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## CO<sub>2</sub> absorption studies with hybrid solvents of 1-butyl-3-methylimidazolium tetrafluoroborate (BMIM[BF<sub>4</sub>]) + N-methyl-2-pyrrolidone (NMP) using a new static-synthetic equilibrium cell

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In order to design and optimize the separation technologies based on absorption method, accurate vapour-liquid equilibrium (VLE) data obtained through reliable experimental apparatus are required. To this end, a “static-synthetic” experimental setup was designed and commissioned. The novel design of the equilibrium cell consists of a sapphire tube compressed between a bottom weld-neck (tapered) flange and a top flat stainless steel flange. The wider base allows for improved agitation of the cell contents; furthermore, the change in height of liquid can be recorded more precisely along the length of the sapphire tube with reduced diameter. An adjustable ruler was designed and attached to the cell to measure the height of liquid. The experimental method was validated by measuring the CO<sub>2</sub> solubility in pure solvents, viz., hexane, NMP and BMIM[BF<sub>4</sub>]. Excellent agreement was obtained between the measured data and that reported in literature. New solubility data was measured for CO<sub>2</sub> in hybrid solvents with different mass compositions (10%, 25% and 50%) of BMIM[BF<sub>4</sub>] at temperatures of 298.15, 313.15 and 323.15 K and in the pressure range of 1 to 20 bar. The viscosity, density and vapor pressure for the NMP + BMIM[BF<sub>4</sub>] mixtures were also measured. Depending on the temperature, pressure and composition of solvents, the solubility of CO<sub>2</sub> in hybrid solvents reveals a decrease of 5% to 25% in comparison to the pure solvents. Meanwhile, the addition of NMP to BMIM[BF<sub>4</sub>], to make a mixture with 74% of ionic liquid, reduces the viscosity by approximately 70% which supports the use of BMIM[BF<sub>4</sub>] for such applications. Furthermore, the loss of solvent and its volatility were decreased when hybrid solvents were used instead of pure NMP. The experimental data were modelled using flash calculations utilizing the Peng-Robinson equation and the Wilson correlation. The average absolute relative deviations (AARD%) obtained were within 3.5%.

### Recent Publications:

1. “Experimental measurement of carbon dioxide solubility in 1-methylpyrrolidin-2-one (NMP) + 1-butyl-3-methyl-1H-imidazol-3-ium tetrafluoroborate ([bmim][BF<sub>4</sub>]) mixtures using a new static-synthetic cell”, Fluid Phase Equilibria journal, 2018.

### Biography

Mojgan Ebrahimejadhasanabadi currently is a final year PhD candidate at the Thermodynamic Research Unit, University of KwaZulu-Natal. Mojgan holds a BSc from University of Tehran (Sep 2007– Sep 2011) and MSc from Isfahan University of Technology (Sep 2011 –Sep 2013) in Chemical Engineering-Process Design. She was ranked top of her 2013 MSc Chemical Engineering cohort, graduating with a GPA score of 18.18 out of 20. She was a researcher at Enhanced Oil Recovery Institute (2011-2013) and Chemistry and Chemical Engineering Research Center of Iran (2015). Her research areas focuses on separation technologies, measurement of phase equilibrium data, equipment design and development for phase equilibrium measurements, CO<sub>2</sub> and H<sub>2</sub>S capture, and mathematical modelling. Her current research is ‘measurement of acid gas solubility in fluorochemical solvents’ to investigate the potential of selected fluorinated ionic liquids as additives to reduce the disadvantages of common technologies for the acid gas removal.

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