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Scale Formation in Oil Reservoir during Water Injection at High-Barium and High-Salinity Formation Water

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waters into porous media was shown by Scanning Electron Microscopy (SEM) micrographs.

Abstract

Scale deposition is one of the most serious oil field problems that inflict water injection systems primarily when two incompatible waters are involved. Two waters are incompatible if they interact chemically and precipitate minerals when mixed. Typical examples are sea water, with high concentration of sulfate ion and formation waters, with high concentrations of calcium, barium, and strontium ions. Mixing of these waters, therefore, could cause precipitation of calcium sulfate, barium sulfate and/or strontium sulfate. This study was conducted to investigate the permeability reduction caused by deposition of calcium, strontium, and barium sulfates in sandstone cores from mixing of injected sea water and formation water that contained high concentration of calcium, barium, and strontium ions at various temperatures (50 - 80 °C) and differential pressures (100 - 200 psig). The solubility of common oil field scales formed and how their solubilities were affected by changes in salinity and temperatures (40 - 90 °C) were also studied. The morphology and particle size of scaling crystals formed as shown by Scanning Electron Microscopy (SEM) were also presented. The results showed that a large extent of permeability damage caused by calcium, strontium, and barium sulfates that deposited on the rock pore surface. The rock permeability decline indicates the influence of the concentration of calcium, barium, and strontium ions. At higher temperatures, the deposition of CaSO_4 , and SrSO_4 scales increases and the deposition of BaSO_4 scale decreases since the solubilities of CaSO_4 , and SrSO_4 scales decreases and the solubility of BaSO_4 increases with increasing temperature. The deposition of CaSO_4 , SrSO_4 , and BaSO_4 scales during flow of injection