Abstract:

Liquid chromatography is used to separate the chemical components of a given sample by passing it through a porous medium. In some cases, and typically in preparative or size exclusion chromatography, the viscosity of the sample is significantly different than that of thedisplacing fluid (the eluent). Displacement of the sample by the eluent of different viscosity leads then to a hydrodynamic instability of either the front or the rear interface of the sample, leading to deformation of the initial planar interface. The less viscous fluid penetrates into the more viscous zone, forming a kind of finger pattern; hence the name "viscous fingering" is given to this instability. This fingering is dramatic for the performance of the separation technique as it contributes to peak broadening and distortions. Mathematical modeling with a theoretical description of the growth rate and wave number from a linear stability analysis induced by this instability will be explained. The numerical simulations, based on a spectral method, of the non-linear viscous fingering phenomena in a Hele-Shaw cell with the effects of adsorption of the solute onto the porous matrix will be discussed. Numerical results will be compared with the experimental investigation obtained in a chromatographic separation.