Determination of CO_2 Solubility in Ionic Liquids for Cellulose Processing

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Ionic liquids (ILs) are gathering increasing attention as a new class of green solvents thanks to their negligible vapor pressure. Moreover, they can be tailored by proper choice of the anion and cation to suit the desired application. Particularly interesting are those ILs capable of dissolving cellulose to be used as a medium for biomass fractionation or cellulose processing. The combination of ILs with another green solvent, supercritical CO_2, can bring additional advantages to the potential applications of the former. CO_2 can decrease the melting point and viscosity of ILs, or form a biphasic system that helps solute recovery. For instance, addition of CO_2 has been demonstrated to be beneficial in the acetylation of cellulose in allylmethylimidazolium chloride (AmimCl). Thus, knowledge of phase behavior of the systems IL + CO_2 is necessary to properly develop these new technologies. A Van Ness-type apparatus is used to determine the solubility of CO_2 in IL. It consists of a static high-pressure equilibrium cell immersed in a water bath to keep constant temperature. A known amount of IL is introduced in the cell and sealed. Then a known amount of CO_2 is added by means of an ISCO pump. When the equilibrium is reached, the pressure is recorded, and the next load of CO_2 is pumped. Solubility is calculated from the total amount of CO_2 added, the density of the mixture IL + CO_2 and the properties of CO_2 provided by REFPROP. The solubility of CO_2 in ILs with capacity to dissolve cellulose (AmimCl, Buthylmethylimidazolium Chloride (BmimCl) and Ethylmethylimidazolium diethylphosphate) are determined at (40, 60 and 80) °C. The possibility of operating the device in isopletic mode is also explored (keeping constant overall composition and changing temperature). The data are modelled with a group contribution equation of state.

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