

Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Linear Stability Analysis of Radial Miscible Viscous Fingering

MANORANJAN MISHRA, VANDITA SHARMA, Indian Institute of Technology Ropar, INDIA, SATYAJIT PRAMANIK, University of Oxford, CHING-YAO CHEN, National Chiao Tung University, Taiwan — Viscous fingering (VF) is a hydrodynamic instability ubiquitous during the displacement of a more viscous fluid by a less viscous one in a porous medium or Hele-Shaw flow. We perform a state-of-the-art linear stability analysis (LSA) of miscible VF with a radial flow. The LSA provides an alternate approach to study time dependent linear system arising in miscible VF. The time dependent base state is calculated numerically using the method of lines. The evolution of the disturbances is studied relative to the time dependent base state using momentary stability. Growth rate is adequately defined to take into account the radial source flow. The LSA captures the competition between advective and diffusive forces during the initial stages of radial VF and gives an insight into the effect of the competition on the onset of instability. The results are verified by performing the experiments and non-linear simulations.

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Date submitted: 29 Jul 2019

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