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Foam for Soil Remediation: Similarities and Differences with Foam for Hydrocarbon Recovery

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Foam has been studied and applied for enhanced oil recovery (EOR) for many decades. There is a large body of research on this topic (Kovscek and Radke, 1994; Rossen, 1996), from pore-level mechanisms of creation and destruction of bubbles and foam mobility to modelling foam processes on the laboratory and field scale. Foam is also increasingly receiving attention as a means of improving soil remediation (Bertin et al., 2017). This raises the question: what findings and modeling approaches that apply to foam for EOR apply to soil remediation, and which require major modification?

In EOR applications in the relatively deep subsurface, foam stability is controlled by capillary pressure. Bubbles are as large as pores, because of inter-bubble diffusion. As a result, foam exists in two flow regimes depending on flowing gas fraction (Alvarez et al., 2001). This is key to modelling foam for EOR.

In soil remediation, as in EOR, foam's primary purpose is to redirect the flow in the formation. In soil remediation, permeability is much greater, which means capillary pressure is less than in EOR. Foam bubbles are not trapped as easily as in EOR foam. Experiments show bubbles smaller than pores, and wet conditions in aquifers, make the effect of diffusion uncertain. As a result, whether the two flow regimes found for EOR foam apply to soil remediation is moot. The goal of EOR is to make a measurable increase in oil recovery; in soil remediation 100% recovery of toxic waste (NAPL) is the goal. Moreover, the remediation fluids must be recovered, not left in the formation. Foam for soil remediation is usually pregenerated before injection, but injection pressure is severely limited. As a result, aquifer flow and gravity play a much larger role in soil remediation than EOR.

Many aspects of foam apply to both applications. Gas mobility is greatly reduced in both cases, and gas trapping is significant in both. Capillary forces are critical at the pore scale, though they are likely to be less dominant at the higher permeabilities in soil remediation. The basic mechanisms of bubble creation are the same. Foam generation in gas flow across layer boundaries was found to be critical to the success of foam in one application to aquifer remediation (Hirasaki et al., 1997). The presentation will discuss how the physico-chemical processes described in EOR apply to environmental application, and if new phenomenon need to be considered specifically for soil remediation.

Participation

In-Person

References

Alvarez et al., "A Unified Model for Steady-State Foam Behavior at High and Low Foam Qualities," SPE Journal 6:, 325-333 (2018) . https://doi.org/10.2118/74141-PA

Bertin et al., "Foam placement for soil remediation,"Environmental Chemistry 14:338-343 (2017). https://doi.org/10.1071/EN17003

Hirasaki et al., "Field Demonstration of the Surfactant/Foam Process for Aquifer Remediation,"SPE paper 39292 (1997). https://doi.org/10.2118/39292-MS

Kovscek and Radke, "Fundamentals of Foam Transport in Porous Media."In L.L. Schramm, Ed., Foams: Fundamentals and Applications in the Petroleum Industry; ACS Advances in Chemistry Series No. 242; American

Chemical Society: Washington, DC, 1994; pp 115–163.
Portois et al., "Foam for Environmental Remediation: Generation and Blocking Effect,"Transp. Porous Media 124:787–801 (2018) . https://doi.org/10.1007/s11242-018-1097-z
Rossen, "Foams in Enhanced Oil Recovery," in R. K. Prud'homme and S. Khan, ed., Foams: Theory, Measurements and Applications, Marcel Dekker, New York, 1996, pp. 413-464.

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