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Analysis for $Ca \to 0$ of smearing during gravure printing UMUT CEYHAN, S. J. S. MORRIS, University of California, Berkeley — During gravure printing, excess liquid must be wiped from the substrate, but wiping itself also smears liquid from the engraved wells onto the substrate. Assuming the wiping blade and substrate to be orthonormal, Ceyhan & Morris (BAPS.2014.DFD.G10.1) treat the case in which the blade–liquid contact angle $\theta \to \pi/2$. Streamlines are then everywhere quasiparallel, and the evolution equation for thin films describes the entire process. Comparing the solution of that equation for an emerging single well in plane flow with that for 3–dimensional flow, we found that smearing can be treated as a problem in plane flow. We now extend the analysis to cover the range $0 \leq \theta < \pi/2$. Streamlines are no longer everywhere quasiparallel, and inner–and–outer analysis of an unsteady plane flow is required. Though the problem might appear intractable, it has two redeeming features: (a) the interface, in effect, pins first at the distal edge of a well and, then later, at its proximal edge; (b) except near the pinning points, the pressure is hydrostatic. Using these features, we show that smearing, including the formation of a local maximum in film thickness, can be understood by combining Euclid (geometry of the circle) with Reynolds (squeeze–film flow).

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