A New Non-Linear Seepage Model in Low Permeability Reservoirs

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Abstract

In petroleum engineering, a low permeability reservoir is an oil reservoir whose permeability of porous media lower than 50 micro-Darcy. Due to the existence of the threshold pressure gradient (TPG), it is hard to describe the seepage characteristics of the low permeability reservoir, and there is no ideal model of this kind. Considering the force between liquid and solid surface, the authors derived a new liquid flow model based on the negative slip boundary model of a micro-channel. Firstly, after defining the non-flowing liquid layer close to the solid surface as the boundary stick layer, and using the inverse proportion of the boundary stick layer to the pressure gradient, the authors derived the formula of the distribution of the flow rate and the flow formula of a round channel; Then, the authors got the low permeability seepage model with consideration of capillaries model; Finally, the authors derived the TPG of low permeability reservoir after testing the flow of the samples. The results show that there does not exist TPG on the low permeability reservoirs on the whole. However, it can be seen in small parts with low pressure gradient. After different power fitting of the experimental data, we find that the first power exponential function fitting is relatively accurate.

Keywords

Low Permeability Reservoirs, No-Darcy's Law, Threshold Pressure Gradient, The Boundary Stick Layer

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