Modeling Asphaltene Phase Behavior in Crude Oil Systems

Sameer Punnapala and Francisco Vargas
The Petroleum Institute, Chemical Engineering Department, Saas Al Nakhl Campus, Abu Dhabi, United Arab Emirates
fvargas@pi.ac.ae

Asphaltenes constitute a potential flow assurance problem in the oil industry because of their tendency to precipitate and deposit due to changes in temperature, pressure and composition. It is well known that asphaltene precipitation is a necessary but not a sufficient condition for deposition. Although a substantial amount of work has been done in this area, the mechanisms by which asphaltene precipitate and deposit are still being actively investigated. Modeling asphaltene precipitation requires tuning of an appropriate equation of state to the crude oil properties and phase behavior. In this work, we propose a new robust procedure to characterize crude oil and plot asphaltene phase envelope using the Perturbed Chain form of the Statistical Associating Fluid Theory (PC-SAFT). With only two adjustable parameters, the model is able to capture very well the phase behavior at high pressures and high temperatures and also for various gas injection cases. The results for constant composition expansion and differential vaporization experiments give very good predictions using PC-SAFT. Current works reported in literature treat asphaltenes as a monodisperse distribution with a fixed molecular weight for the asphaltene aggregate but our model provides a basis to investigate the effect of polydispersity on asphaltene phase behavior.