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An Experimental Investigation of Microemulsion Phase Behavior at High Pressure and High Temperature Conditions

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Surfactants have great potential for increasing the recovery of oil reservoirs. Interfacial tension keep a large portion of the oil trapped inside reservoir rock pores. The reduction of interfacial tension, commonly done in miscible-gas-flooding, can significantly increase reservoir oil recovery. Gas flooding, however, has potential issue of early gas breakthrough due to the significant contrast between the viscosity and density of the injected gas and reservoir oil. Surfactant flooding is a great alternative over gas flooding, since micro emulsions have viscosity and density characteristics closer to oil in addition to ultralow interfacial tension values. The phase behavior of micro emulsions and the resulting interfacial tension are sensitive to reservoir conditions such as pressure, temperature, and water/oil compositions. These conditions vary significantly in a surfactant flooding process. The present study investigates the effect of the water/oil ratio, pressure, temperature, and oil composition on surfactant phase behavior.

The Pressure-Volume-Temperature cell was implemented to adjust the properties of the cell in order to resemble reservoir conditions (Figure 1). The fluid solution in the cell consists of oil, water, and a surfactant. The full visibility option of the apparatus is with ranges of pressure up to 10,000 psia and temperature up to 390 °F. The parameters used for this research caused two distinct phases and a micro emulsion. Software was used to collect the micro emulsion volume. Different tests were done to understand the phase behavior of the micro emulsions. One of the tests was performed under a constant pressure of 8,000 psi, but changing temperature conditions. Experimental results were collected at different time, and were plotted to study the trends (Figure 2). More tests were done to understand the phase behavior at different pressure and temperature conditions. One result is shown in with a constant pressure of 10,000 psi and a constant temperature of 75º F (Figure 3).

Figure 1 PVT Cell Used for Analysis

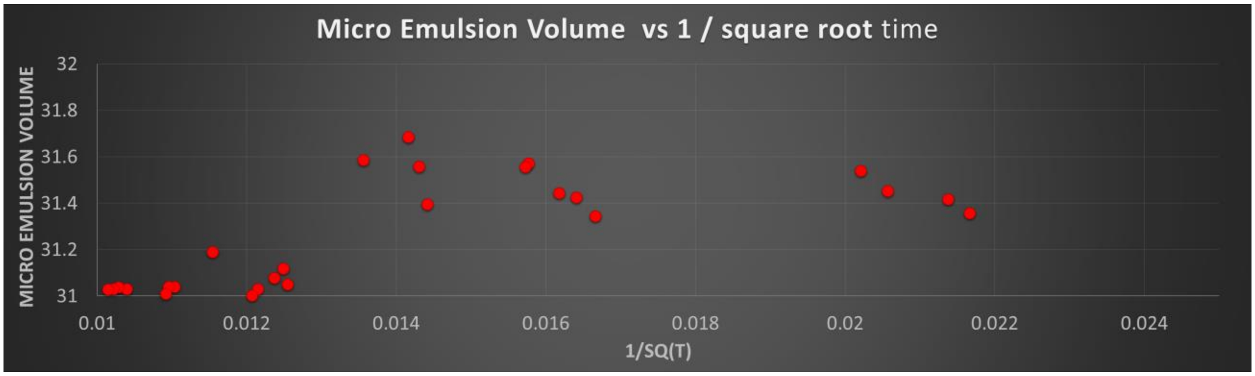

Figure 2 . The micro emulsion volume and time were recorded. The pressure was constantly at 8000 psi and temperature varies

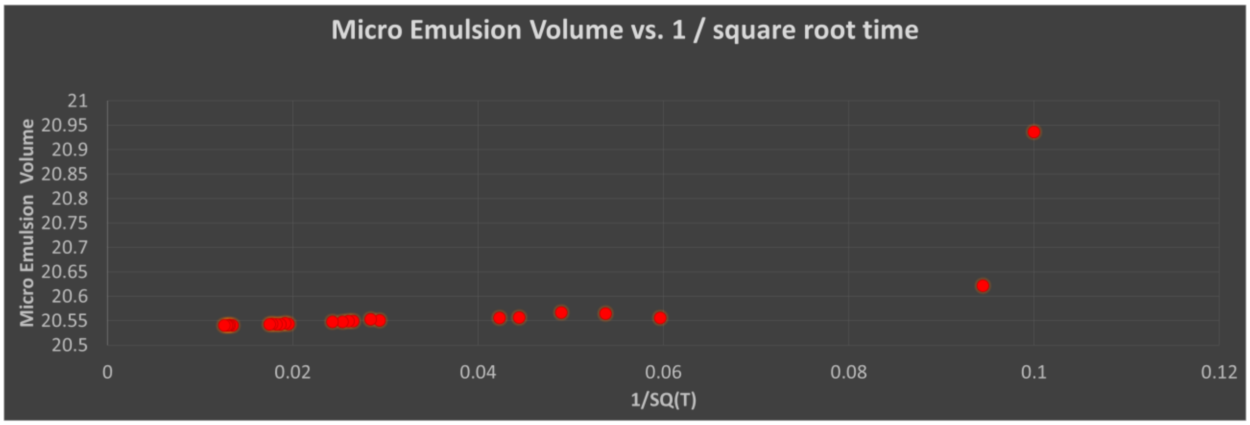

Figure 3 The micro emulsion volume and time were recorded. The pressure was constantly at 10,000 psi and had a constant temperature of 75^{o} F.

So far, different experimental tests have been performed to understand the impact of pressure and temperature on microemulsion phase behavior. Further study will be focusing on more experimental investigation of microemulsion phase behavior by changing the salinity of water and oil composition.