Pressure Effect on Phase Behavior of Surfactant System

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Pressure Effect on Phase Behavior of Surfactant System

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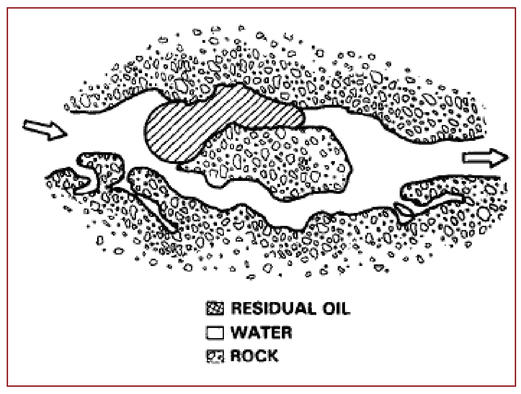
Introduction

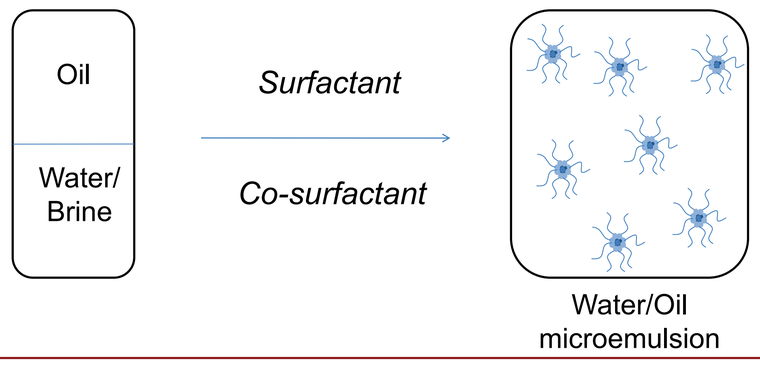
As more than 50 % of the crude oil is expected to remain trapped in many mature oil reservoirs, tertiary oil recovery techniques must be introduced to keep an efficient oil recovery. This is the so-called Enhanced Oil Recovery (EOR). Surfactant flooding is considered as a potential EOR technique, which basically is the injection of appropriate chemicals (surfactants) into the reservoir to lower the interfacial tension (IFT) to ultra low [1].



3.4 % NaCl 6.5 % NaCl 8.3 % NaCl

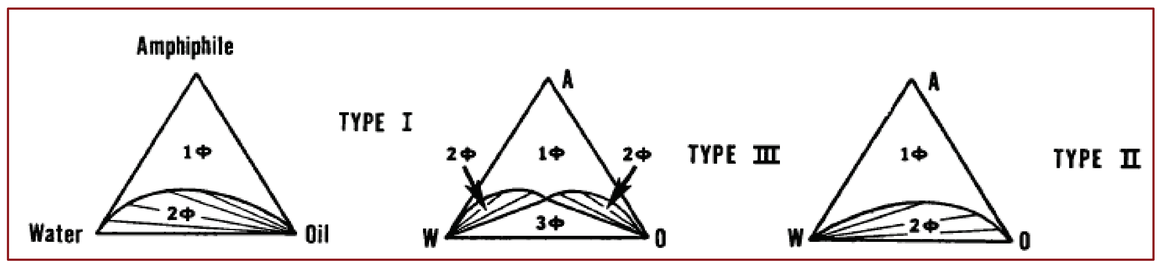
Surfactants help mobilizing the trapped crude oil leading to an increase in oil recovery.
The aim in this project is to study surfactant systems phase behavior at elevated pressures as there are no consensus whether pressure effects the formation of the desired three phase area. Several complex issues follows along, such as sensitivity to salinity, adsorption into the reservoir rock, etc.

Phase Behavior



- **Facts:**
  - An increase in temperature entails an increase in optimal salinity.
  - Effect of pressure is debatable .
- **Type of surfactant systems considered:**
  - Typically the so-called Winsor type system are used.

○ **Emulsions:** Formed in mixtures of liquids as droplets either as macroscopic or microscopic size. In surfactant flooding either water/oil or oil/water microemulsions are required, as the microemulsion reduces the IFT between oil and water.

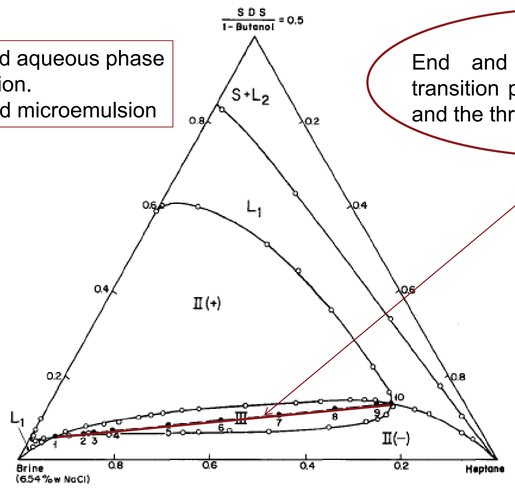


Experimental Work

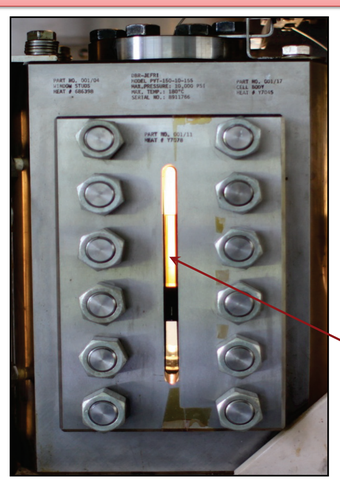
- **Surfactant system tested:**
  Sodium Dodecyl Sulphate/1-Butanol/Heptane/Water in Sodium Chloride [2].

- II(+) is microemulsion and aqueous phase
- III is the three phase-region.
- II(-) is the oleic phase and microemulsion

End and start point is at the transition points between the single- and the three-phase regions.



DBR JEFRI PVT cell



Window for measurements

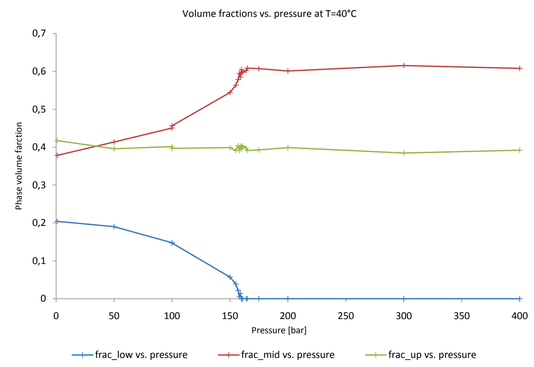
- **High pressure equipment:**
  - DBR JEFRI PVT cell
  - Allowing phase volume measurements through a window.
  - At a wide range of pressures and temperatures.

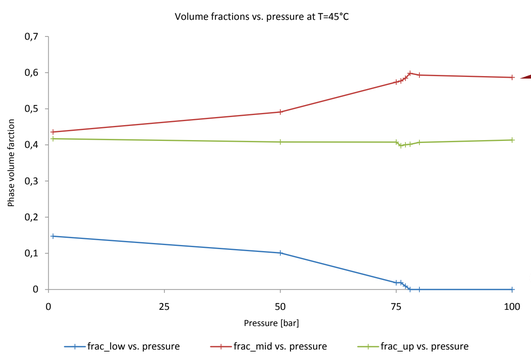
Results

Phase boundaries

#1: 2 phases at P=78 bar and T=45 ˚C
#2: 3 phases at P=50 bar and T=40 ˚C

All observations are reversible an reproduced





Changes from 3 to 2 phases dependent on the effect from increase in pressure.

The effect from pressure is enhanced with increas in temperature

Future Work

Further experimental study of the conditions for change in number of phases, thus presence of an microemulsion phase.

References

[1] B.M. O'Brian, Journal of Chemists' Society, (1982), 59, 839a-852s.
[2] J. Van Nieuwkoop and G. Snoei, Journal of Colloid and Interface Science, (1984), 103, 400-41

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