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Experimental study on silylated polyacrylamide based relative permeability modifiers in porous carbonate gas cores

Wednesday, 1 June 2022 09:20 (1h 10m)

Relative permeability modifiers (RPMs) have been utilized for controlling excess water in fractured shales1. The polymers that are employed as RPMs have the capability of dramatically decreasing water relative permeability with a less impact on gas relative permeability 2, 3. In the study outlined within we have aimed to control excess water in low permeability carbonate gas reservoirs using a newly developed silylated polyacrylamide based RPM was verified by core flooding tests under gas reservoir conditions. Prior to experiments, the RPM was prepared according to our previous study4. As shown in Figure 1, silylated chains in the RPM performs as a part of adsorbing onto rock surfaces via surface functionality and polyacrylamides with long chains act as a role of decreasing excess water in carbonate porous rocks.

Representative carbonate samples were selected for core-flood analysis including an Indiana limestone sample which was achieved through consecutive injection of brine and gas under reservoir conditions (1300psi and 60℃). SEM measurements showed that amorphous polymers were present on the pore surfaces and adhered onto calcite crystals at a high magnification ratio as indicated in Figure 2a. The residual resistance factor to brine (RRF brine) and residual resistance factor to gas (RRF gas) was 10.33 and 2.5 respectively. The disproportional reduction ratio (RRF brine/ RRF gas) was 4.13, showing a higher reduction of water production with a less impact on gas relative permeability. After performing history match of brine production and differential pressure by Sigmund McCaffery correlation5, the out profile of simulated brine production and differential pressure was generated and relative permeability correlated with water saturation was calculated as well. As shown in in Figure 2b, the results indicate that relative permeability curves after the RPM treatment moved to the right side as a whole and the crossover point dropped as well, implying the higher reduction of relative permeability to brine. In addition, the irreducible water (Sir) increased due to the existence of adsorbed water by the polymer in the porous cores. However, the relative permeability to gas presented a minor change, indicating a less effect on gas production.

This novel silylated polyacrylamide based RPM can provide a potential solution to mitigating excess water in carbonate gas reservoirs and present a significant application in gas fields.

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References

1. Song, Z. J.; Liu, L. B.; Wei, M. Z.; Bai, B. J.; Hou, J. R.; Li, Z. P.; Hu, Y. P., Effect of polymer on disproportionate permeability reduction to gas and water for fractured shales. Fuel 2015, 143, 28-37.
2. Zaitoun, A.; Kohler, N.; Marrast, J.; Guerrini, Y., On the Use of Polymers to Reduce Water Production from Gas-Wells. In Situ 1990, 14 (2), 133-146.
3. Al-Shajalee, F.; Arif, M.; Sari, A.; Wood, C.; Al-Bayati, D.; Xie, Q.; Saeedi, A., Low-Salinity-Assisted Cationic Polyacrylamide Water Shutoff in Low-Permeability Sandstone Gas Reservoirs. Energ Fuel 2020, 34 (5), 5524-5536.
4. Qin, L. M.; Arjomand, E.; Myers, M. B.; Otto, C.; Pejcic, B.; Heath, C.; Saeedi, A.; Wood, C., Mechanistic Aspects of Polymeric Relative Permeability Modifier Adsorption onto Carbonate Rocks. Energ Fuel 2020, 34 (10), 12065-12077.
5. Sigmund, P. M.; McCaffery, F. G., An Improved Unsteady-State Procedure for Determining the Relative-Permeability Characteristics of Heterogeneous Porous Media (includes associated papers 8028 and 8777). SPE-5556-PA 1979, 19 (01), 15-28.

Time Block Preference

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

Participation

Online

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