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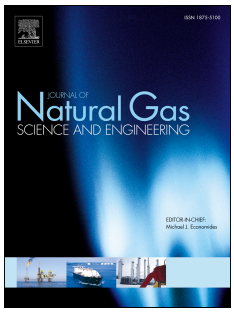

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Parametric Studies on Foam Displacement Behavior in a Layered Heterogeneous Porous Media Based on the Stochastic Population Balance Model

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Abstract

A numerical analysis employing the stochastic population balance (SPB) model is presented on foam displacement behavior in a water saturated heterogeneous porous media consisted of two parallel layers of medium with different permeabilities. Detailed parameter studies of the two key parameters of the SPB model, bubble generate rate K_g and maximum bubble density n_∞, are carried out to understand foam flow behavior and mechanisms in the heterogeneous porous media. Numerical results indicate variation of Kg and n_∞ values could significantly affect the ongoing foam flooding process and lead to obviously different pressure drops and sweep efficiencies. The parameter of K_g stands for the formation rate of foam, therefore determines the distance and time for foam fluid reaching equilibrium in the displacement process. Higher Kg values result in higher pressure drop and lower water saturation after foam sweeping through the heterogeneous porous media. The parameter of n_∞, on the other hand, determines directly the magnitude of foam apparent viscosity through defining the maximum bubble density of the flooding foam fluid. Larger n_∞ values lead to higher pressure drops and higher foam sweep efficiencies of the heterogeneous porous media. Reasonable numerical results indicate the SPB model could adequately describe foam displacement process in the heterogeneous media, therefore supplies an important alternative for foam mechanistic studies to promote essentially the foam field applications.

Keywords: Parameter study, foam displacement behavior, heterogeneous porous media, stochastic population balance model.