

Onset of Convection for a Miscible Fluid in a Porous Medium

Robert Behringer, Michael Carey, Mark Steen, Laurens Howle

Duke University

We describe experiments and simulations for convection of a binary mixture saturating a porous medium. We consider negative separation ratios, ψ . Theory predicts oscillations at the onset of flow. We have carried out experiments using Magnetic Resonance Imaging and shadowgraph techniques with high precision heat transfer measurements. In all cases, we observe a backwards bifurcation to steady convection rather than to oscillatory convection. Through modeling, we have investigated whether these observations are explained by enhanced mixing. Using a truncated version of the full equations, we find that for sufficiently strong enhanced mixing, the bifurcation changes from Hopf-like to backward (with a steady convective flow at onset). We directly measure the strength of the enhanced mixing using NMR, and we find that it is much too small to account for the observations. Hence, the explanation for the difference between theory and experiment must be sought elsewhere.

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