Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Dynamics of complex fluids in rotary atomization BAVAND KESHAVARZ, GARETH MCKINLEY, MIT, MIT, MECHANICAL ENGINEERING DEPARTMENT TEAM — We study the dynamics of fragmentation for different Newtonian and viscoelastic liquids in rotary atomization. In this process, at the rim of a spinning cup, the centripetal acceleration destabilizes the formed liquid torus due to the Rayleigh-Taylor instability. The resulting ligaments leave the liquid torus with a remarkably repeatable spacing that scales linearly with the inverse of the rotation rate. Filaments then follow a well-defined geometrical path-line that is described by the involute of the circle. Knowing the geometry of this phenomenon we derive the detailed kinematics of this process and compare it with the experimental observations. We show that the ligaments elongate tangentially to the involute of the circle and thin radially as they separate from the cup. A theoretical form is derived for the spatial variation of the filament deformation rate. Once the ligaments are far from the cup they breakup into droplets since they are not stretched fast enough (compared to the critical rate of capillary thinning). We couple these derivations with the known properties of Newtonian and viscoelastic liquids to provide a physical analysis for this fragmentation process that is compared in detail with our experiments.

Bavand Keshavarz
MIT

Date submitted: 01 Aug 2016 Electronic form version 1.4