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Role of thermodynamic properties of ionic liquids in industries to reduce pollution

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Statement of the Problem: In the era of rapidly changing global environment, research attempts have been made to replace fossil fuels for the control of greenhouse gases emissions and environmental pollution. Ionic liquids (ILs) have received widespread attention as an eco-friendly reaction medium for various processes involved in industries. Due to their unique properties (negligible vapor pressure, non-flammability, excellent solubility, non-volatility, reusability, high thermal and electrochemical stability), ILs can be considered as safer and more sustainable alternative to volatile organic compounds (VOCs) used in industries. Experimental density, speeds of sound and their derived properties, excess molar volumes, V^E κ_S^E data of ILs and their mixtures with organic solvents may be of great importance in mass and heat transfer processes of working fluids and thus can be utilized for designing and engineering of such processes.

Methodology and Theoretical Orientation: The densities, ρ_{ijk} and speeds of sound, u_{ijk} data of ternary {1-butyl-3-methylimidazolium tetrafluoroborate (i) +1-ethyl-3-methylimidazolium tetrafluoroborate (j) + cyclopentanone or cyclohexanone (k) mixtures have been measured at 293.15 K and 298.15 K using a digital densimeter and speed of sound analyser. The observed ρijk and uijk data have been employed to determine (VE)ijk and $(\kappa_S^E)_{ijk}$ respectively. The (VE)ijk and $(\kappa_S^E)_{ijk}$ data have been fitted to Redlich-Kister equation to see whether the observed data is of required accuracy to be utilized in various industrial processes or not ? The topology of the constituent molecules has been utilized (Graph theory) to obtain information about the state of the components in pure state and also regarding the various processes involved in the mixture formation.

Conclusion and Significance: The $(V^E)_{ijk}$ and $(\kappa_S^E)_{ijk}$ data predicted by Graph theory compare well with their experimental data. Further the measured data are of required accuracy and can be utilized for designing various processes involving fluid in industries.

Recent Publications

1. Gupta H, Malik S and Sharma V K (2017) Excess molar volumes and excess isentropic compressibilities of ternary mixtures containing ionic liquids and cyclic alkanone. J. Chem. Thermodyn. DOI: 10.1016/j.jct.2017.04.013
2. Sharma V K and Kataria J (2015) Thermodynamic properties of ternary mixtures containing 1-ethyl-3-methylimidazolium tetrafluoroborate with cyclic amides and cyclopentanone or cyclohexanone at T = (293.15, 298.15, 303.15 and 308.15) K. J. Chem. Thermodyn. DOI: 10.1016/j.jct.2015.02.018.
3. Yin Y, Fu T, Zhu C and Ma Y J (2017) Volumetric and viscometric study and FT-IR analysis of binary and ternary mixtures of 1-butyl-3-methylimidazolium tetrafluoroborate, methyldiethanolamine and water. J. Mol. Liqs. DOI: 10.1016/j.molliq.2017.08.088.
4. Anwar N Riyazuddeen (2017) Effect of composition and temperature variations on thermophysical properties of binary and ternary mixtures of 1-ethyl-3-methylimidazolium ethylsulfate with 1-butanol and/or methanol. Fluid Phase Equilib. DOI: 10.1016/j.fluid.2017.01.019.
5. Rafiee H R (2015) Volumetric properties for binary and ternary mixtures of allyl alcohol, 1,3-dichloro-2- propanol and 1-ethyl-3-methyl imidazolium ethyl sulfate [Emim][EtSO4] from T = 298.15 to 318.15 K at ambient pressure. Thermochim Acta. DOI: 10.1016/j.tca.2015.04.027.

Biography

Vinod Kumar did his MSc from MD University, Rohtak (India) in the year 1979 with specialization in Physical Chemistry. He did his PhD from the same university in the year 1983. He joined the Department of Chemistry, MD University, Rohtak as Senior Lecturer in 1989 from where he elevated to the post of Professor in 2005. At present he is Dean of Physical Sciences. He has published 140 research papers in journals of international repute. Vinod Kumar has expertise in thermodynamics of liquid mixtures and has developed graph theory to determine thermodynamic properties of liquid mixtures (components being organic solvents, ionic liquids, surfactants, diesel, and bio-fuels). He has attended about 40 national/international conferences and supervised 18 PhD students.

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