APPLICATION OF ACTIVATED CARBONS INCORPORATING [Emim][Gly] IONIC LIQUID FOR POST-COMBUSTION CO_2 CAPTURE

M. Balsamo[1], A. Erto[1], A. Lancia[1], F. Montagnaro[2]
marco.balsamo@unina.it
[1] Dipartimento di Ingegneria Chimica, dei Materiali e della Produzione Industriale, Università degli Studi di Napoli Federico II, P.le Tecchio 80, 80125 Napoli, Italy
[2] Dipartimento di Scienze Chimiche, Università degli Studi di Napoli Federico II, Complesso Universitario di Monte Sant'Angelo, 80126 Napoli, Italy

As long as the use of fossil fuels plays a crucial role in worldwide energy production, CO_2 capture and storage (CCS) is a key strategy for mitigating global climate change commonly related to greenhouse gas emissions. Among CCS technological pathways, post-combustion CO_2 capture from flue-gases is considered a prompt solution to mitigate CO_2 environmental impacts because treatment units can be retrofitted to existing power plants. In this scenario, the investigation of ionic liquids (ILs) as innovative solvents for CO_2 capture appears an attractive option for the development of efficient post-combustion purification systems due to the unique characteristics of this class of compounds, such as negligible vapour pressure, high thermo-chemical stability and tuneable chemico-physical properties. Notwithstanding many scientific papers investigate different ILs in CCS field, there is scarce information concerning the effect of confining ILs into porous substrates on CO_2 capture performances. This application can be considered very promising for ILs use optimization due to their generally high market costs and for the expected improvement of CO_2 adsorption capacity.

This work investigates CO_2 capture capacity of Filtrasorb 400 and Nuchar RGC30 activated carbons (ACs) functionalized with 1-ethyl-3-methylimidazolium glycine [Emim][Gly] IL. The adsorbents were prepared by impregnating each AC at two levels of IL concentration $C°=5.6\times10^{-3}$ and 2.2×10^{-2} M in methanol, followed by solution filtration and residual solvent evaporation. N_2 porosimetric characterization at 77 K of raw and functionalized ACs revealed that [Emim][Gly] preferentially adsorbs in micropores for both ACs and in general the higher the IL loading, the greater the micropore occlusion. CO_2 adsorption tests on functionalized ACs were performed in a fixed bed column at 303 and 353 K with simulated flue-gas (CO_2 1-30% by vol., balance N_2). Results showed that, for both ACs pores blocking induced by the presence of the IL is the prevailing effect at 303 K which determines a worsening of CO_2 capture performances of each functionalized material with respect to the parent one. For both Filtrasorb 400 and Nuchar RGC30 impregnated with [Emim][Gly] at $C°=5.6\times10^{-3}$ M the active phase was able to ameliorate the parent AC capture performances at 353 K thanks to a good compromise between IL loading and pore accessibility (i.e. a low pore volume reduction). Results obtained in this work encourage future research efforts in the field of porous substrates functionalization with amine-based ILs as a potential route to improve their CO_2 capture performances, in particular at high temperatures at which the parent material performances are quite scarce to allow a cost-effective treatment of a real flue-gas.

10.4405/profic2014.C2