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Oil and Gas 2019- Wettability Alteration- Rabia Mohamed Hunky- University in Tripoli

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Abstract
Up to date, several technologies have been developed to enhance heavy oil recovery. All the technologies involve either heating the reservoirs to liquefy the hydrocarbons or attacking the deposits with diluents or solvents. Recent studies have found that a combination of alkali-surfactant flooding, when properly designed, can led to significant improved heavy oil recovery and has considerable potential for non-thermal technology. However, a more challenging case is heavy-oil fractured reservoirs where the recovery is limited only to matrix oil drainage gravity due to unfavorable wettability.

Wettability alteration is usually achieved through application of proper surfactants. In this study, we report our recent research of surfactant improved heavy oil recovery by wettability alteration.

As a non-thermal recovery technology, its application will benefit oil industry by identifying best surfactants to enhance heavy oil recovery. For heavy oil production in U.S., increase the unlocked heavy oil by 1% means more than 1.5 billion barrels production.

Studying the relation between wettability alteration and oil recovery, this research is to provide principles to design surfactant-based formulations for enhanced heavy oil production at lower cost, through low IFT and wettability alteration can be pretend. Surfactants have been used to change the wettability, with the goal of increasing the oil recovery by increased imbibition and change the contact angle of the water into the rock matrix.

In this study considers screen different class of surfactants, a series of branched alcohol propoxylate sulfate surfactants, as candidates for chemical EOR applications. The mechanisms for Heavy oil recovery are combined effects of reduced interfacial tension (IFT), reduced mobility ratio, and wettability alteration with dilute 0.1 wt% surfactant solutions from Berea sandstone cores.

Wetting of solid substrates by liquids is a fundamental phenomenon with relevance to both the technological and natural worlds Wettability of solid-fluid-fluid interfacial phenomena is often characterized by measuring the contact angle formed between a liquid drop and a solid surface. This measurement is considered to be a relatively simple, useful, and sensitive tool for assessing hydrophobicity or hydrophilicity of a surface, surface heterogeneity, surface roughness, solid surface energy, liquid surface tension, and line tension, although this is not straightforward but posses several questions to researchers.

In this study the spreading the water and surfactant on sandstone solid surfaces by considering the contact angle as an expression of wettability of the liquid on a solid surface, but there are many different finding the contact angles, this study apply contact the contact angle as a measure to indicate the wettability. It gives more accurate indication to the wettability and the spreading of different liquids on different solid surfaces.

Prepare Surfactant Solution in the Synthetic Brine; surfactant solution was prepared in the synthetic brine at concentration of 1,000 ppm. Surfactant solution the synthetic brine was Shake very well for 10 minutes. Surfactant concentration solution is diluted to 1000 ppm was as the following:

1. Prepare surfactant solution in the synthetic brine: Weigh out 1.500 grams of surfactant (based on 100% pure, e.g. if one surfactant contains only 40 wt.% of active component, it needs 1.500 g/40 wt.% = 3.750 g) and put into a clean and dry bottle, add the prepared brine to total 300.000 grams. The surfactant concentration in the brine is 0.500 wt.%, or 5000 ppm. Put the bottles on a shaker to shake the solution for 24 hours to ensure the surfactant is completely dissolved in the brine.

2. Prepare surfactant solution in the synthetic brine at 1000 ppm: weigh out 40.000 grams of the above surfactant solution and put into a clean and dry bottle, then 160.000 grams of the synthetic brine to the bottle. Shake the bottle very well for 10 minutes. Surfactant concentration in this new solution is diluted to 1000 ppm.

Results and Discussion
IFT Measurement

In order to determine a chemical formula that could effectively disperse the heavy oil in aqueous solutions, numerous Surfactant and combinations screening tests were performed. The interfacial tension behavior of the heavy oil and brine at different chemical compositions was investigated. Table 4.1 provides the IFT measurement results, and indicates that all the dynamic IFT values are between 0.01 to 0.001mN/m with 1 wt. % compound Surfactant solution.

Figure 4.9 explains measurement of dynamic IFT at different concentration 10, 000, 5000, and 2000 PPM, respectively vs. IFT measurement demonstrate from table 4.1 the minimum IFT is chosen as the representative for next IFT measurement.

For each surfactant concentration, the IFT decreased with the surfactant concentration increased is shown in Fig. 4.9. The IFT reaches 0.06 dyne/cm at Igabel –co-530, 1 wt% concentration; low IFT has been achieved due to the low acid number of crude oil sample (J. Li, at el.,2003) . IFT values shown in Fig indicate that an optimum surfactant concentration at which the lowest IFT is obtained

The relationship between the IFT and Moloucer Structure were investigated and plotted in the Figures from 4.10 to 4.13 respectively. Tables 4.2 shows the surfactant name were plots THE Hydrophillic-Lipophillic Balance (HLB) is a concept for choosing emulsifiers. The value of HLB ranges from 1-20. Low HLB emulsifiers are soluble in oil while high HLB emulsifiers are soluble in water.

Bancroft's Rule: The type of emulsion (i.e. oil in water or water in oil) is dictated by the emulsifier and that the emulsifier should be soluble in the continuous phase. Low HLB emulsifier's are soluble in oil and give rise to water in oil emulsions. HLB method – HLB indicative of emulsification behavior, when the HLB 3-6, the W/O emulsion is created, when the HLB is 8-18, the O/W emulsion is formed.