LOW SALINITY CYCLIC WATERFLOODS FOR ENHANCED OIL RECOVERY IN ALASKA NORTH SLOPE

Kulathu, Sathish[1*]; Dandekar, Dr. Abhijit[1*]; Patil, Dr. Shirish[1];
Khataniar, Dr. Santanu[1]; and Chukwu, Dr. Godwin[1]

[1]College of Engineering & Mines, Department of Petroleum Engineering, University of Alaska Fairbanks, PO Box 755960 Fairbanks, AK 99775-5960; * Corresponding authors: Dr. Abhijit Dandekar, ffayd@uaf.edu, and Sathish Kulathu, ftssk1@uaf.edu

With low salinity waterflooding already implemented, cyclic waterflooding is under extensive research for increased oil recovery than conventional waterflooding. Low salinity cyclic water injection is an interesting combination that offers the effects of both, with notably high oil recovery and less usage of water. Careful evaluation might promote the application of cyclic injection in the fields, especially Alaska North Slope.

Two phase water-oil flow experiments were conducted on new as well as oil aged sandstone cores in a core holder apparatus with overburden pressure at atmospheric temperature for dead oil saturated cores. After initial water saturation, Amott-Harvey Wettability tests were performed with spontaneous and forced displacement of the fluids by one another. After establishing irreducible water saturation, cyclic water floods were conducted to calculate oil recovery from the volume of produced fluids. Pulsed cyclic floods were programmed in the injection pump. The experiments were repeated with cores of different permeability and lab reconstituted brines of 21000, 11000 and 5500 ppm tds salinity. Results were compared with available data from continuous injection performed on the same cores. Cyclic floods were also tested for two symmetric on-off time intervals. Conventional waterflooding experiments were conducted for live oil saturated cores at reservoir pressure and temperature conditions. Live oil was prepared by recombining methane gas with dead oil.

With the dead oil experiments, it is observed that residual oil saturation is achieved as early as 3-4 pore volumes of injected water in cyclic injection as compared to 6-8 pore volumes in continuous injection. Additional oil recovery is observed in cyclic injection's idle time, when the already flooded water spreads smoothly within the pores to displace oil out of the core. Better recovery was obtained with lower salinity brines. Within cyclic injection, shorter pulse intervals yielded better results than longer pulses. With live oil experiments, oil recovery obtained was between 35-40 %. To conclude, low saline cyclic water injection with lesser pulse intervals yield better oil recovery and early residual oil saturation. This is an attractive option for Alaska North Slope operators.