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Assessment of a chemical solution for mitigating PWRI-induced injectivity decline in chalk

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Produced water reinjection (PWRI) has emerged as a sustainable and promising solution for handling the co-produced water in hydrocarbon production operations. While marine disposal has historically been a common method for managing this water, it can result in harmful ecological consequences. PWRI represents an alternative approach that can potentially mitigate these consequences. However, injectivity reduction, caused by various factors related to the quality of reinjection water, can limit the effectiveness of this approach. Hence, the application of PWRI is constrained by the occurrence of injectivity loss during the process.

This study examines the possibility of reducing injectivity issues during PWRI through the application of several chemicals (e.g., scale inhibitor, acid, oxidizer, and chelating agent) in produced water on a continuous basis. We focus on mineral phases within produced water that have the potential to deposit and obstruct flow paths, out of all the colloidal phases that can impact injectivity. We use synthetic brines with a composition in agreement with the actual reservoir fluid samples. A numerical screening method is used to identify mineral scales that could precipitate under relevant conditions. The efficiency of a commercial scale inhibitor in preventing specific mineral phases from scaling is then tested through batch experiments and modeled under various conditions. Mathematical modeling is also used to investigate the benefits of combining the inhibitor with an acid, an oxidizer, and a biodegradable chelating agent to improve inhibition efficiency and prevent the scaling of diverse mineral phases. Chemical recipes for preventing mineral scaling can be obtained from the proposed model at every specific physicochemical condition.

Our findings suggest that reducing the intensity of injectivity decline is possible during PWRI by chemically treating the produced water on a continuous basis within a controlled framework. The predictive chemical model developed in our study is useful in identifying the chemical recipes required for avoiding mineral scaling under relevant conditions. This model can be combined with reactive transport models to account for its effect on restoring the injectivity. The results of this study can aid in developing sustainable approaches for managing produced water and reducing environmental impacts associated with hydrocarbon production.