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Full Length Article

Interfacial tension reduction of hybrid crude-oil/mutual-solvent systems under the influence of water salinity, temperature and green SiO_2/KCl/Xanthan nanocomposites

Fatemeh Motraghi [a], Abbas Khaksar Manshad [a] ✉, Majid Akbari [a], Jagar A. Ali [b c], S. Mohammad Sajadi [d], Stefan Iglauer [e f], Alireza Keshavarz [e f]

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Abstract

In order to maximize oil recovery, combined enhanced oil recovery (EOR) methods can be used, which benefit from several mechanisms simultaneously. The application of nanotechnology and mutual solvents were studied separately in recent years. Mutual solvents have the ability to dissolve in both aqueous and oil phases and can show similar performance to surfactants in the water–oil interface. In this study, the effect of ethanol and methyl ethyl ketone solvents with and without a new nanocomposite on the reduction of interfacial tension (IFT) as a mechanism of the main EOR has been examined. The addition of these solvents to nanofluids is a new strategy that enhances the reactions at the interface of the two phases and improves the performance of the IFT mechanism. Also, diluted formation water samples were used as the simplest and most accessible smart water and synergistic effects on the system were investigated. Mutual solvents were tested at 5, 10, and 15% by volume with and without nanocomposite at 25, 50 and 75°C. In this way, different parameters of salinity, temperature, different concentrations of solvents and nanocomposite on IFT reduction were investigated. According to the results, each of these processes separately has positive effects in reducing IFT. But the combination of smart water - mutual solvent - nanocomposite showed the best effect in reducing IFT. The addition of solvents to water and nanofluids has a good potential to reduce IFT in reservoirs with high temperature and high salinity conditions. The optimum concentration of nanocomposite in the presence and absence of solvent was 1000ppm, which shows that the optimum concentration NCs for IFT reduction is not affected by the presence of the solvent. But adding solvent to different concentrations of nanofluid has positive effects in reducing IFT. In general, methyl ethyl ketone has a stronger effect on reducing IFT than ethanol. Finally, the minimum IFT was observed for a mixture of 1000ppm nanocomposite and 15% methyl ethyl ketone with 50% formation water as the base fluid at the temperature of 75°C.