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Miscible displacements in a Hele-Shaw cell: Linear stability analysis based on the three-dimensional Stokes equations NISHEET GOYAL, ECKART MEIBURG, UCSB — We investigate the miscible fingering instability of neutrally buoyant fluids in a Hele-Shaw cell. As a first step we perform highly resolved two-dimensional Stokes flow simulations in the gap of the Hele-Shaw cell. A quasisteady displacement front is seen to evolve, whose front thickness is seen to scale with $Pe^{-1/2}$, while it depends only weakly on the viscosity ratio. An exponential viscosity-concentration relationship leads to an increase in the tip velocity with the Peclet number for high viscosity contrasts, while a linear relationship has the reverse effect. The simulation results suggest that in the limit of high Pe and large viscosity contrast, the width and tip velocity of the displacement front asymptote to the same values as their immiscible counterparts in the limit of large capillary numbers. The subsequent linear stability analysis of this front clarifies the influence of the Peclet number and the viscosity ratio on the growth rate and wavelength of the dominant instability modes. These findings are compared to corresponding Darcy counterparts, and to experimental data by other authors.

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