Experimental investigation of physical dispersion and in-situ mixing during low salinity waterflooding

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Introduction

Low salinity waterflooding (LSWF) as an enhanced waterflooding technique is applicable in secondary and/or tertiary oil production. As a cost-effective method, the required amount of low-saline brine (LS) affects the efficiency of the process. Although the theoretical background of mixing during low salinity waterflooding has been developed many years ago, underestimating the impact of these phenomena have resulted in unsuccessful field applications of LSWF.

Problem Statement

The performance of LSWF depends on different factors including reservoir heterogeneity, the volume of injected brine, its salinity and in-situ mixing. If the injected volume of LS is not high enough, the expected efficiency of the LSWF will be reduced or even vanished. Consequently, more accurate estimation of the required volume of LS is crucial to guarantee the performance of LSWF.

Mixing is intensified due to adverse mobility ratio at low salinity - high salinity (HS) front. This research focuses on the impact of salinity injection and resident brine (salinity gradient) on physical dispersion through single-phase (miscible) tests.

Methodology

A systematic series of single-phase sandpack tests were performed. In this manner, the sandpack was initially saturated with HS and flooded with LS, afterward. Consequently, the initially uniform salt distribution in the sandpack was altered gradually, leading to development of salinity gradient and mixing zone in the sandpack. The salinity of the effluent brine was measured as a function of injected pore volume (Fig. 1). A coherent analytical approach was then carried out to estimate the length of mixing zone with respect to Peclet number and dispersion.

Summary of the Results

Table 1: Results of sandpack tests

<table>
<thead>
<tr>
<th>HS (ppm)</th>
<th>LS (ppm)</th>
<th>Salinity Difference (ppm)</th>
<th>Dispersivity (ft)</th>
<th>Peclet Number</th>
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References