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A study on fine migration and its role on wettability alteration during smart water flooding in a sandstone reservoir

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The present work aims to study the migration of clays (fines) and its role on reservoir rock wettability alteration during Smart Water flooding in a sandstone reservoir of Upper Assam Basin. The study also includes the identification of different types of clays in the reservoir rock of the study area, their effects on wettability and oil recovery efficiency during Smart Waterflooding experiments.

The clay minerals were studied and identified with the help of X-Ray Diffraction (XRD) and Scanning Electron Microscopic (SCM) study. The water flooding experiments were conducted by flooding the oil saturated core plugs using formation brie and two low salinity water. The oil recovery efficiencies for each core flooding experiments were determined. The presence of the migrated clays in the effluent water was identified with the help of SEM study. The wettability states of the flooded core plugs were determined from the study of the Relative Permeability Curves.

The petrographic study shows the presence of smectite, kaolinite and illite in the rock matrix of the study area. Oil recovery efficiency of 37.69%, 40.47% & 32.71% of OOIP was observed using 500 ppm water, 200 ppm water (low saline) and formation brine respectively in the Smart Water flooding Experiments. The SEM analysis of the effluent waters after the core flooding experiments (using 500 ppm & 200 ppm water) shows the presence of kaolinite and illte clay minerals. The alteration of the wettability states of the flooded core plugs from oil-wet to more water-wet state was observed from the study of the Relative Permeability Curves. Thus, the fine migration (kaolinite and illite) occurs during Smart Water flooding in the study area which is a factor that has affected the reservoir rock wettability and in turn oil recovery efficiency by exposing new underlying surface area of the rock.

The effects of kaolinite and illite clay minerals on reservoir rock wettability alteration in a sandstone reservoir that leads to improved oil recovery have investigated. Our study based on the petrographic analysis and core flooding experiments will help the researchers to apply this mechanism in the similar reservoirs.

Keywords: Smart water flooding, fine, wettability, smectite, kaolinite, illite, X-Ray Diffraction, Scanning Electron Microscope.