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Final Thesis Defense

Masters of Science in Petroleum Engineering

KU THE UNIVERSITY OF KANSAS
Chemical & Petroleum Engineering

Simulation of Produced Brine Water Exchange between Kansas Arbuckle and Lansing-Kansas City Formations

Abstract

Conservation of the earth's usable groundwater is a growing concern not just in the state of Kansas, but on a national level as well. Larger than average portions of the state's water supply are used for irrigation, livestock, and other rural applications which are depleting Kansas' fresh groundwater resources; meanwhile Kansas' strong oil economy generated nearly 40 million barrels of oil in 2016. Over 1.061 billion barrels of formation brine water produced, with a state water-to-oil-ratio (WOR) greater than twenty. Most of the state's produced brine water is unusable with a total dissolved solids (TDS) concentration greater than 100,000 ppm, however, there are areas in Kansas where the TDS concentration of produced brine water is less than 40,000 ppm, or about the quality of seawater. These lower salinity brines are better candidates for affordable treatment for non-potable beneficial reuse applications in Kansas, and research suggests improved oil recovery benefits by waterflooding oil producing carbonate formations in Kansas with such lower salinity of brine compared to the salinity of the brine initially in place. The project objective is to use reservoir simulation to demonstrate a brine exchange where low salinity formation water will be withdrawn and replaced by brine of high salinity while safely maintain well injection rates and pressure in the reservoir.

A statewide brine analysis revealed that over the Central Kansas Uplift (CKU), the Lansing-Kansas City Group produces large volumes of high salinity brine, and the Arbuckle Group produces high volumes of lower salinity brine water. Seismic, DST, core, and well log data were used to create a dual permeability model of the Arbuckle formation in this area using Petrel geologic modeling software. Computer Modeling Group (CMG) software was used to perform dynamic reservoir simulations of a high salinity brine injection and lower salinity brine production exchange in the Arbuckle formation, as well as simulations demonstrating the improved oil recovery benefits of low salinity waterflooding of a representative Lansing-Kansas City reservoir in Kansas using produced lower salinity formation brine water.

Simulation results demonstrate that large volumes of brine can be exchanged while safely managing reservoir pressure in the Arbuckle by balancing the total injection and withdrawal of fluid in the reservoir. Lansing-Kansas City simulation results successfully demonstrate the additional oil recovery and improved oil production benefits of low salinity waterflooding using lower salinity water. Six major oil fields over a 5-county region in central Kansas were identified where Arbuckle and Lansing-Kansas City production is most prevalent, and a formation brine exchange could potentially be implemented to achieve beneficial reuse of the state's produced water.

Committee Chair:

Prof. Reza Barati

Thursday, January 25th
1:00 – 2:30PM
4161 Learned Hall