Hydrocarbon Phase Behavior in Shale Nanopores

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Abstract:
The properties of a fluid confined in micro- and mesoscale spaces (pores of width below 2 nm and 2−50 nm, respectively) differ significantly from those of the bulk fluid. In nanopores, the fluids’ thermodynamic and kinetic properties are strongly affected by surface forces, heterogeneity of media, and pore-size distribution. The study of fluid behavior in confined space has been a crucial part of many research areas such as biotechnology, water purification, and enhanced oil and gas recovery. The increase in shale oil and gas production in the past decade and its impact on US energy security and independence has drawn a great interest in fluid phase behavior in nano-scale pores present in shale rocks. As shown by the pore size distribution studies, 20-40% of the total pore volume from shale rocks can consist of nano-scale pores as small as 2 nm. The confined space of nano-scale pores have a significant effect on hydrocarbon phase behavior due to the pronounced surface-fluid molecular interactions. Ignoring this effect can result in inaccurate production forecasting and sub-optimized production planning.

In this seminar, I will present recent findings by a multidisciplinary research team at Texas A&M University on the hydrocarbon phase change in nano-scale capillaries using experiments, molecular simulations, and a pore-size-dependent equation of state. The team has used two experimental approaches based upon selected “model” porous materials: a) combination of a nanochannel device and epi-fluorescence microscopy, and b) modulated differential scanning calorimetry to accurately measure the effect of confinement on hydrocarbon phase behavior in nanopores. I will also present our recent results using molecular simulation and a pore-size-dependent equation of state to model these experiments.

Biography:
Hadi Nasrabadi is an Associate Professor and the Aghorn Energy Career Development Professor at the Harold Vance Department of Petroleum Engineering at Texas A&M University. Before joining Texas A&M University in 2013, he worked for five years at the Petroleum Engineering Program at Texas A&M University at Qatar as Assistant Professor. Hadi received his B.Sc. degree in Civil Engineering from Sharif University of Technology, Tehran, Iran, in 2002, and the Ph.D. in Petroleum Engineering from Imperial College, London, UK, in 2006. His research interests include hydrocarbon phase behavior and flow in shale reservoirs, multiscale reservoir simulation using the lattice Boltzmann method, and compositional simulation.