# Effect of Viscosity and Heterogeneity on Dispersion in Porous Media during Miscible Flooding Processes

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***Abstract***

*Mixing behaviour of a miscible gas and a displaced fluid is strongly related to oil recovery and miscibility during a miscible flooding process. Quantitative determination of miscible gas transport, which is dominated by dispersion and diffusion, will be beneficial to the design and optimization of miscible flooding projects. To determine mixing characteristics, both formation heterogeneity and properties of the fluid mixture are two factors that are too important to be ignored. In this study, a mathematical model has been developed to quantitatively examine effect of viscosity and heterogeneity on dispersion in porous media at pore-scale during miscible flooding processes. More specifically, the Navier-Stokes equation and advection-diffusion equation are coupled with supplementary equations to describe the miscible gas transport behaviour. Two-dimensional (2D) heterogeneous models are numerically developed as a function of porosity and permeability, assuming that the grain sizes satisfy the normal distribution. Then, performance of miscible hydrocarbon gas injection in heterogeneous formation has been comprehensively evaluated. It is found that a larger ratio of pore-throat size in the single non-flowing pore model not only results in a greater asymmetry of the concentration curve, but also lowers the miscible flooding recovery factor. As for single non-flowing pore models and heterogeneous models, dispersion coefficients increase with an increase in the non-flowing domain. Either a more dramatic variation of viscosity for reservoir fluids caused by the injected solvent(s) or a larger extent of heterogeneity featured by sorting coefficient leads to a more serious asymmetry of the concentration curve in porous media. As for the slug injection, the size of a gas slug of 0.125-0.500 PV along the longitudinal direction is found to be proportional to the maximum concentration of solvent produced at outlet of formation rather than the length of the mixing zone. A large Peclet number caused by a high injection rate or a large porosity enables the advection to dominate the mass transfer during miscible flooding, and thus results in a longer-than-expected mixing zone in the formation.*

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