A comparative study of surfactant adsorption by clay minerals

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The adsorption of surfactants from aqueous solutions in porous media is essential in enhanced oil recovery (EOR) from oil reservoirs. Surfactant loss that is due to adsorption by the reservoir rocks weakens the efficiency of the chemical slurry that is injected and decreases the oil–water interfacial tension (IFT). This project investigated the effect of the mineralogical composition of adsorbents on adsorption. This research was primarily focused on the experimental study of the adsorption quantity of a single surfactant by adsorbents with various mineralogical compositions in static conditions. The experiments were conducted in batches. The adsorbents were composed of various combinations of quartz sand and clay minerals at various percentages and were exposed to nonionic and anionic surfactants. The amount of the adsorbed surfactant was quantified by subtracting the concentration of surfactants after adsorption from the initial concentration. A direct relationship observed between the adsorption of the nonionic surfactant and the amount of the clay mineral in the adsorbents. Moreover, the amount of the surfactant that was adsorbed by the adsorbents increased when the percentage of the clay mineral in adsorbents increased (from 5% to 20% in the mixture). The rank order of adsorption power of clay minerals for the nonionic surfactant was montmorillonite >> illite > kaolinite. The adsorption of the anionic surfactant by all adsorbents was negligible. The results of this study will provide additional insight into the feasibility of surfactant–enhanced flushing for reservoir rock (e.g. sandstone) systems and supply valuable information for the development of effective and safe surfactant–EOR technologies.

Keywords: adsorption; reservoir rock mineral; clay minerals; anionic surfactant; nonionic surfactants