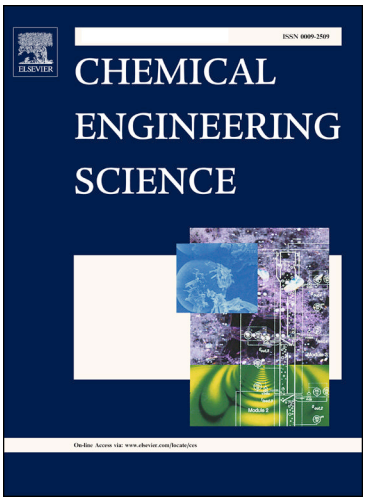

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Experimental study on the effect of interfacial tension on the conformance control of oil-in-water emulsions in heterogeneous oil sands reservoirs

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Abstract: Reservoir heterogeneity is a serious problem for many mature oilfields. Due to heterogeneity, much of the displacing fluid may flow into the high permeability zones in the formation, leaving most of the low permeability areas un-swept, which leads to high water production and low oil recovery. In this work, oil-in-water (O/W) emulsions were used as conformance control agents to reduce fluid flow of the high permeability zones in heterogeneous oil sands reservoirs. As well, for the first time, interfacial tension (IFT) effect on emulsion conformance control performance was studied. Emulsification tests were first performed to screen suitable emulsifiers which could be used to prepare stable O/W emulsions with different IFTs. Physiochemical properties of the emulsions were investigated by characterization tests in terms of their stability behavior, droplet size distribution and rheological properties.

A series of heterogeneous parallel, dual-sandpack flow experiments were carried out to evaluate the profile control ability of emulsions with different IFTs of 0.04, 0.15, 0.92 and 5.20 mN/m in heterogeneous oil sands reservoirs. The results show that for the dual-sandpack models used in this study, emulsion conformance control performance gets better as IFT decreases from 5.20 mN/m to 0.15 mN/m, but it becomes worse as IFT further decreases to 0.04 mN/m. The fractional flow of the heterogeneous dual-sandpack diverts only once when flooded by an emulsion with an IFT of 5.20 mN/m. Emulsion with an IFT of 0.92 mN/m causes several flow diversions in the emulsion injection process, but the profile control ability could be destroyed by the flood of water. Emulsion with an IFT of 0.15 mN/m has good conformance control performance both at the emulsion flooding and subsequent water flooding stages, while emulsion with the least IFT of 0.04 mN/m shows very little profile control effect. The effect of emulsion slug size and sandpack permeability ratio on emulsion conformance control ability are also discussed in this paper.

Key words: oil-in-water emulsion, interfacial tension, heterogeneous reservoir, conformance control.

1. Introduction

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