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Experimental study on CO₂ sorption capacity of the neat and porous silica supported ionic liquids and the effect of water content of flue gas

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Abstract:

In this research, absorption of CO₂ in different ionic liquids (ILs) is studied. Thus four ILs were synthesized containing 1-butyl-3-methylimidazolium as the cation and nitrate [NO₃]⁻, thiocyanate [SCN]⁻, dicyanamide [N(CN)₂]⁻ and hydrogen sulfate [HSO₄]⁻ as the anions, respectively. The resulting ILs were then immobilized into activated silica support in a 1/1 IL/SiO₂ weight ratio via the impregnation-vaporization method. CO₂ sorption behavior of both neat and silica supported ILs (ILs-SiO₂) were investigated at different temperatures and flow rates under atmospheric pressure, while their desorption process were carried out under 20 mmHg at 70°C. In both sorbents, the best results were obtained at 25°C with a flow rate of 12 mL/min, where [bmim][N(CN)₂] with 1.85 (wt%) or 0.42 mmol CO₂ per gram of sorbent and [bmim][HSO₄]-SiO₂ with 2.33 (wt%) or 0.53 mmol CO₂ per gram of sorbent showed the highest sorption capacities. The effect of water on CO₂ absorption capacity of the neat and silica supported ILs were also studied by transmission of CO₂ gas flue containing 400 ppm water. The results indicated that the mass gain was higher when wet CO₂ was passed through the sorbents, opposed to passing dry CO₂. Because of the existence of a weak coulombic interaction between the sorbents and CO₂, desorption occurs rapidly and a readily reuse of the sorbents is therefore provided.

Key words: Carbon dioxide, Sorption, Desorption, Supported ionic liquid, ILs-loaded silica

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