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Increasing the critical speed of wetting failure through meniscus confinement ERIC VANDRE, SATISH KUMAR, University of Minnesota, MARCIO CARVALHO, Pontificia Universidade Catolica do Rio de Janeiro, Brazil — Dynamic wetting is a crucial step of fluid-fluid displacement along a solid surface, such as the deposition of a coating liquid onto a moving substrate. At some critical process speed wetting fails and the displaced phase (e.g. air) is entrained within the displacing phase. Improving upon current industrial production speeds requires a better understanding of how system parameters influence wetting failure. Confinement of the wetting meniscus is one such parameter commonly found in high-speed coating methods, though its influence remains unclear. In this study, we explore the effects of confinement on wetting failure with a laboratory-scale plunge-coating system. Our experimental apparatus consists of a steel roll that plunges into a bath of glycerol. Confinement is imposed by bringing a coating die near the wetting line, and liquid is injected through the die to compensate for liquid being dragged away with the roll. Flow visualization is used to record the critical roll speed at which wetting failure occurs. The data show a clear increase in the critical speed with increasing confinement. A model based on the lubrication approximation does a remarkable job in accurately predicting the increase in the critical speed relative to the unconfined value.

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