Graduate Student Research Seminar

Spring 2022

Bead-on-fiber instabilities in thin film flow of shear-thinning fluids

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Monday, February 28th
3:00 pm (EST) – 132 Fluor Daniel Building

Abstract

Thin film flow down a vertical fiber is susceptible to bead-on-fiber instabilities which exhibit varying degrees of spatiotemporal complexity including Plateau-Rayleigh breakup, isolated bead formation, and convective instabilities. These instabilities produce tunable interfacial patterns that are beneficial for heat and mass transfer systems and fiber coating processes. We perform experiments using shear-thinning xanthan gum solutions over a wide range of fiber diameters and identify a new asymmetric instability that depends critically upon the fiber diameter, surface tension, and rheology. Our results show that increasing the fiber diameter, shear-thinning intensity, or surface tension produces asymmetric patterns. We reveal a unique simplicity in the physics that governs the asymmetric patterns by scaling the data. We conclude by discussing the qualitative differences between the asymmetric instability of Newtonian and non-Newtonian fluids.

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