2) Surfactant flooding in EOR

In surfactant flooding, the chemical system contains surface active agents, surfactants which are polymeric molecules that lower IFT between the liquid surfactant solution & the residual oil. Surfactants adsorb on a surface or fluid/fluid interface when present at low concentrations. The most common structural form for surfactants is where they contain a nonpolar part, a hydrocarbon tail and a polar or ionic part. The structure is shown below:

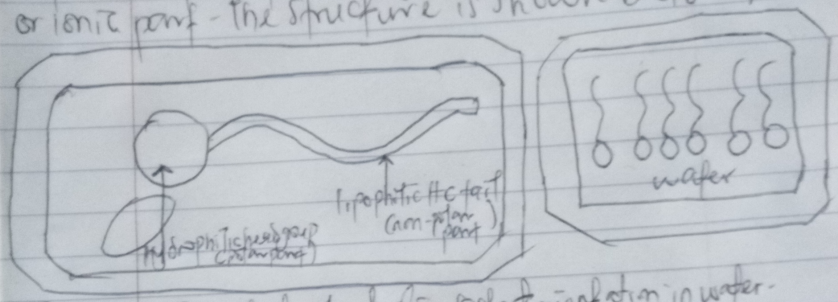

Fig showing Surfactant molecule & surfactant orientation in water.

Surfactants are also referred to as amphiphile molecules because they contain a nonpolar tail & a polar headgroup within the same molecule.

It is the balance btw the hydrophilic & hydrophobic parts of a surfactant that generates the characteristics of the surface active agent. In EOR with surfactant flooding the hydrophilic head interacts with water molecules and the hydrophobic tail interacts with residual oil. Thus surfactants can form water-in-oil or oil-in-water emulsions.

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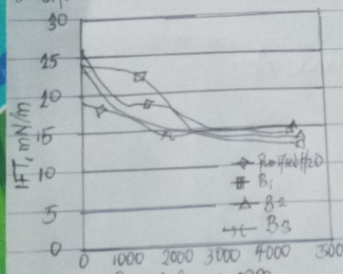
ASSIGNMENT

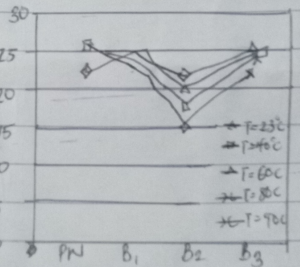
① Salinity play important roles in surfactants system. Discuss (Diagrams inclusive)

The Effect of Salinity on Surfactants System

Surfactants solutions are prepared by diluting the chemicals in pure water and different 10% brines of different conc. of NaCl and CaCl2. The effect of surfactants concentration on Interfacial tension (IFT) measurements in presence of different brine compositions is displayed in the figures below which show a plot of measured IFT values for zonyl FSE and Triton X-405 solutions at different conc. of ssr conditions of 2,000psi (13.79 mpa) & 60°C. Triton x-100 was immiscible at that temperature. The figures indicate exponential IFT decline with increase of conc. but with relatively more drop in IFT values in presence of salt in solution. This effect is favourable for surfactant flooding, suggesting Triton X-405 to be more efficient for chemical flooding at ssr conditions of pressure, temp & salinity conditions.



Effect of salinity on IFT for Crude oil Zonyl FSE diluted in different brines at 2,000psi and 60°C



Effect of brine salinity composition on IFT at variable temperature

Salinity is one of the factors that influence surfactant adsorption. The most commonly used surfactants in chemical EOR are anionic surfactants. These surfactants are strongly influenced by adsorption on rock surfaces due to the presence of salt and divalent cations. Thus, it is a challenge to design surfactant formulations that are salinity & hardness resistant. High salinity water is not desirable for anionic surfactant due to salt precipitate resulting from the interaction btw salt ions and surfactant on the other hand increasing the salinity will reduce the repulsive forces arising btw the anionic surfactant molecules & the rock surface. Salinity has also an impact on non-ionic surfactants which it can change its solubility, surface activity, & adsorption at solid-liquid interface.