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Effect of Volume Fraction on Droplet Break-up in an Emulsion flowing through a Microfluidic Constriction ALISON BICK, SINDY K. Y. TANG, Stanford University — We report the effect of droplet volume fraction on the break-up of droplets within an emulsion flowing as a two-dimensional monolayer through a tapered microchannel into a constriction. A concentrated emulsion was injected into the channel, and an additional continuous phase was injected on-chip to dilute the emulsion to achieve different effective volume fractions. At a fixed flow rate, the break-up fraction decreases significantly when the droplet volume fraction φ decreases below ˜0.50. This result is consistent with our previous report that droplet break-up arises primarily from droplet-droplet interactions. Furthermore, an optimal location for the introduction of the additional continuous phase to dilute the emulsion was identified as approximately equal to one to two droplet diameters upstream of the constriction. Away from this optimal location, the dilution of the emulsion is ineffective. Assuming a tolerance of a maximum break-up fraction of 0.1, diluting the emulsion 2.1 times from φ =0.85 to φ =0.40 increases the throughput by ˜1.3 times. Consequently, although a higher emulsion volume fraction packs more drops per unit volume, the propensity of the drops to undergo break-up limits the throughput of the process if droplet integrity and assay accuracy are to be maintained.

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