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ORIGINAL ARTICLE

Scaling simulation resulting from mixing predicted model between Mishrif formation water and different waters injection in Basrah oil field, southern Iraq

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Abstract Dependable scale prediction is of critical importance in the selection of suitable injection water and the development of an effective scale management strategy. The present study focuses on the Mishrif reservoir in the West Qurna oilfield. In this reservoir, we use compositional modeling to understand the interplay between multiphase flow, phase behavior, and geochemical reactions under reservoir and injection conditions relevant to the field. The numerical model PHREEQC was used to simulate the compatibility between Mishrif formation water with three various kinds of surface waters: Sea Water (SW), Euphrates River Water (ERW), and the Main Outfall Drain Water (MODW), and predict the amount of possible scaling results from the mixing of different ratios under reservoir conditions. The chemical compositions of the Mishrif waters are classified as Brine water due to the high value of Ca^{2+} and Na^{2+} concentration. The waters from the sea, Main Drain Outfall, and the Euphrates River are classified as slightly Brackish waters. All the studied water samples were classified as sodium chloride type (NaCl) due to the increase of evaporation processes, aside from agricultural and domestic activities. The hydrogeochemical facies of the present water samples are fall in NaCl, except in the Mishrif formation water, which is located between NaCl and MixCaMgCl. Scaling prediction models of mixing show that calcium carbonate ($CaCO_3$) and Barite ($BaSO_4$) is expected to cause serious problems in the Mishrif reservoir when all types of waters mix in different ratios in the absence of scale inhibitors, whereas the model results revealed no problems in Celestite, Aragonite, and Strontianite scales due to their minor precipitation behavior through mixing. Gypsum, Sederite, and Anhydrite tend to dissolve when mixing all types of surface waters in different ratios because of a low saturation index. The simulation results show that the best ratios to mix sea water is 90–10% formation water, all ratios to mix Main Drain Outfall water, and 70–30 and 90–10% when mixing Euphrates River water with Mishrif formation water. Chemical inhibitions treatment preferred to be implemented to reduce the carbonate scales during/after water flooding.

Keywords Waterflooding · Scaling · Basra oilfield · Mishrif formation · Saturation ration, Iraq

Introduction

Water flooding is one of the choice methods used to enhance and increase oil production from the oil/gas reservoirs to support reservoir pressure (Jreou 2012), and/or to push oil towards the producer well. However, a new method for waterflood injection is being established. Injection water with significantly lower salinity or presence of ions than sea water or surface water has been shown to have beneficial effects on oil recovery (Morrow and Buckley 2011). The problem associated with dissolved undesirable minerals and gas in the water injection that affected this method (Erany 2016).

The mineralogy problem is usually caused by chemical reactions of the water injection with the sensitive clay, which swells or becomes dislodged and blocks the reservoir pores. Water quality can be affected by several types of contaminants, including suspended solids, scale, bacteria, corrosion products, and marine organisms. Chemical and biological analyses can provide a useful indicator of future

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