Standard Partial Molar Volumes of Aqueous Alkanolamines at Temperatures up to 325 °C: Functional Groups Contributions

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Amino alcohols are used in diversified industrial applications, such as pH control and removing acidic gas from industrial gas streams. These include monoethanolamine (MEA), diethanolamine (DEA), triethanolamine (TEA), N, N-dimethylethanolamine (DMEA), ethylethanolamine (EAE) and 2-diethylethanolamine (DEEA). Apparent molar volumes for aqueous solutions of the alkanolamines and their chloride salts have been determined using a high-temperature and high-pressure vibrating tube densimeter at temperatures from 150 to 325 °C and pressure as high as 15 MPa. The absence of thermal decomposition has been confirmed by NMR spectra of samples collected after passing through the densimeter. The experimental values have been corrected for hydrolysis or dissociation, where necessary and the variation of the volumes with temperature and structure of solutes were discussed. The resulting values for the standard partial molar volumes showed normal behavior, namely V_2^o becomes increasingly positive as the critical point of water is approached. This suggests that the Krichevskii parameter, $A_{12} = V_2^o /(\kappa_1 RT)$, which describes the discontinuities in standard partial molar properties at the critical point of water, is positive. Almost all non-electrolytes are characterized by positive Krichevskii parameters. A new functional group additivity scheme for standard partial molar volumes of aqueous organic solutes has been developed using the high-temperature experimental data from this work and the limited available data from the literature.