Viscous and Permeability Effects on Miscible Displacement in Heterogenous Porous Media

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Abstract

Oil recovery from reservoirs requires an understanding of displacement flow through reservoir porous media. The fluids flow through the microscopic pores of the reservoir that make up the macroscopic reservoir system. Such systems are heterogeneous, particularly the permeability which can vary in any direction. These permeability variations affect the fluid displacement patterns, which in turn affect displacement efficiency. Visual models can display the displacement patterns. In this paper, we demonstrate a number of miscible displacement experiments in visual models of large core size, 20*10*0.6 cm, unconsolidated glass-bead packs having carefully controlled, but simple, permeability heterogeneities. Layered/striped/lensed/quadrant systems and miscible fluids having differing viscosities are illustrated in this paper. Our experimental visual evidence show that even small permeability heterogeneities within the reservoir can significantly affect displacement patterns. Thus, before core tests can be properly interpreted, the heterogeneity of the system needs to be known. Additionally, the displacement patterns can be used to validate the results obtained from numerical simulation, for identification of the physics of fluid flow and for engineers for scale-up to improve the design criteria for efficient recovery.

Keywords: Porous media, displacements, miscible flow, heterogeneity, cross flow, lens structure.