A Novel Generation of Sorbents Capable of Capturing Carbon Dioxide Using Ionic Liquids and Deep Eutectic Solvents

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In large-scale industrial applications, the high cost and energy associated with CO_2 capture from flue gases is a significant obstacle. It is therefore crucial to develop a technically and economically efficient technology for CO_2 capture. Ionic liquids (ILs) have been proposed as potential alternatives to conventional sorbents due to their inherent advantages in CO_2 capture, and interest has grown in the chemical modification of ILs to improve their performance in CO_2 absorption. As a new generation of ILs, deep eutectic solvents (DESs) are investigated as more cost-effective alternatives to overcome the disadvantages of conventional ILs, which have a high viscosity. In this study, the CO_2 absorption potential of functionalized DESs and ILs is investigated. The improvement of the absorption capacity of ILs can be achieved by incorporating CO_2-philic functional groups, such as amines, into the cation and/or anion moiety. Overall, the anion component of ILs is more efficiently functionalized than the cation component. DESs have favorable solvent properties and the ability to capture CO_2, but their research is limited and underdeveloped in comparison to that of ILs. In the present study, the solubility of CO_2 in diisporpylethylammonium-based ILs and polyol-based DESs comprised of choline chloride (ChCl)/diethylene glycol (DEG), ChCl/triethylene glycol (TEG), ChCl/tetraethylene glycol (TTEG), with molar ratios of 1:4, was measured using a high-pressure variable volume cell at temperatures ranging from 298.15 to 373.15 K and pressures up to 150 bar. Experimental vapor-liquid equilibrium (VLE) data were correlated using the PC-SAFT strategy. By adjusting the PC-SAFT parameters to the density data of pure ILs and DESs, pseudo-pure components are referred to as ILs and DESs in this work. The analysis revealed that the PC-SAFT equation of state accurately characterizes the solubility of CO_2 in diisporpylethylammonium-based ILs and polyol-based DESs. Novel ILs and DESs with promising absorption capacities are conceivably developable.

Keywords: CO_2; ionic liquids, deep eutectic solvents; polyols; PC-SAFT