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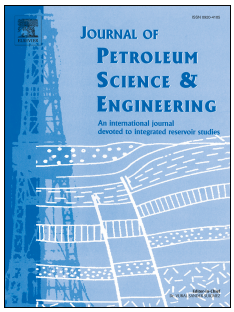

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A fractal irreducible water saturation model for capillary tubes and its application in tight gas reservoir

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Abstract

The existing experimental method of obtaining irreducible water saturation is not applicable for low permeability sandstone reservoir. To calculate the irreducible water saturation of tight sandstone reservoir accurately, an irreducible water saturation model suitable for hydrophilic rock is established by combining the capillary tubes model with the fractal theory. The influence of formation temperature and the critical capillary radius(maximum displacement pressure) on the irreducible water saturation is simulated. The results show that at a certain temperature, the smaller the critical capillary radius is, the lower the irreducible water saturation is. When the critical capillary radius is constant, the higher the formation temperature is, the lower the irreducible water saturation is. To verify the validity of the model, the new model is applied to the gas layer in tight sandstone reservoir of Xujiahe Formation in Sichuan Basin, the calculated data of the irreducible water saturation is compared with the wax sealing water saturation. The results show that compared with the irreducible water saturation calculated under experimental conditions, the calculation results of the new model are closer to the wax sealing water saturation on the condition that the effect of formation temperature and the maximum displacement pressure on the irreducible water saturation is considered. It is proved that the new model is applicable for accurate calculation of the irreducible water saturation of the gas layer in tight sandstone reservoir.

Keywords: fractal theory, capillary tubes model, formation temperature, irreducible water saturation, tight sandstone

1. Introduction

The estimation of initial hydrocarbon reserves during field development planning is of paramount importance, one of the requirements is the accurate determination of irreducible water saturation. It should be mentioned that in petroleum engineering irreducible water saturation (S_{wi}) is the ratio of the immobile water volume in the rock pore space to the pore volume of the reservoir rocks. Water saturation (S_w) is the ratio of the pore volume occupied by water to the pore volume of the rock. In the process of crude oil migration and reservoir formation, because of

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