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A phase-field approach to model evaporation in porous media: Upscaling from pore to Darcy scale

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We develop a phase-field model for evaporation in a porous medium by explicitly considering a vapor component together with the liquid and gas phases in the system. The phase-field model consists of the conservation of mass (for phases and vapor component), momentum, and energy. In addition, the evolution of the phase field is described by the Allen-Cahn equation. In the limit of vanishing interface width, matched asymptotic expansions reveal that the phase-field model reduces to the sharp-interface model with all the relevant transmission conditions at the moving interface. An energy estimate is derived, which suggests that for the diffusion-dominated regime, energy always decreases with time. However, this is not always the case for other regimes. The phase-field model is upscaled to the Darcy scale using periodic homogenization for the diffusion-dominated regime. The effective parameters at the Darcy scale are connected to the pore scale through corresponding cell problems.

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Time Block A (09:00-12:00 CET)

Participation

Online

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