

PHYSICAL PROPERTIES AND SOLUBILITY OF CO₂ IN BIS(2-HYDROXYETHYL)AMMONIUM ACETATE ([BHEAA]), 1-BUTYL-3-METHYLIMIDAZOLIUM TETRAFLUOROBORATE ([BMIM][BF₄]) AND MONOETHANOLAMINE (MEA) BASED HYBRID SOLVENTS

by

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ABSTRACT

An industrially attractive solvent to capture CO_2 , has been developed by incorporating the desirable properties of ionic liquids (ILs) as well as amines through mixing of the targeted ILs with amine to form hybrid solvents for the effective capture of CO_2 . In the present work, ILs of two different families namely, bis(2-hydroxyethyl)ammonium acetate ([bheaa]) and 1-butyl-3-methylimidazolium tetrafluoroborate ([bmim][BF₄]) have been chosen to form a new binary/ ternary solvents in combination with monoethanolamine (MEA) and water for the solubility of CO_2 . In order to establish the physical properties for the new binary [(bheaa + water); (bheaa+ MEA); (bmimBF₄+water); BmimBF₄+MEA) / ternary [(bheaa + MEA + Water) (bmimBF₄ + MEA + Water)] solvents, density, viscosity and refractive index measurements have been made at $T = (293.15 \text{ to } 353.15) \text{ K}$ for the whole composition range. Based on the measured values the effects of temperature and concentration of individual species have been discussed in detail and suitable correlations have been proposed.

The excess properties, namely, the excess molar volume V^E , viscosity deviation $\Delta\eta$, as well as the refractive index deviation Δn_D , have been deduced from the measured density, viscosity and refractive index values respectively for all the binary and ternary systems studied in the research. The Redlich Kister equation was used to correlate the estimated excess properties for the binary systems while the Cibulka equation was used to correlate the excess properties for the ternary systems.

The CO_2 uptake capabilities of the present developed hybrid binary ([bheaa] + water; [bheaa] + MEA; [bmimBF₄] + water; [bmimBF₄]+MEA) / ternary ([bheaa] + MEA + Water, [bmimBF₄] + MEA + Water) solvents, have been made by using the SOLTEQ High Pressure Gas Solubility Cell (Model: BP-22) and the results are presented and the effect of concentration, pressure and temperature on the CO_2 uptake have been

discussed in detail. The present results indicated that the aqueous solution of [bheaa] + MEA have been found to have better CO₂ loading than the aqueous solution of [bmim][BF₄] + MEA. The combination of these chosen ILs with selective amine solution have proved to have the characteristics for efficient CO₂ capture and seems to be a promising alternative for the aqueous amine solution/absorbents which are currently being used for CO₂ absorption.