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Viscoelastic Effects on Spraying and Fragmentation of Polymeric Solutions BAVAND KESHAVARZ, GARETH MCKINLEY, MIT, Mech. Eng. Dept., ERIC HOUZE, JOHN MOORE, MICHAEL KOERNER, Axalta, MIT, MECH.,ENG.,DEPT. TEAM, AXALTA COATING SYSTEMS TEAM — The addition of small amounts of polymer to Newtonian fluids can inhibit the spray process, but the physical reasons behind these effects are still unclear. To explore this phenomenon, model viscoelastic fluids composed of very dilute solutions of polyethylene oxide are tested in a variety of fragmentation processes including air-assisted atomization, jet impact fragmentation, drop impact, and rotary atomization. Spray image analysis shows that when the fluid viscoelasticity is increased the average particle diameter and Sauter Mean Diameter both show a systematic increase before reaching an asymptotic plateau value. As observed for Newtonian fluids, the droplet size distributions are still well described by a Gamma distribution but the addition of viscoelasticity shifts the distribution to smaller values of n, corresponding to a broader size distribution. A linear stability analysis indicates that the effects of fluid viscoelasticity are more pronounced in the final stage of ligament formation than in the initial stages of atomization. The linear analysis can predict the observed trends in the mean droplet sizes; however, the shift in the size distributions seems to rise from the nonlinear dynamics of the stretched viscoelastic ligaments close to break up.

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