

## Densities and Excess Molar Volumes for Binary Mixtures of Ionic Liquid 1-Ethyl-3-Methylimidazolium Ethylsulfate with Co-Solvents

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Present research activities at SAOT-Erlangen are aimed at a fundamental understanding of the nature of interactions in ionic liquid (IL) co-solvent mixtures by investigating their thermophysical properties. For this, dynamic light scattering as well as its application to fluid surfaces, also called surface light scattering (SLS), are used extensively. For the latter, density data are needed. Yet, these can not only be seen as a supplement for the determination of viscosity by SLS but can also be considered as a valuable tool for studying the nature of intermolecular interactions in IL co-solvent mixtures. In this work, reliable density data for binary mixtures of IL 1-ethyl-3-methylimidazolium ethylsulfate [EMIM][EtSO<sub>4</sub>] with acetone, acetonitrile, propylene carbonate, dichloromethane, methanol, ethanol, and water are presented. Measurements were performed to find the dependence on composition for temperatures in the range from 278.15 K to 308.15 K using the vibrating tube method with an expanded uncertainty ( $k = 2$ ) of less than  $\pm 0.02\%$ . The excess molar volumes could be represented by Redlich-Kister polynomial equations. Our experimental data showed decreasing excess molar volumes with increasing temperature, which is in agreement with the well-known behavior for IL co-solvent mixtures. For the investigation in dependence on composition, negative excess molar volumes were obtained for all aprotic co-solvents and the protic co-solvent ethanol. The mixtures with the protic co-solvents methanol and water additionally show positive excess molar volume close to the salt-rich region. This is most likely due to the strong hydrogen bonding between the co-solvent molecules preventing them from interacting with the IL.