Improved Surface Tension Estimations using the Gradient Theory: A New Functionality of the Influence Parameter

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A known procedure to determine the minimum miscibility pressure (MMP) in crude oils consists in estimating (either experimentally of through the use of a model) the interfacial tension (IFT) of the mixture resulting between the injection gas and the oil. The MMP values correspond to the pressure at which the IFT extrapolates to zero when plotted against pressure. Therefore, a reasonable estimation of the IFT plays a paramount role in the correct determination of the MMP. As a preliminary part of such a procedure, the present work presents the formal modeling of the IFT applied to binary and ternary mixtures. The binary and ternary mixtures chosen for such a purpose comprise the most representative compounds typically encountered in common gas-oil mixtures for which a precise knowledge of the MMP values is needed. The model developed in this work is based on the van der Waals gradient theory for non-homogeneous fluids for which new expressions of the influence parameter are presented both for pure fluids and their mixtures. The local values of the model properties such as equilibrium densities of the existing phases and the interface Helmholtz free energy are calculated via the use of cubic equations of state: Soave-Redlich-Kwong and Peng-Robinson.