Miscible fingering instabilities in vertical Hele-Shaw cells: A Stokes based analysis HANNES PICHLER, NISHEET GOYAL, ECKART MEIBURG, UCSB — We study the downward displacement of a heavier/lighter more viscous fluid by a lighter/heavier less viscous fluid in a vertically arranged Hele-Shaw cell. Two-dimensional Stokes flow simulations in the gap of the Hele-Shaw cell are employed to obtain the quasisteady base state, whose linear stability is subsequently analyzed. The base state properties depend on the relative magnitude of gravitational and viscous forces, as well as on the dimensionless displacement velocity. In the gravitationally stable configuration, the front thickness decreases with the viscosity ratio, while the reverse holds true for gravitationally unstable situations. The growth rates of the dominant perturbation modes show a similar dependence on the viscosity contrast. For fluids with highly disparate viscosities, gravitational effects are seen to become negligible. Conversely, for mild viscosity contrasts, the base states and the features of the dispersion relations are dominated by gravitational forces.

Eckart Meiburg
UCSB

Electronic form version 1.4