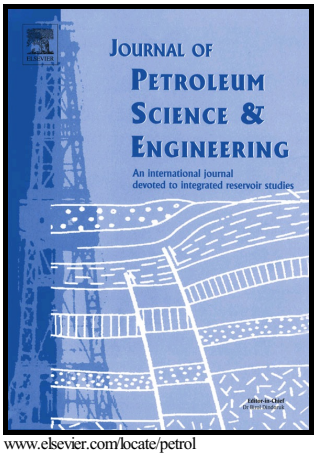

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Impacts of Physical Phenomena on Polymer Flooding Projects

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Abstract

Polymer flooding is a mature EOR technique implemented in many successful field projects. Understanding its mechanisms is very important to manage field operations. From an oil recovery perspective, better results are achieved when more polymer is injected. In field scale, however, the optimization processes usually considers economic indicators, such as net present value (NPV) as objective function so polymer costs are included in the decision process. Several commercial and in-house simulators have the capability to model polymer flooding for the optimization purposes. In this paper, we study the numerical representation of polymer retention and the reversibility, inaccessible pore volume, viscosity vs. polymer concentration, salinity, permeability reduction, non-Newtonian behavior and degradation. We first tested these models in simple benchmark cases, and then applied them to two synthetic field cases. The goal is to understand the impact of each polymer property on field performance indicators, especially NPV. Both fields have high average permeability with heavy oil (~14^{o} API) with characteristics of target oil fields in Brazil. The optimization resulted in polymer injection of 5% and 35% of pore volumes. Retention of polymer, salinity, polymer rheology and degradation all decrease NPV as high as 25% compared to the tests without the consideration of these phenomena. Permeability reduction, adsorption reversibility, inaccessible pore volume and dependence of viscosity on concentration have influenced NPV by less than 3%. Knowing the impacts of the polymer properties helps with the decision for key laboratory tests and reducing uncertainties associated with each. This information also helps on the selection of simulation models and key sensitivity parameters where unimportant parameters can be neglected in simulation studies.

Keywords

Reservoir Engineering, Polymer Flooding, Reservoir Simulation, Enhanced Oil Recovery

1. Introduction

Polymer flooding is a chemical EOR technique where polymer is added to the injection water to increase viscosity and decrease the mobility ratio. In field scale, the optimization usually considers economic indicators, such as net present value (NPV) as objective function so polymer costs are included in the decision demanding optimization of amount of polymer and slug sizes. Values as low as 5 to 10% of pore volumes can be used in practical cases. Different physical phenomena take place in this method, such as molecules adsorption, permeability reduction and viscoelastic behavior of solution.