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Salting effect of tetraalkylammonium salts on the clouding thermodynamic functions of aqueous butanol system

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Biobutanol, the primary four-carbon alcohol produced based on fermentation processes, has been considered a renewable energy source to reduce the emission of greenhouse gases and air pollutants [1]. Moreover, 1-butanol, having complete miscibility with organic solvents and partial miscibility with H_2O, is widely used as a solvent (purely or in mixed solvent systems) in a variety of chemical and industrial processes [2]. Investigating the salting effects of different solutes on the clouding (liquid-liquid demixing) phase diagram of 1-butanol/water mixed solvent systems provides valuable information for extracting biobutanol from fermentation broth or optimum designing of separation processes involving alcohol-based aqueous biphasic systems [3].

This work focused on the salting effect of a wide range of tetraalkylammonium salts, including tetramethylammonium bromide, tetraethylammonium bromide, tetrapropylammonium bromide, tetrabutylammonium bromide, tetrabutylammonium chloride, tetrabutylammonium hydrogen sulfate, dodecyltrimethylammonium bromide, and cetyltrimethylammonium bromide on the water-solubility of 1-butanol. The effects of anion type, cation alkyl chain length, and concentration of the salts on the thermodynamic quantities of the clouding process have been scrutinized in a wide temperature range (283.1-353.1 K). The values obtained for the relative contribution of enthalpy and entropy to the clouding Gibbs free energy demonstrate that the clouding process of 1-butanol in aqueous solutions of tetraalkylammonium salts with smaller hydrocarbon portion is entropy-driven. However, the clouding process for 1-butanol in aqueous solutions of tetraalkylammonium salts with longer hydrocarbon chains, especially at higher temperatures and higher salt concentrations, is often enthalpy-driven.

Keywords: Clouding diagram; Butanol; Tetraalkylammonium salts; Salting effect

References

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