Effect of Capillary Pressure on Fluid Density and Phase Behavior in Tight Rocks and Shales

Pore sizes can be on the order of nanometers for shales and tight rock formations. Such small pores can affect the phase behavior of insitu oil and gas owing to increased capillary pressure. In this paper, capillary pressure is coupled with phase equilibrium equations and the resultant system of nonlinear equations is solved. Effects of small pores on the dew point and bubble point curves, as well as on interfacial tension and fluid densities are investigated. Both binary mixtures of methane with heavier hydrocarbons and real fluids are considered.

Development of analytical methods for well test and decline curve analysis

The principle goals of this project are to:

1. Develop analytical methods to determine the ultimate recovery of hydrocarbons and to assess key formation properties such as transmissibility

2. Include important wellbore effects when formation permeabilities are ultra low. Such effects include temperature variations and momentum transfer along the vertical/horizontal wellbore.

3. Determine the best methodology to reduce uncertainties in estimated formation parameters. Questions such as whether downhole pressure transducers and/or rate measurements should be made to limit wellbore effects will be examined.

4. Include the effect of pressure history during drilling on the measured pressure response.

5. Include gas adsorption in gas shales using Langmuir type isotherm.

Advanced well test simulator for fractured gas shales

This project will develop an advanced well test simulator for a horizontal/multilateral well configuration with numerous multiple discrete hydraulic fractures. The main hydraulic fractures will be modeled as “tree” fractures based on observed microseismic responses in gas shales and in tight gas/oil sands. From each branch, we will allow for numerous small fractures that increase the contact area significantly between the well and the gas formation. The smaller fractures will be modeled as a zone of higher permeability emanating radially from each fracture branch. The fractures and matrix will be decoupled in a novel approach that is currently being developed to increase computational speed and accuracy.

Russell T. Johns [rjohns@psu.edu]
Beghini Professor of Petroleum and Natural Gas Engineering
John and Willie Leone Family Department of Energy and Mineral Engineering
rjohns@psu.edu