World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:17, No:10, 2023

Influence of the Adsorption of Anionic–Nonionic Surfactants/Silica Nanoparticles Mixture on Clay Rock Minerals in Chemical Enhanced Oil Recovery

Authors : C. Mendoza Ramírez, M. Gambús Ordaz, R. Mercado Ojeda.

Abstract : Chemical solutions flooding with surfactants, based on their property of reducing the interfacial tension between crude oil and water, is a potential application of chemical enhanced oil recovery (CEOR), however, the high-rate retention of surfactants associated with adsorption in the porous medium and the complexity of the mineralogical composition of the reservoir rock generates a limitation in the efficiency of displacement of crude oil. This study evaluates the effect of the concentration of a mixture of anionic-non-ionic surfactants with silica nanoparticles, in a rock sample composed of 25.14% clay minerals of the kaolinite, chlorite, halloysite and montmorillonite type, according to the results of X-Ray Diffraction analysis and Scanning Electron Spectrometry (XRD and SEM, respectively). The amount of the surfactant mixture adsorbed on the clay rock minerals was analyzed from the construction of its calibration curve and the 4-Region Isotherm Model in a UV-Visible spectroscopy. The adsorption rate of the surfactant in the clay rock averages 32% across all concentrations, influenced by the presence of the surface area of the substrate with a value of 1.6 m2/g and by the mineralogical composition of the clay that increases the cation exchange capacity (CEC). In addition, on Region I and II a final concentration measurement is not evident in the UV-VIS, due to its ionic nature, its high affinity with the clay rock and its low concentration. Finally, for potential CEOR applications, the adsorption of these mixed surfactant systems is considered due to their industrial relevance and it is concluded that it is possible to use concentrations in Region III and IV; initially the adsorption has an increasing slope and then reaches zero in the equilibrium where interfacial tension values are reached in the order of x10-1 mN/m.

Keywords : anionic–nonionic surfactants, clay rock, adsorption, 4-region isotherm model, cation exchange capacity, critical micelle concentration, enhanced oil recovery
Conference Title : ICPNGE 2023 : International Conference on Petroleum and Natural Gas Engineering
Conference Location : Barcelona, Spain
Conference Dates : October 23-24, 2023