The Effect of Hydration on the Thermal Effusivity of Aqueous Solutions of Liquid Ethylene Glycol Polymers

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The relationship between experimentally obtained values of some physical parameters and the concentration of a non-electrolyte organic liquid in aqueous solution is considered. Chemical compounds with different molecular weights, belonging to a homology series of ethylene polyglycols (DEG, PEG 200, PEG 300, and PEG 400), were used in the investigations. Individual polyglycols differ in the number of ether groups in one molecule, i.e. in the number of hydrogen bond acceptors. In aqueous mixtures, these compounds interact with water via hydrogen bonds, which results in admixture concentration-dependent structural changes of the liquid [1], [2]. We have shown that such changes could be detected by measuring the thermal properties of the mixtures.

Variations of adiabatic compressibility for the aqueous solutions of the compounds as a function of molar concentration were examined with the use of the acoustic method [2]. By analyzing the shapes of the plots obtained, the maximum number of water molecules that can be bound by one admixture molecule was determined. The employment of the photoacoustic open cell technique with microphone registration made it possible to examine the thermal effusivity of the mixture as a function of molar and mass concentration [3]. In the case of the formation of hydrogen bonds between the solution components, both types of characteristics were nonlinear. It has been shown that the position of the excess effusivity minimum was strictly related to the ability of the admixture to form such bonds. For comparison, the adiabatic compressibility and thermal effusivity characteristics for a mixture of liquids which, due to their chemical structure do not interact via hydrogen bonds, was obtained.

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