On the necessity of multi-phase, field scale, and long term simulations in reservoir souring studies

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Abstract:

Reservoir souring is a phenomenon in which Sulfate Reducing Bacteria (SRB) produce hydrogen sulfate, a hazardous and corrosive gas, through their activity in oil reservoirs, usually due to seawater-flooding. Several methods such as biocide injection and nitrate, nitrite, and perchlorate injection, have been proposed to mitigate this problem. Injection of biocides, which suppress microbial population and injection of nitrate, or perchlorate, which impact the activity of SRB through numerous inhibitory or competitive mechanisms, are some of such approaches. In this regard, several experimental and modeling studies have been done to help better understand the underlying mechanisms and efficiency of these methods in various scales. While these studies provide valuable information in terms of pathways and processes happening during reservoir souring and mitigation, the results of most of them cannot be directly attributed to the real-world conditions. Scarcity of injected reactants deep in the reservoir due to fast consumption near wellbore, existence of excess amounts of reactants deep in the reservoir, presence of oil and/or gas phase, which can retard or facilitate movement of some components, and total consumption of some reactants by the passage of time are some of the mechanisms we look into in different 32 scales. In this study, we represent a series of simulations on synthetic models in various conditions to emphasize how neglecting some essential factors, namely reservoir heterogeneity, flow patterns, presence of oil and gas phase, and temperature can severely alter the results, thus resulting in misleading conclusions, if attributed directly to the real-world situations.