**Effects of Shear and Extensional Rheology on Liquid Transfer between Two Flat Surfaces**

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**Abstract**

Liquid bridges with moving contact lines play a central role in several industrial applications and natural phenomena. In printing processes, liquid bridges undergo signiﬁcant extension so that liquid can be transferred from one surface to another. In addition, shear deformation arises as the contact lines move along the surfaces. Although the liquids involved often exhibit non-Newtonian rheology, the inﬂuence of rheology on liquid transfer is not well understood. To address this issue, ﬂow visualization experiments complemented with numerical simulations are used to determine the role of shear and extensional rheology in liquid transfer between two vertically separating ﬂat surfaces. Shear thinning is found to enhance liquid transfer to the more-wettable surface compared to the Newtonian case at the same capillary number, Ca, where Ca is deﬁned based on the zero-shear viscosity and plate separation speed. This enhancement increases with stronger shear-thinning eﬀects and allows nearly complete transfer for values of Ca *>* O(10−1) with a suﬃciently large surface-wettability diﬀerence. The underlying mechanism involves reduced viscosities near the contact line on the less-wettable surface, which allow that contact line to slip more. For strain-hardening liquids, the evolution of the contact radius on the less-wettable surface exhibits two distinct stages during bridge stretching. In the ﬁrst stage, the contact radius decreases and contact-line motion is primarily governed by shear rheology. In the second stage, a thin liquid thread is formed and the contact radius changes only weakly. During the second stage, extensional rheology dominates and strain hardening stabilizes the thin thread. This extends the breakup time, but has little eﬀect on contact-line motion and the amount of liquid transferred. (J-T. Wu et al., J. Non-Newtonian Fluid Mech. 274 (2019) 104173)