Pore Structure Impact on Polymer Retention in Carbonate Cores

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Abstract. Polymer flooding can significantly improve oil recovery by increasing the injection water viscosity, hence reducing the displacing front mobility and improving the sweep efficiency. One of the major concerns in determining the feasibility of a polymer flooding project is polymer retention which is attributed to physical surface adsorption, mechanical entrapment and hydrodynamic retention. A clear understanding of the magnitude and significance of these interactions and effects for carbonates is still lacking.

In this study, we investigate the impact of pore structure on the retention of a polyacrylamide polymer in carbonates. Reservoir carbonate core samples are characterized through X-ray diffraction (XRD), nuclear magnetic resonance (NMR) and BET (Brunauer, Emmett, and Teller) surface area measurements. Polymer retention in these cores are evaluated by coreflooding experiments at reservoir conditions. The effluent polymer concentrations were analyzed by total organic carbon (TOC) method for determining polymer retentions.

Results show that the studied polymer exhibits dynamic retention in carbonates ranges from 0.155 to 0.530 mg/g-rock, and polymer inaccessible pore volume ranges from 15.2 to 20.9 % polymer volume (PV) of the studied core samples. XRD results reveal that the core samples consist mainly of calcite, with a small amount of dolomite, anhydrite and quartz, and there is no clay minerals. NMR results show that all the studied cores exhibit similar bi-modal pore size distribution, indicating they belong to a same rock type. Among the varied pore characteristics, surface area plays the most important role in polymer retention. A close relationship between polymer retention and surface area is observed. Core samples with larger BET surface area exhibit larger amount of polymer retention. Results also show tighter core sample tends to have larger value of inaccessible pore volume. This study indicates that physical surface adsorption is the main retention mechanism, and in the absence of clay minerals, surface area is a governing impact factor on polymer retention.

The results in this work help to gain insight into the interactions between the transported polymer and the carbonate pore characteristics. The governing influencing factors on polymer retention and inaccessible pore volume are investigated. This study demonstrates the potential of the studied polymer for carbonate reservoir application, as well as providing essential data for designing and evaluating polymer flooding in carbonates.