

Abstract Submitted
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A Computational Study of Surfactant Effects in the Bretherton Problem¹ METIN MURADOGLU, UFUK OLGAC, GOKALP GURSEL, Koc University — The finite-difference/front-tracking method developed by Muradoglu and Tryggvason (2008) is used to study the motion and deformation of a large bubble moving through a capillary tube in the presence of both insoluble and soluble surfactants. Emphasis is placed on the effects of surfactant on the liquid film thickness between the bubble and tube wall. The numerical method is designed to solve the evolution equations of the interfacial and bulk surfactant concentrations coupled with the incompressible Navier-Stokes equations. A non-linear equation of state is used to relate interfacial surface tension to surfactant concentration at the interface. The method is validated for simple test cases and the computational results are found to be in a good agreement with the analytical solutions. The film thickness is first computed for the clean bubble case and the results are compared with the lubrication theory in the limit of small capillary numbers, i.e., $Ca \ll 1$. Finally the method is used to simulate the effects of insoluble and soluble surfactants on the film thickness for a wide range of governing non-dimensional numbers.

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