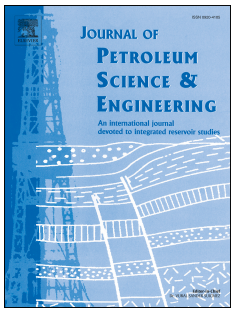
Accepted Manuscript



Increasing efficiency of calcium sulfate scale prevention using a new mixture of phosphonate scale inhibitors during waterflooding

Azizollah Khormali, Anar R. Sharifov, Dmitry I. Torba

PII: S0920-4105(18)30067-6

DOI: 10.1016/j.petrol.2018.01.055

Reference: PETROL 4642

To appear in: *Journal of Petroleum Science and Engineering*

Received Date: 5 November 2017

Revised Date: 2 January 2018

Accepted Date: 27 January 2018

Please cite this article as: Khormali, A., Sharifov, A.R., Torba, D.I., Increasing efficiency of calcium sulfate scale prevention using a new mixture of phosphonate scale inhibitors during waterflooding, *Journal of Petroleum Science and Engineering* (2018), doi: 10.1016/j.petrol.2018.01.055.

Increasing efficiency of calcium sulfate scale prevention using a new mixture of phosphonate scale inhibitors during waterflooding

Azizollah Khormali*, Anar R. Sharifov, Dmitry I. Torba
199106, 2, 21st liniya, Vasilevskiy Ostrov, Saint Petersburg Mining University, Saint Petersburg, Russia
*E-mail: Aziz.khormaly.put@gmail.com
Phone: +79111443828

Abstract

Inorganic salt precipitation is one of the main problems in oilfield operations. Different factors affect scale formation and inhibition. Calcium sulfate scale formation occurs during waterflooding due to incompatibility of injection and formation waters. In this work, synthetic formation and injection waters were prepared to determine the influence of reservoir conditions (temperature and pressure), and mixing ratio of the waters on calcium sulfate scale deposition during waterflooding. A new mixture of phosphonate scale inhibitors (SI) was developed for increasing the inhibition efficiency of calcium sulfate scale formation in oil reservoirs. The developed mixture consists of three different industrial phosphonate SI and some additives. The concentrations of components of the developed mixture of phosphonate SI were determined on the basis of a synergistic inhibition effect. The maximum value of the synergistic inhibition effect was about 1.091. Performance of the developed mixture and four different industrial SI (HEDP, ATMP, PPCA and DTPMP) was determined by jar test. The experimental results showed that the developed mixture of phosphonate SI has a better inhibition performance than the industrial inhibitors under any conditions. Its effectiveness was more than 90% at any reservoir temperature (60-120 °C) and content of formation water in the solution (10-90%). Furthermore, a minimum inhibitory concentration of the developed mixture of phosphonate SI was about 25 mg/L. Moreover, formation damage due to calcium sulfate precipitation in carbonate rock samples with and without the use of scale inhibitors was investigated. Without the addition of any SI, the damaged permeability was about 58% of the initial rock permeability. The damaged permeability in the presence of the developed mixture of phosphonate SI was about 93.5% of the initial permeability of the used rock samples. Also, a new correlation was developed for predicting a permeability reduction of the rock samples due to calcium sulfate precipitation. The coefficient of determination between experimental and predicted (form correlation) data was 0.99. In addition, the developed mixture of phosphonate SI had the enhanced adsorption/desorption capacities. Its squeeze lifetime was longer up to 22.6% than other inhibitors. The corrosion rate in the solution of the developed mixture of phosphonate SI was lower than 0.063 mm/y at any concentration.

Keywords:

Calcium sulfate; Formation damage; Scale inhibitor; Synergistic inhibition effect; Waterflooding.