Mechanics of the Separating Surface for a Two-Phase Co-current Flow in a Porous Medium - DTU Orbit (08/11/2017)

Mechanics of the Separating Surface for a Two-Phase Co-current Flow in a Porous Medium

A mechanical description of an unsteady two-phase co-current flow in a porous medium is developed based on the analysis of the geometry and motion of the surface separating the two phases. It is demonstrated that the flow should be considered as essentially three-dimensional, even if the phase velocities are co-directed, since the phase interface is on average inclined to the direction of the flow. Kinematics of the flow is described, distinguishing between the average velocities of the bulk phases and their velocity near the interface between them. Dynamics of the flow is analyzed by means of the extended Maxwell-Stefan formalism, as in our previous paper (Shapiro 2015). Force balances are formulated in the directions parallel and orthogonal to the flow. A complete system of the flow equations, generalizing the traditional Buckley–Leverett and Rappoport–Leas system, is derived. Sample computations show that one of the main effects produced by the new system is sharpening of the displacement front, which otherwise would be washed out by the capillary forces, as in the solution of the Rappoport–Leas equation.

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