

Excess Molar Volumes for Binary (Ionic Liquid + Methanol or Water) and Ternary (Ionic Liquid + Methanol + Water) Systems at $T = 298.15$ K, 303.15 K and 313.15 K and at Atmospheric Pressure

P. Bhujrajh and N. Deenadayalu^{C,S}

School of Chemistry, Durban Institute of Technology, Durban, KwaZulu-Natal, South Africa
NirmalaD@dit.ac.za

Excess molar volumes, V_m^E have been evaluated from density measurements, using a vibrating tube densimeter over the entire composition range for binary liquid mixtures of (ionic liquid + methanol or water) and ternary liquid mixtures of (ionic liquid + methanol + water) at $T = 298.15$ K, 303.15 K and 313.15 K and at atmospheric pressure. The experimental densities were used to calculate the excess molar volumes for the binary and ternary liquid mixtures from the equations below:

$$V_m^E = \frac{x_1 M_1 + x_2 M_2}{\rho} - \frac{x_1 M_1}{\rho_1} - \frac{x_2 M_2}{\rho_2}$$

$$V_m^E = \frac{x_1 M_1 + x_2 M_2 + x_3 M_3}{\rho} - \frac{x_1 M_1}{\rho_1} - \frac{x_2 M_2}{\rho_2} - \frac{x_3 M_3}{\rho_3}$$

where x_1 , x_2 and x_3 are mole fractions, M_1 , M_2 and M_3 denote molecular masses, ρ_1 , ρ_2 and ρ_3 stand for the densities of the pure components 1, 2 and 3, respectively, and ρ is the density of the mixture.

The binary experimental data were evaluated for thermodynamical consistency by correlation with the Redlich-Kister equation of the form:

$$V_m^E = x(1-x) \sum_{i=0}^N A_i (2x-1)^i$$

The ternary data were fitted to the Redlich-Kister equation of the form:

$$V_m^E = x_1 x_2 \left[\sum_{n=0}^2 A_{12}^{(n)} (x_1 - x_2)^n \right] + x_2 x_3 \left[\sum_{n=0}^2 A_{23}^{(n)} (x_2 - x_3)^n \right] \\ + x_1 x_3 \left[\sum_{n=0}^2 A_{13}^{(n)} (x_1 - x_3)^n \right] + x_1 x_2 x_3 [A_{123} (x_2 - x_3) x_1]$$

where x_1 , x_2 and x_3 are the mole fractions of component 1, 2 and 3. $A_{ij}^{(n)}$ ($i = 1$ or 2 and $j = 2$ or 3 ; $n = 0-2$) are parameters characteristics of (1+2), (2+3) and (1+3) binary mixtures. V_{123} is a parameter for the ternary system.

There exist very few reliable data on excess molar volumes of ionic liquids in the literature, and no V_m^E data exist for the above mentioned systems. The objective of this work is to report the dependence of V_m^E data on composition and temperature for these binary and ternary systems.