Slurries of complex fluids: Rheology, microstructure and fluid mechanics

Sarah Hormozi*
Cornell University
Ithaca, NY, United States of America

Abstract

Slurries of complex fluids are suspensions of non-Brownian particles in complex fluids (e.g. shear thinning, shear thickening, yield stress and viscoelastic fluids). These materials exist all around us. Examples include the following: food products, hygiene products, mine tailings, concrete, fracturing fluids, shock absorbing materials, drilling muds and muds in mudslides, lava, and numerous others. As expected from their ubiquity, non-Newtonian slurries contribute significantly to the economy both positively and negatively. Therefore, even small increases in efficiency when processing slurries of complex fluids could make significant positive economic and environmental impacts.

Obviously, a thorough understanding of the rheology and fluid mechanics of these materials in natural and industrial settings is essential to improving the efficiency of production. However, this is extremely challenging due to the complex rheology of the suspending fluids, the interaction of fluid and particle phases, and multiple-body and short-range interactions of particles. My presentation will introduce an array of experimental and modeling techniques that my research team uses to investigate rheological properties and fluid dynamical behavior of the slurries of complex fluids. The goal is to establish a continuum framework and refine it through a series of microstructure investigations. I will discuss how our recent results can be used to address and resolve mixing and pumping problems in concrete industries and to maximizing petroleum reservoir production using hydraulic fracturing processes. Finally, open questions will be disclosed, which must be answered to build a firm foundation for a long-term contribution to the area of complex suspensions.

*e-mail: hormozi@cornell.edu