Effects of Surfactant on the Motion of Large Bubbles in a Capillary Tube[1] METIN MURADOGLU, UFUK OLGAC, Koc University — The effects of surfactant on the Bretherton problem are studied computationally using both insoluble and soluble surfactant models. Emphasis is placed on the liquid film thickness between the bubble and the tube wall. We 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 employed based on Langmuir adsorption. The numerical method is first validated for the clean bubble case and the results are found to be in a good agreement with the semi-analytical Taylor's law. Then the method is used to investigate the effects of insoluble and soluble surfactants on the film thickness for a wide range of governing non-dimensional numbers. It is found that both the insoluble and soluble surfactants have a thickening effect on the liquid film, which compares qualitatively well with both the experimental results and analytical predictions. Further computations are performed to examine the effects of non-dimensional numbers in the insoluble and soluble surfactant cases and it is found that elasticity, Damkohler and Peclet numbers have significant influence on the film thickness. Finally the computations are performed to examine the validity of insoluble surfactant for a wide range of governing nondimensional parameters.

Metin Muradoglu
Koc University

Electronic form version 1.4