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Boundary integral simulations of dissolving drops in segmented two-phase flows ARUN RAMCHANDRAN, THOMAS LEARY, University of Toronto — Recent years have seen an upsurge in the literature reporting the microfluidic measurement of the kinetics of 'fast' gas-liquid reactions by recording the shrinkage of bubbles in segmented flows of these gas-liquid combinations in microfluidic channels. A critical aspect of the data analysis in these experiments is the knowledge of how dissolution influences the velocity field in the liquid slug, and hence, the mass transport characteristics. Unfortunately, there is no literature on this connection for dissolving bubbles. Our research addresses this gap using boundary integral simulations. The effects of the dissolution rate on the film thickness and the inter-drop separation are examined as a function of the capillary number and the viscosity ratio. The results demonstrate that dissolution can enhance the degree of mixing appreciably from one slug to the next. A curious result is that the film thickness and the droplet separation distance can change significantly beyond a critical capillary number, producing flow patterns completely different from those known for the undissolving bubble case. These results will guide the selection of operating regimes that enable convenient interpretation of data from experiments to deduce kinetic constants.

Arun Ramchandran
University of Toronto

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