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Theoretical Studies of Flow-Induced Coalescence

L. Gary Leal, Fabio Baldessari, Marcos Borrell, Yosang Yoon

Department of Chemical Engineering, University of California, Santa Barbara, USA

We study the dynamics of collision and film drainage that leads to coalescence of two drops in a flow. The objective is comparison with experimental observations from our laboratory. The basis is to study head-on collisions with a time dependent force along the line of centers of the drops that varies with time in the same way that the force along line of centers varies with time in a "normal" glancing collision. Experiments carried out with a computer-controlled version of the 4-roll mill demonstrate that the coalescence process in such a head-on collision is identical to that in the corresponding glancing collision for low capillary numbers. The focus on head-on collisions allows a much greater degree of spatial resolution than is possible in a fully 3D collision. Two kinds of theory are discussed: thin-film theory based on the asymptotic limit $\mathrm{Ca} \ll 1$; and boundary integral calculations.

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