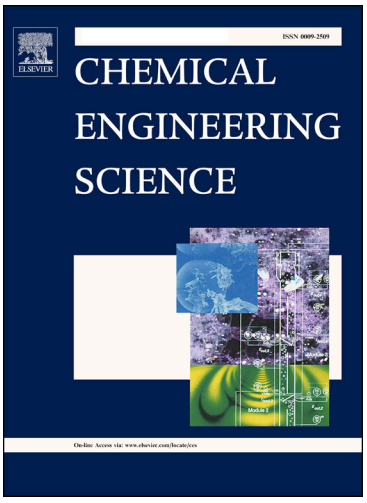

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Polymers and Polymer-Based Gelants for Improved Oil Recovery and Water Control in Naturally Fractured Chalk Formations

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ABSTRACT

Polymers and polymer-based gels are used in the oil industry to improve the oil displacement efficiency and address unwanted fluids (water and/or gas) production, respectively. In this work, existing commercial polymer and polymer-based chemicals are screened and evaluated in the laboratory for water management and enhanced oil recovery applications in naturally fractured carbonate (chalk) reservoirs. Several bulk- and core-based testing techniques are used to achieve this goal with the selected chemicals undergone thorough investigation of their filterability, injectivity, gelation time, gel strength, gel shrinkage, and impact on oil production. Injection of high and low molecular weight hydrolyzed polyacrylamide (HPAM) polymers into fractured-porous cores does not hinder the oil production mechanism in chalk formations yielding a lower oil recovery rate but comparable ultimate recoveries with water injection. The environmental friendly Polymer B gelant is "inconsistent" related to the formation of gel; when it gels, the quality of the formed gel is poor and provide no resistance to a post-treatment water injection. The non-environmentally friendly Polymer A gelant worked consistently concerning gelation and yielded good quality, strong gels that can withstand post-treatment applied pressures during water injection.

INTRODUCTION

Water injection is traditionally used in the oil industry to sweep reservoir oil from an injection to a production well while maintaining sufficiently high average reservoir pressures. Polymer flooding is a well-known method to improve the oil recovery. Small amounts of high molecular weight polymers added to the injected water improves the injected fluid mobility and oil reservoir sweep efficiency, mainly by increasing the water viscosity. Some of the injected polymer will adsorb on the rock surface or be retained in the pores thus yielding reduced formation permeability (Sorbie, 1991; Lake et al., 2014; Green and Willhite, 2018). The permeability reduction is phase selective and water-based polymers reduce the water permeability more than the oil permeability; this forms the basis for Disproportionate Permeability Reduction (DPR).

Water flooding of naturally fractured carbonate (NFC) formations always poses several challenges related to formation sweep, oil recovery efficiency and rate of extraction from matrix blocks, and water management. The presence of natural fractures can decrease formation sweep, delays oil recovery rates, and often yields high injector/producer conductive paths which increase produced watercuts with