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Reentry to the two-thirds power law for the surfactant-laden Bretherton problem in a slippery tube DAVID HALPERN, University of Alabama, HSIEN-HUNG WEI, National Cheng Kung University — Recent reports on the clean-interface Bretherton problem show that the well-known two-thirds power law can break down due to wall slip (Liao et al. Phys. Rev. Lett. 111, 136001, 2013; Li et al. J. Fluid Mech. 741, 200-227, 2014). Instead, the film thickness can vary quadratically with the capillary number Ca for Ca below some critical value, corresponding to the situation where slip effects are strong. Here we find that the presence of insoluble surfactant completely changes the above result. Specifically, combined effects of surfactant and wall slip can not only make the strong-slip quadratic law disappear, but also completely suppress the usual Marangoni film thickening along the two-thirds law, making the film behave as if surfactant and wall slip were absent. How to test the above finding experimentally is also discussed.

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