Application of Nanofiltration for adjusting seawater ionic composition for enhanced oil recovery

Nanofiltration (NF) is a relatively new technique among all pressure-driven membrane separation technologies, being currently used for water treatment, seawater desalination, solvent recovery and removal of solutes from complex process streams. The selective ions permeation through nanofiltration (NF) membranes is the rationale of its application in different fields. In the offshore oil prospecting, Nanofiltration (NF) membranes have been currently used to remove sulfate from seawater. In this work, NF membranes were employed to adjust ionic composition of sweater for water injection. Water ionic composition significantly influences reservoir wettability and hence microscopic oil sweep. Then, the effect of sweater ionic composition modified by NF on enhanced oil recovery in Berea sandstone was evaluated. These effects were examinated by interfacial tension (IFT) of water/crude oil, zeta potential and contact angle (CA) at water/crude oil/rock interface was evaluated to identify changes in wettability and also to relate with spontaneous imbibition experiments. The results demonstrate that it is possible to improve the oil recovery efficiency by controlling the injection water salinity using NF process. Increased water salinity resulted in lower electrokinetic potential near the sandstone surface, approaching null values, suggesting adsorption of cations. The oil droplet interface also was affected in a similar way. Furthermore, in the presence of low salinity water, both rock and oil zeta potential was negative, which leads the electrical double layer (EDL) expansion, changing wettability and intensifying spontaneous imbibition.