Characterization and Commingling of Oils Based on Semi-Continuous Thermodynamics

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Before a simulation of the phase behavior of reservoir oils can be assessed, a compositional characterization procedure must be used in conjunction with an equation of state (EOS).

The predicted phase behavior and many other properties are very sensitive to the compositional characterization of the oil's heavy fraction.

Following extensive previous work, we applied the Chi-squared distribution function to derive an accurate representation of the oil-heavy fraction mass distribution. This procedure allows for accurately representing the heavy fraction in a well-balanced reduced number of heavy fractions, which can be correlated to empirical equations for the parameters that the EOS may require. This characterization, in combination with an EOS such as the Peng-Robinson EOS (PR EOS), results in well-balanced predictions of phase behavior and several other properties, such as caloric ones or friction theory viscosity models applicable in wide ranges of conditions.

We further demonstrate in this work how this characterization procedure can be extended to the commingling of oils based on the mixing of the optimal distribution functions of two or more oils or even blends of oils. The resulting commingled distribution function is mathematically similar to the ones of the original oils without any need to mix discrete heavy fractions. Therefore, the commingled distribution function can again generate a reduced number of discrete pseudo-compounds for the optimal representation of the blend.

In summary, the blending of different oils is made using a continuous approach so that a mass-distribution-based blend model is obtained. This is in contrast to just mixing discrete characterizations of different oils, resulting in an extended number of pseudo compounds. Therefore, in the end, one may find that a reduced number of pseudo compounds, such as four, may adequately represent individual oils and any commingling of two or more different oils. The ultimate result is conserving a numerically accurate and efficient model for any possible blend of oils. Furthermore, the commingled model can accurately predict the resulting phase equilibria and transport properties of the blend.