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Fragmentation of Newtonian and viscoelastic liquids during rotary atomization BAVAND KESHAVARZ, MIT, JOHN MOORE, ERIC HOUZE, MICHAEL KOERNER, Axalta Coating Systems, GARETH MCKINLEY, MIT, MIT COLLABORATION, AXALTA COATING SYSTEMS COLLABORATION
— Animals drying their wet fur by rapidly shaking their body and rotary atomization in paint coating are just a few examples in which centripetal acceleration is used to disintegrate liquid films into smaller fragments. Narrower size distributions and well-defined geometrical fluid pathlines (similar to the involute of a circle) are the main advantages of this type of atomization as compared to air-assisted atomization. Despite these inherent advantages there is a paucity of fundamental knowledge about the roles of fluid rheology in this process. We study the effects of viscosity by performing rotary atomization tests on silicone oils with a wide range of viscosities (1-1000 mPa.s). Viscoelastic effects are also probed by spraying solutions of polyethylene oxide (PEO) dissolved in water at different concentrations. Our results show that understanding the effects of liquid properties on the instabilities that control rotary atomization (primarily Rayleigh-Taylor instability during the ligament formation followed by Rayleigh-Plateau instability during droplet pinch-off) can help us understand the resulting fragment size distributions.

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