

Phase Properties and Viscosity Modeling and Prediction of Petroleum Fluids based on SAFT-type EoS and the Friction Theory

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Viscosity and phase properties are key for the evaluation, simulation and development of petroleum reservoirs. In the oil industry the modelling of phase properties has traditionally been based on cubic EoS and, when coupled with the friction theory (FT), the modelling possibilities have been successfully extended to viscosity. Cubic EoS FT models are currently capable of achieving accurate viscosity modelling of petroleum fluids covering practically the full range required by the oil industry (IJT 25, 2004, 1353). More recently, the FT was generalized to the use of any kind of EoS – not only cubic ones (*J. Phys. Chem. B*, 2006, 110, 12820) – and further demonstrated that the physics that is built into the EoS is mapped onto the viscosity surface making possible the achievement of highly accurate and self-consistent thermophysical-rheological models. In the case of the accurate modelling of petroleum fluids, our experience shows that there are two main issues to be considered: 1) a correct description of the fluid mass distribution and 2) the use of an accurate EoS. Naturally, in the case of cubic EoS we are confronted with major intrinsic limitations and, in some cases, it would be recommendable to look beyond cubic EoS and into modern more theoretically robust models. In this work we will cover the modelling of reservoir fluids from an accurate mass characterization (lumping and delumping) to the full self-consistent thermophysical and rheological modelling of petroleum fluids. Concerning the use of a more accurate EoS, it is widely accepted that the SAFT EoS family offers important improvements over the traditional cubic EoS, particularly in the representation of derived thermophysical properties. On the other hand, the mathematical simplicity of cubic EoS is still an important advantage, particularly in computationally intensive applications such as reservoir flow simulations. For this purpose two of the main SAFT-type EoS are studied: the PC-SAFT EoS and the SAFT-VR-Mie EoS. Thus, advantages and disadvantages of advanced SAFT models compared to the traditional cubic EoS modelling will also be discussed.