Contribution ID: **220** Type: **Poster (+) Presentation**

Modeling of the droplets capture/release dynamic of Water-Alternated-Emulsion flooding in porous media through a non-equilibrium mass transfer.

Wednesday, 2 June 2021 09:00 (1 hour)

Water-alternated-emulsion (WAE) injection is an alternative chemical enhanced oil recovery method (cEOR) that improves water mobility control and sweep efficiency flow diversion. When injected, the dispersed phase of stable diluted oil-in-water (O/W) emulsions flow as conformance agents towards the thief or high permeable porous media zones blocking the preferential flow paths by different entrapment mechanisms, diverting the chased water front to upswept zones. This method is promissory in the Brazilian pre-salt oilfields since seawater along with produced water might be conditioned in the offshore petroleum platforms and re-injected in the reservoir reducing logistic costs as well as weight and space constraints typically high in comparison with other cEOR methods such as polymer or surfactant injection.

Indeed, the execution of a pilot test of some enhanced oil recovery method requires previous assessment at laboratory scale and subsequent reservoir upscaled results as part of a decision-making process that includes uncertainties analysis through numerical simulation. To properly model complex phenomena, as emulsion flow in porous media, representing the physical-chemical-mechanical coupling mechanisms occurring at the microscale and their correlation with the macroscopic effect is challenging. Inherent characteristics of the injected emulsion and porous media, such as drop-to-throat size ratio, impacts the emulsion flow and performance as water mobility control agent. Several models intend to represent and forecast emulsion flow through porous media, however, there is a lack in the understanding and modeling the fundamental physical phenomena occurring at pore scale, i.e., drop capture and release mechanisms, and its upscaling to macro-scale through a reservoir simulation software is still rather vague.

This work encompasses the modeling of straining, interception, release and re-entrainment droplets phenomena through nonequilibrium mass transfer equations. Furthermore, it incorporates parameters as emulsion viscosity, rock permeability reduction due to oil drops retained concentration, and blockage effects on the WAE performance. This approach was validated through the history matching of the WAE core flooding experiments at low capillary numbers. The differential equations were solved using Thermal & Advanced Processes Simulator - STARS - from Computed Modelling Group - CMG.

The numerical approach demonstrates the improvement of the history matching of the experimental data by using three kinetic reactions that represent the non-equilibrium mass transfer between oil drops component to the rock surface. In this model, the emulsion mobility control and sweep efficiency effects are accounted through permeability changes, which are updated according to the emulsion concentration retained in the porous media. The results enable easier upscaling, already coupling with a reservoir simulation software, for future numerical assessment and forecasting of WAE in reservoir models.

Time Block Preference

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

References

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