Contribution ID: **781** Type: **Oral Presentation**

Study of the Combined Effect of Reservoir Souring and Scale Formation in hydrocarbon reservoirs

Monday, 31 May 2021 16:25 (15 minutes)

Seawater flooding, is a widely used improved oil recovery technique in oil reservoirs. Due to presence of sulfate (SO42-) in seawater, this technique can be associated with two side effects. The first side effect is the formation of various types of scale (e.g. BaSO4, CaSO4, and SrSO4) due to the incompatibility of seawater and formation brine that reduces permeability both in the reservoir and wellbore. For example, seawater containing SO42−, with field water rich in Ba2+ may cause BaSO4 scale precipitation both within the formation and also on co-production at the wellbore[A]. Second, the activity of sulfate reducing bacteria (SRB) may result in bio-conversion of sulfate into hydrogen sulfide, a hazardous[B] and corrosive gas. In case both of these processes are possible, they will compete for sulfate and one may limit the other. Therefore, it is important that the both are studied simultaneously. Furthermore, use of souring mitigation strategies can also affect the availability of sulfate through different pathways[C], which in turn calls for the necessity of a comprehensive simulation of all the processes. What makes this complex is that the microbial activity happens through one-way chemical reactions, which is the microorganisms consume sulfate among other things to generate the products, especially hydrogen sulfide in case of SRB. However, scaling happens through equilibrium processes, which mean the reaction path is determined based on the comparison of a state with the equilibrium state. Hence, the microbial reactions can heavily disturb possibly already existing equilibrium of sulfate with other ions and minerals in the reservoir.
In this work, we first present a model that simulates reservoir souring and mitigation together with scale formation simultaneously. Next, we use available experimental data in the literature to validate the model. A series of simulations are then conducted to identify the important parameters that control hydrogen sulfide production, scale formation, and the competition between them. The effect of scaling on porous media properties (porosity and permeability) is then discussed. Additionally, we discuss the possibility of optimizing souring mitigation strategies such that it doesn't trigger sever scaling.

References:

[A]: K.S Sorbie, E.J Mackay, 2000. Mixing of injected, connate and aquifer brines in waterflooding and its relevance to oilfield scaling, Journal of Petroleum Science and Engineering, Volume 27, Issues 1–2, Pages 85-106, ISSN 0920-4105.

[B]: Jiang, J. et al. 2016. Hydrogen sulfide-mechanisms of toxicity and development of an antidote. Sci Rep 6, 20831.

[C] Veshareh, M.J., Nick, H.M., 2019. A sulfur and nitrogen cycle informed model to simulate nitrate treatment of reservoir souring. Sci. Rep. 9, 1–2.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

[A]: K.S Sorbie, E.J Mackay, 2000. Mixing of injected, connate and aquifer brines in waterflooding and its relevance to oilfield scaling, Journal of Petroleum Science and Engineering, Volume 27, Issues 1–2, Pages 85-106, ISSN 0920-4105.

[B]: Jiang, J. et al. 2016. Hydrogen sulfide-mechanisms of toxicity and development of an antidote. Sci Rep 6, 20831.

[C] Veshareh, M.J., Nick, H.M., 2019. A sulfur and nitrogen cycle informed model to simulate nitrate treatment of reservoir souring. Sci. Rep. 9, 1–2.

Acceptance of Terms and Conditions

Click here to agree

Newsletter

Student Poster Award

Primary author: MAHMOODI, Ali (Danish Hydrocarbon Research and Technology Centre, Kgs, Lyngby, Denmark)

Co-authors: Mr ALIZADEH, Mohammad Reza (Danish Hydrocarbon Research and Technology Centre, Kgs, Lyngby, Denmark); JAHANBANI VESHAREH, moein; M. NICK, Hamid (DTU)

Presenter: MAHMOODI, Ali (Danish Hydrocarbon Research and Technology Centre, Kgs, Lyngby, Denmark)

Session Classification: MS5

Track Classification: (MS5) Biochemical processes and biofilms in porous media