Effect of Mass Distribution Characterization in the Phase and Barotropic Behavior of Reservoir Fluids

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Reservoir fluids of high economic value are typically light fluids whose mass distributions can be represented by exponentially decaying distribution functions, whereas heavier, depleted or degraded reservoir fluids tend to have flatter mass distributions with maxima at higher molar masses. For the thermodynamic modeling of a reservoir fluid the heavy oil fraction is usually represented by a number of reasonably chosen pseudo-compounds. Petroleum fluids are extremely complex and, even in the simplest possible representation, one must account for the differences of molecular sizes and the resulting asymmetry. The asymmetry can have a profound effect on the phase behavior of reservoir fluids and consequently on the characterization of the reservoir as a whole. An exponentially decaying function will result in a larger degree of asymmetry between the heavy fraction pseudo-compounds, and this is likely to cause complex phase behavior including, in some cases, barotropic behavior (density inversions). On the other hand, fluids with flat mass distributions may be heavier overall, but with a lower degree of asymmetry, resulting in less complex fluid phase behavior (not considering solid phases). Thus the wrong choice of a distribution function for the characterization of the oil heavy fraction can result in serious modeling, prediction or characterization errors. Such a misrepresentation may even lead engineers to believe that a reservoir may be segregated in cases when an asymmetry-induced density inversion has take place. In this work, it is shown how drastically the phase and barotropic behavior may change just as a result of the choice of the mass distribution function for the characterization of a reservoir fluid heavy fraction.