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Title Influence of Connate Water and Condensate Saturation on Inertial Effects in Gas-Condensate Fields
Authors J-M. Lombard, SPE, D. Longeron, SPE, F. Kalaydjian, SPE, Institut Français du Pétrole

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Abstract

Reliable predictions of productivity decline of gas-condensate wells require a proper description of complex flow behavior occurring in the near wellbore region. In that region, high pressure gradient induces both large condensate saturation and high gas velocities which may lead to significant deviations from Darcy's law for gas permeability. At the present time, no physically relevant model does exist which takes into account these non-Darcian two phase flow phenomena. This paper presents a contribution to the improvement of the description of gas-condensate flowing properties in the near-wellbore region. A laboratory study has been performed with the aims (i) to estimate the influence of the pore structure on the gas inertial coefficient b and (ii) to integrate the effect of the condensate dropout in the Forchheimer flow equation. Specific laboratory equipment has been built in order to perform gas-condensate displacements under conditions as representative as possible of near wellbore conditions i.e. pressure, temperature and velocities up to 1.5cm/s. Experiments were conducted to measure b on sandpacks and sandstone core samples, with and without connate water saturation (Swi), using dry gas (N2) and analog gas-condensate systems (C1-C3 mixtures). For dry gas floods, the measured b-values were found in good agreement with previous published data. b was found to increase with water (immobile) saturation. In addition a new correlation between b and a mean pore radius, r*, is proposed. Gas-condensate steady state experiments performed at different values of condensate saturation showed that b-values increased with the total liquid saturation. Finally a comprehensive methodology is presented to determine, for each specific application, the relevant parameters which must be taken into account to correctly predict the productivity decline.