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X-Ray Fluoroscopy of Sedimentation in Elastic Fluids

T.A. BRZINSKI, R. KARUNAMUNI, A.D.A. MAIDMENT, P.E. ARRATIA, D.J. DURIAN, University of Pennsylvania — Dispersions of spheres in a Newtonian fluid will sediment until all grains form a packing. While the system approaches its final configuration, the dispersion is roughly homogenous in space and time except at two well-defined interfaces: a dispersion-supernatant interface, and an interface below the dispersion at which grains stack to form a packing. In order to better understand this packing process we perturb the dynamics at the lower interface by adding a flexible, high molecular weight polymer that enhances fluid elasticity. The fluid strain-rate between spheres has an extensional component that is inversely proportional to grain separation, so elasticity dominates the fluid forces as the grain separation becomes small, thus frustrating the packing process. In order to observe the effect of this perturbation, we utilize x-ray fluoroscopy. In the case of a system without polymer we observe settling rates in accordance with a typical Stokes' model until all grains have settled into a random packing. In the polymeric case we see that, alongside the Newtonian-like settling, there's a time- and depth-dependent compression of the disperse phase, resulting in a smooth transition between dispersion and packing rather than the sharp interface observed in the Newtonian case.

[X] Prefer Oral Session
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