Isotope Effects on Standard and Partial Molar Volumes of NaCl, HCl and NaOH Measured in Light and Heavy Water at 250 °C and 300 °C

E. Balodis[S]
University of Guelph, Guelph, ON, Canada

L.N. Trevani and P.R. Tremaine[C]
Department of Chemistry, University of Guelph, Guelph, ON, Canada
tremaine@uoguelph.ca

In this work, apparent molar volumes were measured for aqueous solutions of NaCl, HCl (DCl), and NaOH (NaOD) in light and heavy water at 250 and 300 °C and p = 14 MPa using a vibrating platinum u-tube densitometer in the molality range from $0.25 < m < 2.5$ mol kg^{-1}. The experimental results have been represented with an extended Debye-Huckel model to describe the molality dependence of the apparent molar volumes.

Standard partial molar volumes of NaCl, DCl and NaOD in heavy water were determined for the first time above 100 °C as part of an ongoing project in our lab to determine thermodynamic properties of electrolytes and non-electrolytes in heavy water. The implications for the difference in the pressure dependence of the ionization constants of heavy water and water are discussed.

Heavy water is used in CANDU Pressurized Reactors, reaching temperatures between 250 to 320 °C as a heat transfer medium between the reactor core and the steam generation system through the "primary" coolant loop. Careful optimization of operating conditions requires an understanding of the isotope effect on chemical equilibria under these conditions.