

Calculation of Solubility of Cannabinoids in Supercritical CO₂

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Currently, cannabinoids are used in clinical studies as active pharmaceutical ingredients to treat different diseases. For the development of a production process, it is essential to know the thermodynamic data in different solvents ranging from water via organic solvents to supercritical CO₂. However, this requires a high experimental effort. Therefore, thermodynamic models which allow to interpolate between experimental points as well as to calculate the thermodynamic properties at other temperatures and pressures are desirable. In principle, such calculations can be carried out using equations of state (EOS). One of the most successful EOS is the Perturbed Chain Statistical Association Fluid Theory (PC-SAFT) approach [1,2]. For non-associating compounds, the EOS needs three pure-component parameters, namely the segment number, m_i , the segment-diameter, σ_i , and the dispersion energy, ε_i . Usually, these parameters are fitted to vapor-pressure and saturated density data. However, this approach cannot be applied to cannabinoids because they cannot evaporate without degradation. In mixtures, usually a binary interaction parameter, k_{ij} , which corrects the selected combining rule, must also be fitted to experimental binary data. For the parameter estimation for the systems containing cannabinoids, the pure-component parameters and the binary parameter must be fitted to experimental data of the binary mixtures.

In this contribution, we discuss different parameter fitting procedures. The first task is the analysis of the available experimental data. It turned out that only a limited number of experimental data related to the solubility in CO₂ is available [3,4,5]. The most important result was that the experimental data can be fitted leading to a satisfactory agreement between the calculated and experimental data. However, there are plenty of parameter sets which describe the experimental data. The obtained parameters cannot be used for extrapolation. Usually, the pure-component parameters can be connected to the physical properties of the molecules under study. However, the obtained segment numbers and segment diameters lead to molecules that are too small. It must be concluded that a reliable fitting procedure using only the solubility in CO₂ is not possible. For this purpose, additional experiments must be performed.

References

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