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Characteristics of air entrainment during dynamic wetting failure along a planar substrate SATISH KUMAR, ERIC VANDRE, University of Minnesota, MARCIO CARVALHO, PUC-Rio — We report results of experiments characterizing the onset of air entrainment during dynamic wetting failure along a planar substrate (J. Fluid Mech. 747 (2014) 119). Using high-speed video, dynamic contact line (DCL) behavior is recorded as a tape substrate is drawn through a bath of a glycerol/water solution. Air entrainment is identified by triangular air films that elongate from the DCL above a critical substrate speed. Meniscus confinement between the substrate and a stationary plate delays air entrainment to higher speeds for a wide range of liquid viscosities. Liquid pressurization moves the meniscus near a sharp corner, changing its shape and further postponing air entrainment. Meniscus shapes recorded near the DCL demonstrate that smaller entrained air films appear in the more viscous solutions. Regardless of size, air films become unstable to thickness perturbations and ultimately rupture, leading to entrainment of air bubbles. Recorded critical speeds and air-film sizes compare well to predictions from a hydrodynamic model for dynamic wetting failure, indicating that strong air stresses near the DCL trigger the onset of air entrainment. The results suggest strategies for postponing air entrainment, which often limits the maximum speed of industrial coating processes.

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