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Liquid bridge stability and breakup with a receding contact line

KENNETH BREUER, BIAN QIAN, Brown University — We have used experimental and theoretical methods to study the evolution and pinch-off of a liquid bridge fixed at the upper attachment point, but with a free contact line at the lower attachment point. High speed video shows that the contact line motion consists of two stages: a slow retraction at the beginning and a rapid retraction immediately prior to the bridge pinch-off. During the first stage, the evolution is quasi-static, and only a function of the bridge's height and volume. Agreement between experiments and solutions to the Young-Laplace equation is excellent during this phase. At some point, however, the static solution becomes unstable, and the contact line retreats rapidly, pinching off to form a droplet on the substrate. Theoretical and numerical approaches are used to analyse and predict this motion. Excellent agreement with experiments is achieved using a Tanner-like formulation for the dynamic contact angle.

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