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Investigation of Transport and Retention of a Novel Sub-microgel in Porous Media

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Sub-microgels, crosslinked polymer particles, have attracted increasing interest in Enhanced Oil Recovery (EOR), Enhanced Geothermal System (EGS), carbon storage, and groundwater management field. However, it is still unclear how to properly utilize these elastic particles underground because the transport and retention are not well studied so far, especially in oil fields. This study investigates the transport and retention of novel sub-microgels in sandstone rocks, providing critical insights into their behavior in subsurface environments. A series of monodispersed sub-microgels were synthesized and characterized for size, elasticity, and swelling kinetics. Dispersing these sub-microgels in 1% KCl, the transport pressure and retention amount were determined by injecting them into sandstone rocks with known permeability and pore size distribution. We evaluated the influence of varying transport velocity, particle concentration, particle size to pore size ratio, elasticity, temperature and existence of oil phase on the transport and retention of the sub-microgels. After injection and swelling of the particles, the permeability reduction and saturation change of the rocks were investigated. The results show that the novel polymer sub-microgels can be transported easily to the in-depth of sandstone rock, with resistance factors lower than 2. Besides, the retention amount and injection pressure increase with higher oil saturation and these particles also contribute to mobilizing residual oil by wettability alteration and interfacial tension reduction. This work enhances the understanding of polymer particle transport in porous media and introduces a promising particle gel for mitigating reservoir heterogeneity in subsurface energy applications.

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References

Primary author: LIU, Junchen (Missouri University of Science and Technology)

Co-authors: BAI, Baojun (Missouri University of Science and Technology); Prof. SCHUMAN, Thomas (Missouri University of Science and Technology); Prof. WEI, Mingzhen (Missouri University of Science and Technology)

Presenter: LIU, Junchen (Missouri University of Science and Technology)

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