Volumetric Properties and Viscosity of Imidazolium Based Ionic Liquids with Varying Alkyl Functional Groups and their Mixtures with Ethanol Under Pressure

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Ionic liquids (ILs) are considered designer solvents due to the wide range of possible cation and anion combinations. By adjusting the ions and any functional groups used in an IL, physical and solvent properties can be changed, and an appropriate solvent can be selected for a particular process. The effect of alkyl chain length on the volumetric, thermodynamic, and transport properties of ILs containing the cation 1-alkyl-3-methylimidazolium was studied. Various alkyl chain lengths between 2 to 6 carbons were used. Two different anions were studied in conjunction with these cations: chloride and acetate. Due to physical limitations such as the high viscosity and the current high cost of ILs, a cosolvent, such as ethanol, may be preferred for the broader and effective use of these molten salts in a process. PVT data for these ILs and their mixtures with ethanol were generated using a variable-volume view-cell from 10-40 MPa at 298 K, 323 K, 348 K, 373 K, and 398 K. PVT data were fit to a fluid lattice model, the Sanchez-Lacombe equation of state, allowing for the determination of thermodynamic properties, such as isothermal compressibility, isobaric expansivity, internal pressure, and free volume. Hildebrand solubility parameters for these ILs and their mixtures were estimated as a function of temperature, pressure, alkyl chain length, and fluid composition. In addition, a unique high pressure rotational viscometer was used to study the effect of both alkyl chain length and ethanol as a cosolvent on the viscosity of these mixtures at pressures up to 40 MPa, temperatures up to 373 K, and rotational speeds up to 800 rpm. Viscosity was then related to density through free volume based methods such as the Doolittle equation and scaling factor based approaches.