SHEAR-TRIGGERED COALESCENCE

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ABSTRACT

An emulsion is a fine dispersion of a liquid (dispersed phase) in another one (bulk phase) while two liquids are immiscible. Emulsions are thermodynamically unstable, so over time, droplets of the dispersed phase join together (through coalescence) to form larger droplets until complete phase separation occurs. The terminal desire in such industries as food, cosmetics, and pharmaceuticals is a super-stable emulsion, which is not phase-separated over a long period of time. However, immediate phase separation is critical for oil and gas industries to separate as much dispersed oil as possible from the oily wastewater before discharging it into the environment. That being said, controlling emulsion stability is critical for the various industries mentioned. Prior work has shown that for crude oil emulsions, gentle oscillating shear can dramatically increase the rate of coalescence relative to no shearing. However, the effect has not been rigorously quantified and the physicochemical mechanisms involved require more study to see if this effect can be reproduced in other emulsions. In this study, we present results using a cantilevered capillary force apparatus to precisely manipulate two oil droplets with a range of surfactants and/or nanoparticles, and compare the droplet coalescence time in oscillating shear vs. head-on droplet collisions. We also make bulk emulsions and test them both under shear and at rest to find out how the results compare with the single-droplet results.