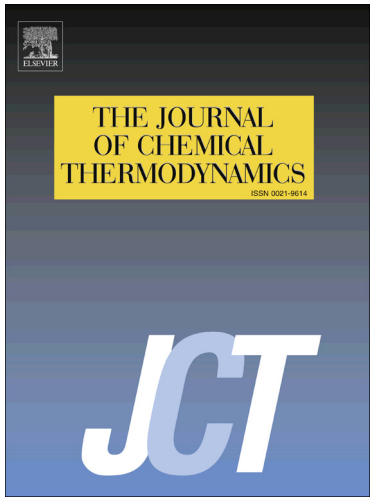

Density and volumetric properties of the aqueous solutions of urea at temperatures from T = (278 to 333) K and pressures up to 100 MPa

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Density and volumetric properties of the aqueous solutions of urea at temperatures from T = (278 to 333) K and pressures up to 100 MPa

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ABSTRACT

This paper highlights the values of densities of aqueous solutions of urea in the concentration range m (from 0.1809 to 12.801) mol·kg^{-1} at T = (278.15, 288.15, 298.15, 308.15, 323.15 and 333.15) K and at p = (0.101, 10, 25, 50, 75 and 100) MPa. The densities were also measured for dilute aqueous solutions m (from 0.093 to 2.505) mol·kg^{-1} with temperature from 274.15 to 283.15 K, with increment of 1 K at atmospheric pressure, in order to study the effect of urea on the temperature of the maximum water density. Volumetric properties calculated from the density, such as apparent molar volumes of urea, $V_{\phi,2}$, molar isothermal compressions, $K_{T,\mathrm{m}}$, and molar isobaric thermal expansions, $E_{P,\mathrm{m}}$, of solution are considered depending on concentration, temperature and pressure. Also, certain volumetric characteristics for infinitely diluted urea in water were obtained: the limiting partial molar volumes, V_2^{∞} ; limiting partial molar isothermal compressions, $K_{T,2}^{\infty}$; and limiting partial molar isobaric thermal expansions, $E_{P,2}^{\infty}$. Obtained results are discussed from the standpoint of solute – solute and solute – solvent interactions. With the help of various approaches based on volumetric characteristics, the character of the disturbing effect of urea on the water structure was described.

Keywords: Urea, Aqueous solution, Density, Molar Thermal Properties, Limiting partial molar properties, Temperature of maximum density.

1. Introduction

Aqueous urea solutions in view of their importance in various biological processes attract much attention of researchers [1-28]. Ability of urea to denature the protein at a high concentration in aqueous solution is widely used in studies on folding of protein. Mechanism whereby denaturation occurs is still debated [2]. Probably, a detailed understanding of the features of