

Abstract Submitted
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Dynamic Wetting Failure in Shear-Thinning and Shear-Thickening Liquids¹ VASILEIOS CHARITATOS, WIESLAW SUSZYNSKI, Department of Chemical Engineering and Materials Science, University of Minnesota, MARCIO CARVALHO, Department of Mechanical Engineering, PUC-Rio, SATISH KUMAR, Department of Chemical Engineering and Materials Science, University of Minnesota — Dynamic wetting failure in shear-thinning and shear-thickening liquids is examined in this work. Flow visualization experiments using a curtain-coating geometry suggest that shear thinning postpones the onset of wetting failure and the resulting air entrainment. To advance fundamental understanding of the underlying physical mechanisms, a hydrodynamic model consisting of liquid displacing air in a rectangular channel in the absence of inertia is developed. Both shear thinning and shear thickening are considered by using Carreau-type models to describe the liquid rheology. Steady-state solutions are calculated using the Galerkin finite-element method and the critical capillary number where wetting failure occurs is identified. Shear thinning is found to postpone the onset of wetting failure whereas shear thickening is found to promote it. The underlying mechanism involves thickening/thinning of the air film as a consequence of shear thinning/thickening of the liquid and the tangential stress balance.

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Satish Kumar
University of Minnesota

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