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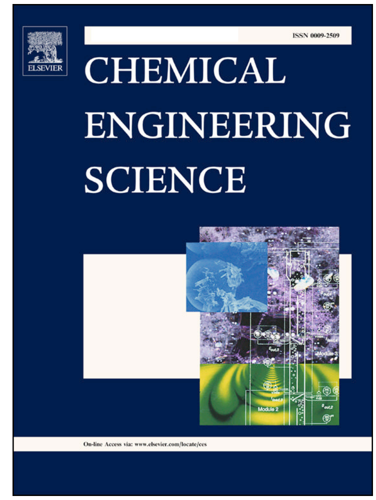

Reform of the drift-flux model of multiphase flow in pipes, wellbores, and reactor vessels

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Reform of the drift-flux model of multiphase flow in pipes, wellbores, and reactor vessels

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Abstract

To aid the understanding of multiphase flows and development of associated computational simulations, we reappraise the drift-flux model to improve accuracy and physical understanding. New insights are supported by careful re-derivation, literature review, and empirical verification. We directly calculate C_0 and C_1 using simultaneous measurements of instantaneous gas fraction and gas-liquid velocities, all obtained from a microscopic measurement volume (~1 mm^3) inside a macroscopic gas-liquid pipe flow (~5000 cm^3). A reformulated drift-flux plot is created for this macroscopic flow by using •-beam densitometry and total flow measurements. The microscopic and macroscopic data both confirm that significant error exists in common methods and assumptions regarding the drift-flux model, namely that the drift-flux parameters C_0 and C_1 are assumed to remain invariant with respect to changes of flow. Our reformulated drift-flux model finds greatly different values of C_0 and C_1 from those predicted by the standard drift flux model, and finds values of C_0 and C_1 to undergo a regime transition due to the bubble dynamics in the multiphase flow, wherein.at low gas flow the bubbles seldom interact, as if they are at infinite dilution, while above a critical gas flow the hydrodynamics change due to bubbles interacting significantly with each other. These insights are uncovered only by reformulation of the nominal practices of the drift-flux model.

Topical Heading: Transport Phenomena and Fluid Mechanics