

WETTABILITY EVALUATION OF A CARBONATE RESERVOIR ROCK

Pierre M. Lichaa, Hayri Alpustun, Jasper H. Abdul, Wasef A. Nofal and Alhasan B. Fuseni
Research Institute
King Fahd University of Petroleum and Minerals
Dhahran, Saudi Arabia

Abstract Recent studies have shown that carbonate reservoir rocks from the Middle East are generally neutral, mixed, or preferentially oil-wet. Wettability changes during stages of "preserved as received", cleaned, and restored were evaluated by the USBM and Amott methods. Contact angle measurements were also evaluated on calcite and marble surfaces for comparison purposes. Rock/fluid interaction was studied by determining rock composition, brine and oil chemistry, and zeta potential. The wettability was intermediate in nature regardless of the stage during which it was tested. The results showed that the rocks were neutral to slightly oil-wet in the "preserved as received" state, neutral to very weakly water-wet after cleaning with long and tedious procedures, and remained neutral to slightly oil-wet in the restored state. A technique was developed, and the preliminary results obtained indicate the possible existence of a mixed-wettability system for the reservoir. A core cleaning technique using steam was utilized which proved to be at least as effective as the currently used solvents, such as methylene chloride, chloroform, pyridine, tetrahydrofuran, and chloroform/methanol azeotrope. Moreover, it is less expensive and much less hazardous to

work with. The results showed that it was impossible to achieve a strongly water-wet condition for these cores. The chemistry of the crude oil, formation and preserving brines, and rock surface properties support the findings of an intermediate wettability state.

The experience gained from this investigation reinforced the need for better understanding of the mechanisms of rock/fluid interactions and wettability at the pore level, or improvement to existing methods especially for carbonate rocks.