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Chemical EOR In Carbonates - Reservoir Analogs For Core Flood Experiments

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Summary

Core flood experiments under reservoir conditions are a sensible step between laboratory trials and field tests. An evaluation cycle of suitable surfactants for enhanced oil recovery (EOR) from defined carbonate reservoirs in Middle East (high temperature, high salinity) is demonstrated: reservoir and analog characterization, flooding experiments on selected analogs and finally, test of selected surfactants and original Middle East core material.

One appropriate option to close the gap between conventional core analysis, chemical lab trials and surfactant injection tests in the field are core flood experiments under reservoir conditions.

The evaluation cycle of suitable surfactants for enhanced oil recovery (EOR) from defined carbonate reservoirs in Middle East (high temperature, high salinity) included as a first step identification of suitable reservoir analogs and their property characterization. Injection and flooding experiments on selected analogs constituted the secondary stage. As a third step, same set-ups were tested with a by then narrowed down selection of surfactants and original Middle East reservoir core material. During all steps, original crude oil was used.

Using analog rock was necessary since original core material was limited and experimental standardization was greatly enhanced by well-defined analog material. Furthermore, the employed analog outcrop rocks included no residuals in their pores. Thus, cleaning as well as flooding procedures did benefit from that.

In preparation of testing surfactants for EOR in certain Middle East carbonates, different reservoir analogs that covered all known major reservoir rock types of a pre-selected reservoir, have been characterized via petrographic description and conventional core analysis. This was later enhanced by analysis of wettability and capillary pressure. Formulations of chemicals were tested in parallel, considering the given reservoir conditions and demand towards surfactant stability.

The resulting dataset enabled to judge suitability of the single analogs mainly regarding mineralogy, facies, porosity, permeability and pore network characteristics. One analog rock was in the end chosen (representing one reservoir rock type) and used for first fluid flow experiments. These were conducted with a tailormade experimental core flood setup. Comparing the outcomes of these flooding trials and of ongoing chemical lab analysis (formulations series), further supported a more realistic approximation towards the original system. This approach was later iterated for the other relevant reservoir rock type analogs.

Subsequent core flood experiments were then conducted using original Middle East reservoir core samples and the tested, now fit-for-purpose surfactants. These tests of multiphase flow behavior, chemical effectiveness and improvement of recovery rates are the for now last step towards dynamic simulation and field tests.