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Long wave evolution of a two-fluid channel flow with surfactant and gravity DAVID HALPERN, ALEXANDER FRENKEL, University of Alabama — For a horizontal two-fluid channel flow (with top-to-bottom aspect ratio n and viscosity ratio m) in the presence of surfactants and gravity, with no inertia, the lubrication approximation yields two coupled evolution equations for interface and the insoluble surfactant. Even for arbitrarily strong stabilizing gravity, there is a band of unstable wavenumbers for certain (m,n)-ranges. We show that gravity violates the significance of vorticity (Wei 2005) for the surfactant instability. The two types of normal modes are characterised in physical terms, in the spirit of Charru and Hinch (2000). We observe that the role of vorticity hinges on inertia. With no gravity, a small-amplitude saturation of the surfactant instability is possible in contrast to the semi-infinite case studied by A.F. and D.H. (2006). For certain (m,n)-ranges, the interface is governed by a decoupled Kuramoto-Sivashinsky equation, and it provides a source term for the linear convection-diffusion equation of the surfactant . When diffusion is negligible, the surfactant equation has an analytic solution consistent with numerics. The surfactant wave is as chaotic as the interface; however, the ratio of the two waves is just constant. Strongly nonlinear regimes are found at finite n for $m < 1$.

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