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Studies on alkyl polypropoxy sulfate surfactants for SP/SSP flooding

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Abstract

ASP chemical combination flooding field tests showed that chemical combination flooding can remarkably increase oil recovery for high water cut oilfields in China. The major problem of alkali-surfactant-polymer (ASP) flooding technique was the difficulties of lifting and produced liquid treatment process due to scaling and emulsification caused by alkali. In order to avoid the side effect caused by strong alkali, the tendency of chemical combination flooding changes from strong alkali ASP flooding to weak alkali ASP flooding and alkali-free surfactant-polymer (SP) flooding. The challenge in the weak alkali ASP flooding/SP flooding technique is to develop surfactants with strong interfacial tension reducing ability, good oil displacing ability and low cost.

This article relates the preparation, interfacial properties and oil displacement experiments of lab-synthesized alkyl polypropoxy surfate surfactants for SP/salt-surfactant-polymer(SSP) flooding.

Series of alkyl polypropoxy surfate surfactants were synthesized. The interfacial tension (IFT) measurements of both model oil/water and crude oil/formation water indicated that the difference of molecular structure of surfactants such as length of carbon chain affected IFT greatly. The formula of SP/SSP system was selected for KS crude oil and Karamay crude oil. The IFT measurements showed that ultralow IFT between crude oil and SP/SSP displacing fluid could be obtained at the concentration range of surfactants from 0.1wt% to 0.3wt% and NaCl from 0.0wt% to 0.6wt%. The dynamic adsorption experiments showed that adsorption loss of surfactant APOS-1 on the core was about 0.37 mg/g sand. Core flooding experiments of SP/SSP combination flooding showed that the oil recovery for SP/SSP flooding could reach 66.7-68.7%(OOIP) which was about 17-18% higher than that of the conventional water flooding.

The synthetic process of alkyl polypropoxy surfate is simple and the cost is low. It has potential to be applied in chemical combination flooding even under high salt reservoir conditions.