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Experimental Research of Spontaneous Water Imbibition in Oil-Saturated Reservoirs with Ultra-low Permeability

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Spontaneous water imbibition (SWI) in porous media is of great importance in many industries. It is useful to predict the oil production in the fractured reservoirs developed by water flooding or associated with aquifers. The objective of this study is to investigate the combined effects of interfacial tension (IFT), salinity, and wettability on spontaneous Imbibition of water in ultra-low permeability rocks saturated with oil and the related mechanisms. Rock plugs with permeabilities ranged from 0.01 to 5 md were sampled from Yanchang Oilfield, China. A series of experiments on SWI have been conducted in these rock samples after cleaning, drying, and saturating with simulated oil at different IFT, salinity, and wettability conditions. The tests were done at room temperatures but the ratio of the oil-water viscosity in the experiments was equal to those at the reservoir conditions. Surfactants were used to alter the interfacial tension, and wettability. The experimental data of oil recovery by SWI under different conditions were then analyzed using different methods, including Li-Horne imbibitionmodel. The combined effects of IFT, salinity, and wettability on the oil recovery by SWI in ultra-low permeability rocks have been obtained experimentally. The results demonstrate that brine could imbibe into the oil-saturated rock with an ultra-low permeability of about 0.01 md at a relatively fast rate beyond our expectation. The oil recovery by SWI increased with the decrease in interfacial tension, contact angle, and brine salinity. The water imbibition rate is inversely proportional to the oil recovery, which follows the Li-Horne imbibition model. A mathematical model has been utilized to predict the oil recovery by considering almost all of the parameters involved in the spontaneous water imbibition. It is worth to further study the mechanisms of SWI imbibition in ultra-low permeability rocks, including the fluid flow in nanometer pores.

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References

Time Block Preference

Time Block C (18:00-21:00 CET)

Participation

Online

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