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Transfer of Rate-thinning and Rate-thickening Liquids Between Separating Plates and Cavities JYUN-TING WU, University of Minnesota, MARCIO S. CARVALHO, PUC-Rio, SATISH KUMAR, University of Minnesota — One promising technology for large-scale fabrication of printed electronics is roll-to-roll gravure, which involves transfer of inks from micro-scale cavities to a second surface. Although printing inks usually exhibit non-Newtonian behavior, the influence of ink rheology on liquid transfer is not yet well understood. To address this issue, an axisymmetric model is used to develop fundamental understanding of how ink rheology affects liquid transfer between vertically separating surfaces. Deformation-rate-dependent liquids described by a Carreau model are considered, inertial and gravitational forces are neglected, and the nonlinear governing equations are solved with the Galerkin finite-element method. For liquid transfer between two flat surfaces, the results reveal that rate-thinning (rate-thickening) rheology allows more (less) liquid to be transferred from the less wettable surface to the more wettable one. For liquid transfer between a flat surface and a trapezoidal cavity, the influence of rate-dependent rheology is found to primarily occur near the flat surface. This behavior is attributed to the presence of the cavity wall, which reduces the interfacial curvature gradients, the associated capillary pressure gradients, and thus the influence of rate-dependent rheology.

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