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Effects of shear and extensional rheology on liquid transfer between two flat surfaces SATISH KUMAR, JYUN-TING WU, University of Minnesota, MARCIO CARVALHO, PUC-Rio — 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. This enhancement increases with stronger shear-thinning effects and allows nearly complete transfer with a sufficiently large surface-wettability difference and capillary number. The underlying mechanism involves reduced viscosities near the contact line on the less-wettable surface, which allow that contact line to slip more. Extensional rheology extends the breakup time, but has little effect on contact-line motion and the amount of liquid transferred.

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