Contribution ID: **608** Type: **Poster (+) Presentation**

Computational modeling based on decomposition methods applied to polymer flooding in oil reservoir

Tuesday, 1 June 2021 19:00 (1 hour)

Polymer flooding is an enhanced oil recovery technique applied to reduce mobility ratio and improve sweep efficiency [7]. In addition, polymer solutions can be used as relative permeability modifiers (RPM) in order to increase the recovery factor due to flow diversion [1]. In the applications mentioned above, high viscosity and polymer retention (mechanical retention and adsorption) may cause injectivity problems in cases where there are limitations on injection pressure [7]. In the techniques mentioned above, accurately modeling the coupling between the near-well region and the rest of the reservoir phenomena in different spatial and temporal scales is essential. For instance, a local spatial and temporal mesh refinement is necessary near the well to capture the formation damage and non-Newtonian behavior. However, refining the entire reservoir is impractical due to the high computational cost [5]. Therefore, an alternative to efficiently couple these regions is to apply a space-time domain decomposition technique. The main idea is to split the reservoir domain into subdomains with appropriate space-time refinement, taking advantage of the parallel computational architecture to reduce computational cost. This work aims to deduce an innovative mathematical and computational model for polymer flooding in oil reservoirs based on domain decomposition techniques to efficiently couple the near-well region and the reservoir. The governing two-phase flow equations consist of Darcy's law and mass balance for fluid (oil and water) together with the transport equation for the polymer movement in the aqueous phase [7]. Additional closure equations are applied to describe adsorption, mechanical retention, formation damage, and the non-Newtonian pseudoplastic behavior. For the computational model, Darcy's law and total mass balance are discretized by applying the mixed finite element method [3]. Moreover, the aqueous phase and polymer transport equations are approximated using the central upwind finite volume scheme [4]. To the domain decomposition method, we consider the reservoir domain partitioned into nonoverlapping subdomains. Then, for the hydrodynamics equations, the mortar finite element method is applied to ensure continuity of pressure and fluxes across the interfaces [2]. For the transport equations, due to the hyperbolic PDE nature, the explicit finite volume method is applied assuming Dirichlet interface conditions to compute the solution for saturation and polymer concentration [6]. To validate the accuracy and stability of the proposed computational model, we propose some numerical simulations by comparing the discrete solutions with analytical and high-fidelity solutions. We also simulate the dependence of the injectivity and production curves with the non-Newtonian behavior, mechanical retention, and formation damage considering more general domains, such as the five-spot reservoir in the presence of perforated wells. The numerical simulations show that the proposed computational model has a low computational cost and accurately captures the solutions in several scenarios for polymer flooding in oil reservoirs.

Time Block Preference

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

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