Experimental Determination of Setschenow Constants of Selected Solutes in a Series of Inorganic Salt Solutions at 298.15 K

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The Setschenow constant as a measure of solute behavior in an electrolyte solution has attracted the attention of scientists for more than 100 years. It is supposed that the Setschenow constant can be expressed as the sum of the individual cation and anion contributions, but the hypothesis of its additive character has not yet been proved. In this work, limiting activity coefficients of methyl tert-butyl ether, toluene, vinyl acetate, and acetone were determined by the Inert gas stripping method in pure water and in a series of aqueous inorganic salt solutions. Experiments were done at a single temperature (298.15 K) and always at several salt concentrations up to 1 mol/kg. The new values of limiting activity coefficients are of the highest precision; their relative standard uncertainty is lower than 1 %. The newly determined data on limiting activity coefficients and their dependences on the solution salt concentration were used for the evaluation of the Setschenow constants. To obtain reliable values of the Setschenow constant, it was shown to be necessary to treat some particular solute – inorganic salt pairs in which specific interactions occur by a non-linear version of the Setschenow equation. The newly obtained values of the Setschenow constant were subsequently used in order to test the possible additive character of the Setschenow constant. The tests were performed for each solute i) by the comparison of the Setschenow constant value determined experimentally for one salt with the value calculated as a linear combination of the Setschenow constants determined for independent salts and ii) by the comparison of differences between contributions of two individual ions calculated from the Setschenow constants determined in two salts with the identical counterion. The results proved that the Setschenow constant is definitely additive.