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Droplet Size Distributions in Atomization of Dilute Viscoelastic Solutions BAVAND KESHAVARZ, GARETH MCKINLEY, M.I.T. Mechanical Engineering Department, ERIC HOUZE, JOHN MOORE, MICHAEL POTTIGER, PATRICIA COTTS, DuPont, M.I.T. COLLABORATION[1], DUPONT COLLABORATION[2] — The droplet size probability distribution functions (PDF) for atomization/fragmentation processes in Newtonian fluids are now generally accepted to be close to Gamma distributions. Despite the great practical importance, little is known about the nature of corresponding distributions for viscoelastic liquids, e.g. polymeric solutions such as pesticide sprays and paints. We present data from air-assisted atomization experiments for model viscoelastic solutions composed of very dilute solutions of polyethylene oxide. Although the addition of small amounts of high molecular weight polymer keeps the fluid shear viscosity and surface tension close to the solvent values, the size distributions are skewed towards higher values of the Sauter mean diameter. We show that the PDF curves for these weakly-elastic fluids are well described by Gamma distributions, but the exponent n is systematically decreased by fluid elasticity. Flow visualization images show that this behavior arises from the non-linear dynamics close to the break-up point which are dominated by an elasto-capillary force balance within the thinning ligaments and the magnitude of the extensional viscosity in the viscoelastic fluid.

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