

Thermodynamic properties of binary and ternary mixtures containing cellulose, caffeine, carbon dioxide and water, in supercritical fluid conditions

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Abstract

In this paper, we have studied the literature data of thermophysical properties as individual components, such as caffeine and cellulose, as well as binary and ternary systems containing tea leaf components. Also, data on the heat capacity of pure caffeine of various authors.

On the automated experimental setup created on the basis of the scanning calorimeter, the heat capacity of pure caffeine was obtained in the temperature range 323-523K. The densities of binary and ternary systems are determined. Measurements of the heat capacity and the density of the binary mixture caffeine-supercritical carbon dioxide (SC-CO₂) system are performed at pre- and supercritical pressures. The calculation formula for determining the specific heat of the component. The dependences of the heat capacity of the caffeine-SC-CO₂ system at various temperatures and pressures are graphically shown. Also graphically shows the dependence of the density of the caffeine-SC-CO₂ system on the pressure and at temperatures of 308, 323 and 343 K.

The results of measurements of the heat capacity of a mixture of caffeine-SC-CO₂ are recalculated into an excess heat capacity and are shown in the graph in the form of the dependence of the excess heat capacity of the system on the pressure at temperatures 308.323 and 343 K. According to the obtained values of the excess heat capacity of the caffeine-SC-CO₂ system, the enthalpy of dissolution of the system at various pressures and temperatures. Comparison of calculated and experimental data of the enthalpy of dissolution of the caffeine-SC-CO₂ system is shown graphically and indicates qualitative agreement.

The results of measuring the enthalpy of mixing of SC-CO₂ in an aqueous caffeine solution at various temperatures are presented. Comparison of the enthalpy of dissolution of CK-CO₂ in caffeine, cellulose, tea leaf and caffeine aqueous solution at a temperature of 308 K.

The method of determining the excess enthalpy associated with the calculation from the data of solubility is shown in the work. On the basis of literature data on solubility, molar volume and vapor pressure, enthalpy values were calculated. The results of the calculation and their comparison with the experimental data are shown in graphs.

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