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Effect of solubility on the interfacial-surfactant instability of shear flows ALEXANDER L. FRENKEL, The University of Alabama — A slow flow of a two-layer system with a soluble surfactant in the film and on the interface is considered. The linear stability theory of the plane Couette flow is developed for the liquid film adjoining a thicker layer of fluid. For the (Frenkel and Halpern 2002) non-inertial longwave instability which results from an interplay between the interfacial surfactant and flow shear, the effect of the surfactant solubility is studied, assuming a Langmuir-type adsorption-desorption kinetics at the interface and the advection-diffusion dynamics of the bulk surfactant. It is not a priori clear that the instability persists for the non-zero values of the surfactant solubility: The limit of vanishing solubility might be different from the case of zero solubility (= an insoluble surfactant case). For certain parametric regimes, this work analytically demonstrates that the instability does persist for non-zero surfactant solubilities; however, no matter how weak the surfactant solubility, its mitigating effect on the instability is found to be arbitrarily large for sufficiently long waves. Thus, the insoluble surfactant approximation fails for such waves.

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