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Surfactants non-monotonically modify the onset of Faraday waves[1] STEPHEN STRICKLAND, Dickinson College, MICHAEL SHEARER, KAREN DANIELS, North Carolina State University — When a water-filled container is vertically vibrated, subharmonic Faraday waves emerge once the driving from the vibrations exceeds viscous dissipation. In the presence of an insoluble surfactant, a viscous boundary layer forms at the contaminated surface to balance the Marangoni and Boussinesq stresses. For linear gravity-capillary waves in an undriven fluid, the surfactant-induced boundary layer increases the amount of viscous dissipation. In our analysis and experiments, we consider whether similar effects occur for nonlinear Faraday (gravity-capillary) waves. Assuming a finite-depth, infinite-breadth, low-viscosity fluid, we derive an analytic expression for the onset acceleration up to second order in $\epsilon = \sqrt{1/Re}$. This expression allows us to include fluid depth and driving frequency as parameters, in addition to the Marangoni and Boussinesq numbers. For millimetric fluid depths and driving frequencies of 30 to 120 Hz, our analysis recovers prior numerical results and agrees with our measurements of NBD-PC surfactant on DI water. In both case, the onset acceleration increases non-monotonically as a function of Marangoni and Boussinesq numbers. For shallower systems, our model predicts that surfactants could decrease the onset acceleration.

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Stephen Strickland
Dickinson Coll

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