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Liquid-Film Coating on Topographically Patterned Rotating Cylinders WEIHUA LI, University of Minnesota, MARCIO CARVALHO, PUC-Rio, SATISH KUMAR, University of Minnesota — The coating of discrete objects having surface topography is an important step in the manufacturing of a broad variety of products. To develop fundamental understanding of this problem, we study liquid-film flow on rotating cylinders having sinusoidal topographical features. The Stokes equations, augmented with a term accounting for centrifugal forces, are solved in a rotating reference frame using the Galerkin finite element method. When gravitational effects are negligible, there is a critical rotation rate below which liquid accumulates over the troughs before merging to form multiple larger drops whose number depends on the topography wavelength and rotation rate. When the rotation rate is above this critical value, liquid accumulates over the crests with similar merging events. When gravitational forces become significant, liquid accumulates over the troughs, leading to a more even distribution of liquid around the cylinder relative to the case where topography is absent. These observations are in agreement with predictions from a lubrication-theory-based model provided that the free-surface curvatures are sufficiently small. For sufficiently large pattern amplitude, recirculation and flow reversal are observed, phenomena that could strongly influence film drying.

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