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Gas water two phase flow in fractured-porous carbonates

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The recoverable natural gas in carbonate reservoirs account for 45% of the total gas reserves. However, the physical heterogeneity of carbonate reservoirs is strong, and the fractures play a strong role in flow controlling. Therefore, gas-water two-phase flow in fractured carbonates is the key to hydrodynamic modeling of gas reservoir development with bottom and edge water. Here, using in situ X-ray microtomography, we provide the observational evidences of dynamic trapped gas and residual water distribution in a fractured carbonate. Finally the characteristics of gas–water flow during the gas flooding and water flooding in a fractured carbonate rock were described. We found that the gas preferentially entered into large pores and connected fractures due to the large gas flow resistance in micro fractures. The gas began to enter into micro fractures until the gas flooding pressure was increased to 1 MPa. Inversely, water preferentially entered into micro fractures during water flooding, because gas-water flow is mainly controlled by capillary force at low flooding rate (0.01 mL/min). As the water film thickened, water flowed along the fracture wall in the form of connected phase, while disconnected bubbles or gas columns flowed in the middle of the fracture. Furthermore, we concluded three types of trapped gas, which are trapped gas formed at dead ends and blind corners, trapped gas formed by Jamin effect and snap-off. We also studied the size distribution of individual trapped clusters in the pore space. The gas cluster volume V plotted against cluster surface area A also correlated with a power-law correlation $A \propto Vp$, and p was always ≈ 0.75. The gas-cluster-size distributions were measured and followed a power-law correlation $N \propto V-\tau$, where N is the frequency with which clusters of volume V are counted, and decays exponents τ is 0.22.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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