Stability of the liquid-gas contact interface in a porous medium described by a network model

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The problem of hydrodynamic stability of fluid displacement by gas in a porous medium in the case where the gas is above the fluid is considered. The occurrence of instability and evolution of small short-wave perturbations are investigated. It is shown that when Darcy law is used, the appearance of instability may occur at infinitely large wave number when the normal modes method is inapplicable. The results of numerical simulation of the nonlinear problem indicate that the anomalous growth of the amplitude of short-wave small perturbations is preserved, but the amplitude growth rate significantly decreases compared to the results of linear analysis. The analysis of the stability of the gas/liquid interface is also carried out using the network model of the porous medium. It is shown that the results of surface evolution calculations obtained with the network model are qualitatively consistent with the results of the continuum approach, but the continuum model predicts a higher rate of interfacial surface motion in capillaries. The perturbation growth rate in the network model increases with decreasing wavelength of perturbation at constant amplitude.

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