performance considering Boger (viscoelastic with constant viscosities) and Newtonian fluids. To ensure a fair comparison, a series of glucose-based fluids were prepared such that the shear viscosity for both Boger and Newtonian fluids were closely matched. Compared to Newtonian fluids, the onset of Boger fluid coiling is delayed and the coiling frequency was smaller under the same experimental conditions. We hypothesize that these differences are due to the prevalence of high extensional viscosity values in viscoelastic Boger fluids, in accordance with previous rheological measurements. Moreover, we show that the coiling frequency curves of different Newtonian fluids can be collapsed using a pendulum frequency and gravitational length scaling. This frequency and length scales can also be used to collapse the viscoelastic coiling data by considering the extensional viscosity instead of shear viscosity. This corrected scaling confirms the prevalence of extensional viscosity effects on filament coiling of Boger fluids. Data of the filament radius and coiling radius are also presented in attempt to complete the understanding of coiling phenomena in viscoelastic liquids.

Yunxing Su
Brown University

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