Pore-Level Modeling of Drainage:
Crossover from Capillary Fingering to Compact Invasion

M. Ferer*, Grant S. Bromhal, and Duane H. Smith
US DOE, National Energy Technology Laboratory
Morgantown, WV 26507-0880.

Abstract

Motivated by a wide range of applications from enhanced oil recovery to carbon dioxide sequestration, we have developed a pore-level model of immiscible drainage in two-dimensions, incorporating viscous, capillary, and gravitational effects. We have validated this model quantitatively, in the very different limits of zero viscosity ratio and zero capillary number. For increasing the capillary number, N_C, for a range of stable viscosity ratios ($\mu_{injected}/\mu_{displaced} > 1$), we have studied the way in which the flows deviate from capillary fingering (the fractal flow of Invasion Percolation) and become compact for realistic capillary numbers. Results exhibiting this crossover from capillary fingering to compact invasion are presented for the average position of the injected fluid, the interfacial width and the saturation profile. Our modeling results agree with earlier predictions.

*Permanent Address Department of Physics, West Virginia University, P. O. Box 6315, Morgantown, WV 26506-6315