ME Seminar

Complex flow behaviors of complex fluids in porous medium for applications in energy industry

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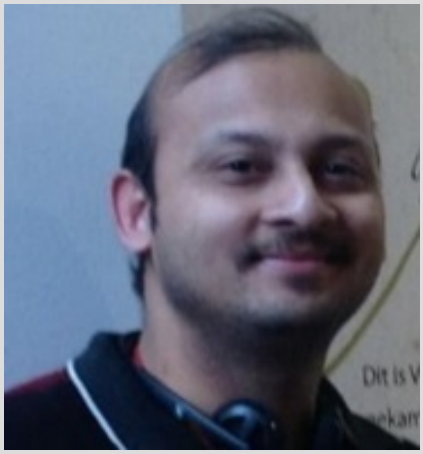
ABSTRACT

During oil and gas recovery from subsurface, the recovery efficiency is mainly limited by two factors: pore-scale trapping resulting in irreducible hydrocarbon saturations and bypassing because of limited sweep efficiency due to rock heterogeneity, viscosity contrast and viscous instabilities. In order to improve the sweep efficiency, hydro-soluble polymer solutions with Non-Newtonian rheology are applied. The difficulty is in predicting the in-situ effective viscosity in Darcy-scale flow in the porous medium, based on bulk rheology provided for instance by shear rheometers [1]. Most of the relevant polymer systems, however, also exhibit viscoelasticity which can lead to elastic turbulence during flow through porous medium [2]. Here we show progress on the fundamental side, how to visualize the respective pore scale flow fields and understand the fundamental origins using a system that contains one single pore throat [3] and multiple pore throats and its effect on residual oil saturation [4]. In addition, we demonstrate how we numerically simulate the flow of viscoelastic fluids in porous medium and characterize elastic turbulence [5]. In the field of CCUS and hydrogen storage similar complex pore scale flow behavior are also observed and the talk with also provide challenges and opportunities in such emerging research areas.

1. Berg & van Wunnik, Transport in Porous Media 117(2), 229-246, 2017.
2. S De, J Van Der Schaaf, NG Deen, JAM Kuipers, E Peters, JT Padding, Physics of Fluids 29 (11), 113102
3. Eguagie et al. Phys. Rev. E 101(4), 042605, 2020.
4. S De, P Krishnan, J Van Der Schaaf, JAM Kuipers, E Peters, JT Padding, Journal of colloid and interface science 510, 262-271
5. S De, JAM Kuipers, E Peters, JT Padding, Physical Review Fluids 2 (5), 053303

ABOUT THE SPEAKER



Dr. Shauvik De is a researcher at Shell technology center Bangalore, and a part of the Computational Science (systems modeling) group. Shauvik's main research area ranges from complex multiphase fluid flow in porous media and reactive flow from reactor to systems scale. Shauvik holds a PhD degree in the topic of complex multiphase fluid flow through porous media, from TU Eindhoven & TU Delft in the Netherlands (2017), and a degree in chemical Engineering from IIT Bombay. In Shell, Shauvik is involved in novel sustainable technology development and deployment for energy transition and industrial decarbonization through high fidelity modeling, systems integration and physics based digital twin. Shauvik is a recipient of Shell AI Sciences prolific inventor award (2022), Shell VP R&D technology awards (2019-2021), American Physical Society - Scilight Award 2017, Dow Industrial Challenge award (2015). Shauvik has published multiple peer reviewed papers and has filed seven international patents and reviewer of multiple peer reviewed journals.

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4:00 PM, A. R. Auditorium