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Confinement and viscosity ratio effect on droplet break-up in a concentrated emulsion flowing through a narrow constriction JIAN WEI KHOR, Department of Mechanical Engineering, Stanford University, YA GAI, Department of Aeronautics and Astronautics, Stanford University, SINDY TANG, Department of Mechanical Engineering, Stanford University — We describe the dimensionless groups that determine the break-up probability of droplets in a concentrated emulsion during its flow in a tapered microchannel consisting of a narrow constriction. Such channel geometry is commonly used in droplet microfluidics to investigate the content of droplets from a concentrated emulsion. In contrast to solid wells in multi-well plates, drops are metastable, and are prone to break-up which compromises the accuracy and the throughput of the assay. Unlike single drops, the break-up process in a concentrated emulsion is stochastic. Analysis of the behavior of a large number of drops (N >5000) shows that the probability of break-up increases with applied flow rate, the size of the drops relative to the size of the constriction, and the viscosity ratio of the emulsion. We found that the break-up probability collapses into a single curve when plotted as a function of the product of capillary number, viscosity ratio, and confinement factor defined as the un-deformed radius of the drop relative to the hydraulic radius of the constriction. The results represent a critical step towards the understanding of the physics governing instability in concentrated emulsions.

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