Effect of soluble surfactants of kinetics of liquid bridges and formation of satellite droplets

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Bespoke drop formation is an essential part of many industrial processes such as emulsification, spray drying, inkjet printing and others. Surfactants are often present in the aqueous formulations used in these processes and therefore influence the quality of the final product. In particular the formation of satellite droplets is undesirable in most cases. Despite the essential practical importance and theoretical interest in the behaviour of surfactants at highly dynamic conditions including fast surface deformations, the systematic experimental studies on the effect of soluble surfactant on thinning liquid bridges and accompanying processes are quite rare.

Here we consider the effect of soluble surfactants on formation of aqueous drops at the tip of a capillary in air. Kinetics of bridges thinning, presence and size of satellite droplets, transition from dripping to jetting regime are studied in a broad range surfactant concentrations and activities as well as flow rates through the capillary.

It is shown that the surfactant solutions with dynamic surface tension equal to the equilibrium one on the timescale of the drop formation behave similar to the pure liquids, whereas for slower equilibrating solutions dynamic effects should be taken into account. The pronounced effect of dynamic surface tension was observed by formation and size of satellite droplets.

Transition from dripping to jetting occurs at smaller flow rates for the liquids with smaller surface tension, but for surfactants with small cmc value this transition was observed at the same flowrate as that of water even for solutions at concentration equal to cmc.

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