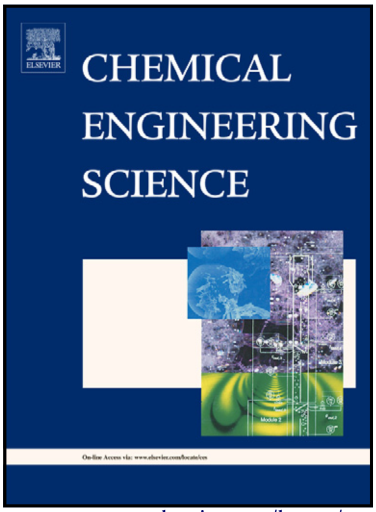

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Upscaling immiscible two-phase dispersed flow in homogeneous porous media: A mechanical equilibrium approach

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Abstract

In this work, we model immiscible two-phase dispersed flow in homogeneous porous media by upscaling the governing mass and momentum transport equations at the pore scale using the method of volume averaging. The model consists of a closed set of macroscopic equations for mass and momentum transport applicable for the dispersed and continuous phases. Furthermore, under the local mechanical equilibrium assumption, only one macroscopic equation arises for momentum transport, which resembles an extension of Darcy's law; whereas for mass transport, the equilibrium model reduces to the continuity equation. These macroscopic models are written in terms of effective medium coefficients that are computed from solving the associated closure problems in representative regions of the pore scale. After performing a parametric analysis, we observe that the magnitude of the longitudinal component of the permeability-like coefficient increases with the saturation and viscosity of the dispersed phase. We validated the model by comparing the predictions of the permeability coefficient with experimental data available in the literature. The results exhibit a relative error percent that ranges from 1 % to 15 %.

Keywords: Immiscible two-phase dispersed flow, upscaling, volume averaging, permeability predictions.

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