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

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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 acetone) and ternary liquid mixtures of (ionic liquid + methanol + acetone) 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 Eq.(1) and Eq.(2), respectively:

$$V_m^E = \frac{x_1 M_1 + x_2 M_2}{\rho} - \frac{x_1 M_1}{\rho_1} - \frac{x_2 M_2}{\rho_2} \tag{1}$$

$$V_m^E = \frac{x_1 M_1 + x_2 M_2}{\rho} - \frac{x_1 M_1}{\rho_1} - \frac{x_2 M_2}{\rho_2} - \frac{x_3 M_3}{\rho_3} \tag{2}$$

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, and ρ the density of the mixture.

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

$$V_m^E = x(1-x)\sum_{i=0}^{N} A_i (2x-1) \tag{3}$$

to estimate the fitting parameters and the root –mean deviations between the calculated and experimental data. The ternary data were also fitted to the Redlich-Kister equation of the form:

$$\begin{aligned} V_m^E = {} & x_1 x_2 [\sum_{n=0}^{2} V_{12}^{(n)} (x_1 - x_2)^n] + x_2 x_3 [\sum_{n=0}^{2} V_{23}^{(n)} (x_2 - x_3)^n] \\ & + x_1 x_3 [\sum_{n=0}^{2} V_{13}^{(n)} (x_1 - x_3)^n] + x_1 x_2 x_3 [\sum_{n=0}^{2} V_{123}^{(n)} (x_2 - x_3)^n x_1^n] \end{aligned} \tag{4}$$

where x_1, x_2 and x_3 are the mole fractions of component 1, 2 and 3. $V_{12}^{(n)}$ (n = 0-2) etc. are parameters characteristics of (1+2), (2+3) and (1+3) binary mixtures. There exist very few reliable data on excess molar volumes of ionic liquids in literature, but 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.