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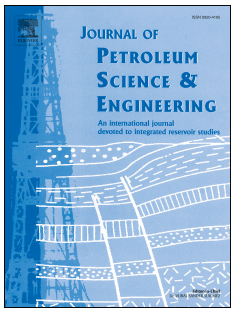

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Numerical well test model for caved carbonate reservoirs and its application in Tarim Basin, China *

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Abstract

The caved carbonate reservoir is a special and complex reservoir with different size cavities, which implies a strong heterogeneity. It is a big challenge to characterize such reservoirs. The dual-porosity model and radial composite model are the two most commonly used models for the interpretation of well test in caved carbonate reservoirs. However, more studies are needed to determine whether these models can be applied to this special and complex type of reservoir. In this paper, first we classify the log-log plots of test pressure into four types and analyze the characteristics of each type. The results show that the cavity controls the pressure response and that the above-mentioned models are not appropriate for the well test interpretation of caved carbonate reservoirs. We also developed a numerical well test model for caved carbonate reservoirs. The model includes two cases: a well drilled outside a cavity and a well drilled inside a cavity. The model's equations were solved by the finite-element method. We analyzed the pressure response of the developed model and found that the log-log plots for the model of a well outside a cavity are similar to that of the dual-porosity model, but the physical mechanisms of these two models are different. The model of a well inside a cavity is similar to the radial composite model except for a deviation in the distance of the well from the center of the cavity. Sensitivity studies show the size of the cavity, its permeability, and the distance from the well to the cavity are the main factors influencing the pressure response behavior. Two field examples of build-up pressure tests are provided to show how the proposed model can be used to understand the properties of caved carbonate reservoirs and characterize them.

Keywords: caved carbonate reservoir, type curves, numerical well test, finite element

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