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Desulfated Seawater Flooding for the Purpose of Enhanced Oil Recovery, Microbial Reservoir Souring Mitigation, and Produced Water Reinjection

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Modified Salinity Water (MSW) flooding is an attractive solution to improve oil mobilization in subsurface reservoirs. Removal of sulfate (desulfation) is one way of modifying the salinity of the seawater. Aside from improving oil recovery, desulfation can be a mitigation strategy for reservoir souring, during which Sulfate Reducing Bacteria (SRB) reduce sulfate and generate hydrogen sulfide. Moreover, desulfation is advantageous in terms of produced-water management since it decreases the possibility of scale formation in the whole system, enabling Produced Water Re-Injection (PWRI).

However, there is a valid common concern regarding the effectiveness of desulfation in cases of mature fields when there has been years of the injection of untreated seawater, containing high concentrations of sulfate. In such cases, the presence of high sulfate concentrations inside the subsurface reservoir before MSW flooding may render desulfation pointless. This concern is especially significant when the installation of desulfation facilities is costly (e.g., on offshore platform with no pre-designed space for such facilities).

The present study investigates the benefits of desulfation after around 20 years of untreated seawater injection, in a sector of an oil field in the Danish North Sea. The results show that depending on the Cessation of Production (COP) point in time and the efficiency of residual oil saturation reduction of MSW flooding, desulfation will result in an at least 3.1% until 2040 and at most 13% until 2060 of increase in cumulative oil production. Moreover, desulfation is shown to be considerably more effective than nitrate treatment in mitigating microbial reservoir souring. Furthermore, in case of PWRI, the possibility of scale formation at the injection points is decreased considerably due to desulfation, which further encourages the practice. Aside from financial incentives, desulfation will be considerably beneficial to the marine environments through removing or lowering the environmental concerns of the use of nitrate and chemicals to mitigate souring and enabling PWRI, which prevents produced water discharge into the marine environments.