An Investigation of the Effect of Gravity on Foam in Model Fractures

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the reconstructed models obtained before and after exposure of the composite sample to CO2-brine solution (250 bars and 90oC) were analyzed qualitatively to ascertain the extent of the physical and chemical changes. It was clearly observed that small cracks were filled by mineral precipitation. Pore-scale analysis showed that both precipitation and dissolution mechanisms have been active during the exposure time. As a result of precipitation, a clear reduction in the volume of the void space in individual pores was observed. Petrophysical and geo-mechanical analysis showed a significant reduction in permeability of the composite samples after the long-term exposure to CO2-brine solution; however, the effective porosity and mechanical properties of the cement and caprock, as well as the bond between them, were not affected significantly.
The integration of X-ray μCT and permeability measurements showed that dissolution and precipitation of some minerals started from early stage of exposure. The high-permeable small cracks in the cement were filled as the result of precipitation and/or carbonation and reduced the composite permeability significantly. This phenomenon may help mitigate against leakage at reservoir pressure and temperatures considered in this research.

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An investigation of the Effect of Gravity on Foam in Model Fractures

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Gas-injection EOR processes have poor sweep efficiency due to conformance problems including channelling, gravity override and fingering. In naturally fractured reservoirs, sweep efficiency is further jeopardized, because gas breaks through fractures first, leaving most oil behind in the matrix. Strong foam can be created in fractures1, thus diverting the flow of gas into matrix and hence increasing the oil recovery[3]. In the field, natural fractures are usually vertically oriented, because the least principal stress is in horizontal direction in most formations. Foam performance in fractured reservoirs is affected not only by fracture roughness, aperture, etc., but also by gravity.

In this study, we investigate how gravity affects foam in fractures. To this end, we have conducted several sets of foam-scan experiments (i.e., a set of constant-total-velocity experiments, each with a different gas fractional flow) on three glass model fractures (model A, model B and model C) with hydraulic aperture of 78, 99 and 128 µm respectively.
The models have the same dimensions of 1 m x 0.15 m (L x W) and the same fracture roughness pattern. The transparency of glass models allows a direct investigation of foam texture inside the fracture using a high-speed camera. All experiments have been carried out at 20℃ and 1 atm. Nitrogen is the gas phase, and surfactant solution is 1 wt % AOS C14-16.
Experiments were carried out on all three models by placing the model either horizontally or on its side. Stable foam was created and reached local equilibrium in all horizontal-flow experiments: the rate of foam lamella creation was equal to the rate of destruction. The roughened fracture surface provided sufficient generation sites to re-create foam bubbles in sections further from the entry, hence maintaining a stable foam.
In the sideways flow experiment, the effect of gravity on foam stability was not significant when fracture aperture was small (model A). As hydraulic aperture increased (model B and model C), the effect of gravity was more pronounced. Drier foam propagated along the top part of the fractures and wetter foam along the bottom. Gas saturation was 18% greater at the top than the bottom for model B, and 27% for model C. Foam was still stable during the sideways flow experiments in model B. However, foam breakage alternated with re-generation near the top in model C.
We conclude that the application of foam in vertical natural fractures (meters tall and tens of meter long) with an aperture of hundreds of microns is problematic. The gravity segregation of phases for the foam in our experiments would disable its capacity to divert gas flow from a tall fracture like our model into the matrix. As a result, there would be a gas-rich regime at the top of the fracture and a liquid-rich regime at the bottom. The regimes segregate more as the aperture increases.

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Analysis of Factors Affecting Fracturing and Absorbing Parameters in Tight Reservoir

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Abstract: At present, the development of tight oil mostly adopts horizontal well multi-fragmentation fracturing technology. The recently developed non-returned clean fracturing hydraulic fluid retains the reservoir for a long period of time, tends to zero damage to the reservoir, and is conducive to the promotion of spontaneous infiltration Oil and water replacement. The pilot test of tight reservoirs in foreign countries has verified the effectiveness of the production of muddy wells without returning fracturing fluid. However, there is still no effective optimal design method for the design parameters of the infiltration scheme. This paper mainly considers the geological and fluid characteristics of tight oil reservoirs, and establishes a numerical simulation model for fracture-matrix reservoirs in vertical wells and horizontal wells in tight reservoirs during fracturing and infiltration. In the model, the effects of osmosis and surfactants are mainly considered. The effects of natural fracture permeability, matrix porosity, fracturing fluid injection volume, well-removal time, cluster spacing, and crack spacing on the effect of non-return fracturing and wicking were studied. The simulation results show that: The best natural fracture permeability and well-inspiratory time are the best. The greater the porosity of the matrix, the injection volume of the fracturing fluid, the more effective the fracturing and infiltration effects are. When the pressure crack cluster spacing and crack spacing are set at a reasonable value, the suction effect will be the best. Among the above factors, the natural