Improving the Conductivity of Tar-Mat Formation Using Chemical Injection Approach

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Abstract

The presence of tar mats at the oil-water contact (OWC tar mats) can induce enormous problems affecting the productivity of the wells. It can limit the performance of natural water drive and water flooding operations. Different approaches are used to treat the tar mats and improve the formation productivity. This work aims to introduce a new acid system that can destabilize the tar mats and dissolve the asphaltenic leading to permeability enhancement of tar mat formations.

In this study, the impact of acid treatment on the geomechanical properties of tar mats and the influence of tar content and distribution on the formation productivity were examined. The proposed acid system consists of HCl, chelating agents, and thermochemical fluids. The acid performance was examined on different rock types including tight carbonate and sandstone. The experimental work includes NMR, CT-scan, Helium porosimeter, gas permeameter, geomechanical measurements, and chemical flooding experiments.

First, the rock samples were characterized to identify the petrophysical properties, mineral composition, and pore size distributions. Then, compatibility analysis was conducted for the acid/thermochemical/tar system utilizing the HPHT cell. The tar dissolution and precipitation were investigated at different acid concentrations and pH. Afterward, a coreflooding experiment utilizing an acid system was performed. The formation conductivity was assessed before and after the treatment, based on the pressure drop profiles and the acid injection rates. Finally, the changes in tar-mats geomechanical properties were evaluated using a scratch test machine.

The proposed acid system showed a significant improvement in the tar mat conductivity. The absolute permeability was increased by 180 times as a result of the treatment. Results showed that HCl and chelating agents were able to destabilize the integrity of the tar mat, while thermochemical fluids excited the reaction by generating elevated temperature and pressure. In addition, the in-situ generated pressure induced tiny fractures within the rock sample, which improved the penetration of injected acid through the tar mat formation. All measurements confirmed that the treated samples have higher permeability and enhanced pore connectivity.

The novelty of this work is developing a new chemical treatment to improve the conductivity of tar mat formations. The proposed acid system showed attractive performance and can be applied for field treatments to enhance the performance of water injection operations by improving reservoir connectivity.