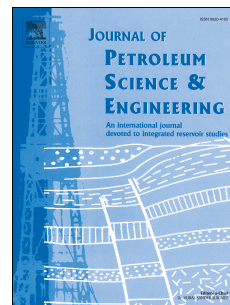


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Abstract

The synergy between various enhanced oil recovery (EOR) processes has always been raised as a potential optimization route for achieving a more economic and effective EOR application. In previous work, beside the established positive impact of SmartWater on polymer rheology, we have demonstrated polymer positive impact on SmartWater effects through measurements of surface potential and contact angles. The results were also supported by forced oil-displacement experiments. In this work, we further investigate this SmartWater/Polymer synergy focusing on the possible impact of SmartWater on polymer floods specifically polymer injectivity, retention and acceleration. For this purpose, a set of thoroughly designed single-phase displacement experiments were performed at reservoir conditions. Many of the observed effects of SmartWater on polymer injectivity and transport can be attributed to polymer coil expansion in the lower-salinity SmartWater. The results mainly demonstrate that SmartWater has: (1) a slight negative impact on both polymer and chase water injectivity, (2) a positive impact on polymer retention, and (3) a negligible impact on polymer, hence oil bank, acceleration. Given the minor negative impact on injectivity, we conclude that SmartWater/Polymer flooding exhibits an overall favorable synergy that reduces chemical consumption, improves sweep, and enhance recovery.

Introduction

Polymer flooding processes can be considered as one of the very matured EOR technologies and they are typically classified under chemical EOR category. These processes involve the addition of polymer to the injection water to increase the aqueous phase viscosity thereby lowering the water-oil mobility ratio during the displacement. The favorable mobility ratio reduces viscous fingering/channeling and hence improves both the vertical as well as areal sweep efficiencies in the reservoir. Polymer addition to the injection water also reduces reservoir rock permeability to favorably impact fractional oil flow for oil recovery (Pye 1964, Jennings et al. 1971). This technology has been applied successfully in the field with incremental oil recoveries ranging from 5 to 15% of original oil in place (Wang et al, 2002, Chang et al. 2006).

There are several studies reported in the literature to provide good reviews on the successful polymer EOR projects (Jewett and Schurtz 1970, Chang 1978, Needham and Doe 1987, Chang et al. 2006, Sheng 2015). Jewett and Schurtz (1970) summarized 61 past polymer flooding field projects and these data showed the applicability of polymer flooding processes for oil viscosities less than 126 mPa.s and reservoir temperatures as high as 110°C. Chang (1978) and Taber et al. (1997a, 1997b) developed the

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