JOEL TETTEH

FINAL PH.D. DEFENSE

PETROLEUM ENG

" Interfacial Phenomena Associated with Low and Modified Salinity Waterflooding in Carbonate Rocks: A Nano- to Macro- Scale Investigation of Fluid-fluid and Rock-fluid Interactions "

Abstract

Length scale approach from nano- to macro- scale was used to investigate fluid-fluid and rock-fluid interactions associated with low salinity waterflooding in limestone. Formation of water-in-oil micro-dispersions was observed as O-H bond stretching, using Fourier transform infrared spectroscopy, and visualized using environmental scanning electron microscopy after encountering low salinity brine (~8200 ppm and below) with crude oil. These microdispersions resulted in oil remobilization and improved sweep efficiency as observed in reservoir-on-a-chip microfluidic device. Low interfacial tension and high dilatational surface elasticity at oil-seawater (~33,000 ppm) interface resulted in a rigid oil-brine interface, suppressed crude oil snap-off, and improved sweep efficiency as compared to both oil-formation water (~160,000 ppm) and oil-low salinity interfaces. Coreflooding analysis in non-aged limestone showed that, these fluid-fluid interactions contributed to the overall improved oil recovery (IOR). At the rock-brine interface, reduced electrostatic bond attraction, a spike in brine pH and repulsive disjoining pressure at the crude oil-brine-rock interface observed at the nanoscale, contributed to wettability alteration from oil-wet to intermediate-wet as brine salinity reduced and, in the absence of Ca^{2+}ions on the limestone surface. The use of modified salinity brine also showed efficacy and applicability in improving recovery in reservoir limestone in Kansas.

Date:

Wednesday, Dec 16th, 2020

Time:

Starts @ 1:00PM

Zoom Meeting Details:

HYPERLINK

Meeting ID: 952 4599 6804

Password: 034826

Committee Chair:

Associate Professor Reza Barati