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Do Ether Functionalized Ionic Liquids Improve the CO_2 Solubility?

Lawien F. Zubeir*, Wilko M. A. Weggemans, Maaike C. Kroon

*Presenting author's email: L.F.Zubeir@tue.nl

Eindhoven University of Technology, Eindhoven, The Netherlands, 5600 MB

Abstract

CO_2 absorption using a solvent is accepted as the most compatible technology. In the recent years ionic liquids (ILs) have shown to be good candidates for CO_2 capture. They exhibit major advantages compared to amine-based systems. Their negligible vapor pressure, high thermal and chemical stability and tunability outweigh the disadvantages of lower absorptive capacity and kinetics.

In this work a comprehensive study of the ILs [C_2mim]-, [C_4mim]-, [C_6mim]-, [C_7mim]- and [C_8mim] tricyanomethanide (TCM) has been carried out. Furthermore, in order to evaluate the presence of ether groups in the alkyl chain of the imidazolium, this work includes 1-(2-methoxythyl)-3-methylimidazolium- and 1[2-(2-methoxyethoxy)ethyl]-3-methylimidazolium tricyanomethanide. These non-flourinated and low-viscous ILs are studied for the first time as a solvent for CO_2 capture. Two different methods (volumetric vs gravimetric) were applied to study the thermodynamics (i.e., absorptive capacity and Henry's law coefficient) and kinetics (i.e., diffusion coefficient) at several temperatures and pressures up to 150 bars. The experimentally determined phase behavior of the IL and CO_2 systems are correlated using the Peng-Robinson equation of state. Furthermore, the thermal operating window (e.g., glass transition and decomposition temperature) and physical properties (e.g., density, viscosity, conductivity and surface tension) were determined.

It will be shown at the conference that TCM-based ILs are promising sorbents for pre-combustion CO_2 capture due to their high (physical) absorptive capacity, their low regeneration energy consumption (low heat of absorption) and improved kinetics (due to their low viscosity) compared to the conventional ILs.