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Pore-Scale Investigation of Nano-Enhanced Chemical Strategy for In-situ Crude Oil Contaminated Soils Remediation

Thursday, 3 June 2021 11:15 (15 minutes)

In recent decades, the problem of soil pollution by crude oil and other petroleum-derived fuels, has faced growing attention due to the quick urbanization and industrialization. Unfortunately, petroleum hydrocarbons-contaminated soil is causing significant environmental problems due to the persistence of pollutants and their carcinogenic and mutagenic compounds, which accumulate in soil, infiltrate into the groundwater and threaten human health and ecological security [1]. In-situ soil flushing treatment where a water-based solution containing the surfactant (with other conceivable amendments) is injected into the subsurface, has appealed to various researchers [2-4] due to the high efficacy of removing the non-aqueous phase liquids. This study focuses on the synergy effect of the Sodium Dodecyl Sulfate (SDS) surfactant, a polymer (Xanthan Gum), and silica nanoparticles on the removal of asphaltenic crude oil from saturated media. The formulation of chemical solution was optimized through the measurement of interfacial tension (IFT) between the crude oil and aqueous phase, and emulsification studies. The stability of proposed nanofluid was evaluated using the measured zeta (ζ) potential values. The efficiency and pollutants removal mechanisms of optimized nano-enhanced chemical solution in porous media were assessed using a microfluidic device with heterogeneous pore and throat structure. The results showed that the values of IFT between the crude oil and aqueous phase decline in presence of SDS surfactant, and in the existence of silica nanoparticles the reduction is more dominant. The synergy of SDS-Xanthan Gum-silica nanoparticles resulted in better emulsification for asphaltenic crude oil and as a consequence more contaminants removal. The results of pore-scale investigation indicated that during in-situ surfactant flushing, the petroleum contaminants removal from porous media occurs mainly due to the mobilization and solubilization mechanisms. However, emulsification may also happen and contribute to the pollutants' removal. This study shows promising results for the application of the nano-enhanced chemical solution to improve the in-situ petroleum contaminants treatment.

Time Block Preference

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

References

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- [3] Javanbakht G, Arshadi M, Qin T, Goual L. Micro-scale displacement of NAPL by surfactant and microemulsion in heterogeneous porous media. *Advances in water resources* 2017;105:173-87.
- [4] Pak T, Archilha NL, Mantovani IF, Moreira AC, Butler IB. The dynamics of nanoparticle-enhanced fluid displacement in porous media-a pore-scale study. *Scientific reports* 2018;8(1):1-10.

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