Contribution ID: **740** Type: **Poster (+) Presentation**

Reactive Transport Modeling of Nanocapsules for Controlled Release of Cross-linking Agents for Conformance Control

Wednesday, 2 June 2021 16:00 (1 hour)

Nanotechnologies have recently been proposed for use in conformance control applications to modulate the release of cross-linking agents, facilitating deeper placement of polymer-gel systems. In any potential nanotechnology application for improved conformance, large-scale nanocapsule mobility (100s of meters or more) and precise control of crosslinking agent release rate or time (up to few weeks) are essential. These requirements make full-scale experimentation for application design infeasible. Since pilot studies will also be very expensive, test design, performance evaluation, and optimization will need to be completed using laboratory-validated and calibrated mathematical simulators.

The goal of this work is to develop and evaluate a mathematical model for the simulation of nanocapsule conformance control applications in large-scale heterogeneous formations. The model incorporates nanocapsule and co-injected polymer transport [1] and attachment, controlled release of cross-linking agents from the nanocapsule shell, and subsequent gelation processes. Illustrative simulations are presented for hypothetical inter-well nanocapsule injection tests within heterogeneous subdomains of a statistically simulated reservoir (Stanford VI) [2, 3]. These subdomains exhibit a wide range of petrophysical properties, as well as a dense sampling (25m x 25m x 1m grid blocks) of the entire 3.75km x 5km x 200m domain. Constituent attachment/sorption and gel rheology modules were developed based on calibration to laboratory column and batch experiments performed in similar systems or found in the literature. Pre- and post-treatment tracer and nanocapsule injection scenarios were simulated in a series of inter-well injection-extraction tests to identify conditions that would maximize technology performance, i.e. reduce water cut and maximize sweep efficiency of the post gelation tracer. A model sensitivity analysis is used to highlight the impact of nanocapsule attachment, crosslinker release mechanisms, and gel strength on conformance control performance. The simulation results show that the conformance efficiency strongly depends on high nanocapsule mobility and that additional processes, such as co-polymer injection [4], maybe needed to further improve system performance.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

1. Mohammadnejad, H., et al., Development and validation of a two-stage kinetic sorption model for polymer and surfactant transport in porous media. Environmental science & technology, 2020. 54(8): p. 4912-4921.
2. Lee, J. and T. Mukerji, The Stanford VI-E reservoir: A synthetic data set for joint seismic-EM time-lapse monitoring algorithms. 25th annual report: technical report, Stanford Center for Reservoir Forecasting, Stanford University, Stanford, CA, 2012.
3. Becker, M.D., On the Influence of Co-Constituents on Nanoparticle Transport in Heterogeneous Porous Media. 2015, Tufts University.

4. Mohammadnejad, H., et al., Development and experimental evaluation of a mathematical model to predict polymer-enhanced nanoparticle mobility in heterogeneous formations. Environmental Science: Nano, 2021.

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