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Use of DES and DES supported membranes for CO2 solubilization and separation

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PURPOSE OF THE ABSTRACT

CO2 anthropogenic emissions are responsible for climate changes and the current climate crisis, having a direct impact in our society, economy, and health. It is therefore urgent to find technologies and solutions to deal with this problem. Given that the radical change to zero CO2 emissions is possible, it is a goal that is still being challenged for economic and political reasons. The most immediate, practical and pragmatic way to deal with CO2 emissions, is to consider post-combustion capture strategies, that capture and separate CO2 before its emission into the atmosphere. Although the solubilization in alternative solvents such as ionic liquids is well studied and presents attractive features, the benchmark process for CO2 capture and solubilization is still amine scrubbing- use of aqueous amine solutions to chemically capture CO2, which is then separated by applying heat. This process, however, is not aligned with the green chemistry philosophy, since the energetic cost of regeneration of the amines is very high, the formed amines can cause corrosion and they need to be regularly substituted due to loss of solvent, compromising its reutilization.

In the last years, deep eutectic systems have been considered as potential solvents for CO2 solubilization. Various DES have been tested as CO2 absorbents, mostly the ones composed of choline chloride and urea or glycerol, showing high values of CO2 solubility[1]. Li et al. tested CO2 absorption in ChCl:urea (1:2) and ChCl and glycol based DES, Leron et al. also measured CO2 solubility in ChCl:glycerol[1]. All of the DES presented CO2 uptake values comparable to the ones obtained for ILs, but still lower when compared to the aqueous amine-based processes. Recently, the solubility of CO2 for ChCl based DES was determined, and DES supported membranes were prepared, exhibiting good selectivities towards CO2 compared to CH4 and N2[2]. The use of enzymes can also improve the absorption process of CO2 in these systems, such as the use of carbonic anhydrase (CA)[3].

In this work, different families of DES were studied regarding CO2 solubility, mainly based in betaine, with different amounts of enzyme CA. Also, these DES were supported in PTFE membranes, and the permeability of these membranes to different gases such as N2, CH4 and CO2 was measured. The ideal selectivity of the DES supported membranes was determined yielding very promising results. The results obtained also took into account the viscosity of the DES, and the influence of their water content in their properties and on the CA activity.

The results obtained show that DES supported membranes are efficient in selective absorption of CO2 in ideal gas mixtures, and these membranes can have applications in biogas purification, for example.

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FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

CO2 | DES | Membranes | CO2 capture

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