CO$_2$ CAPTURE FROM HIGH TEMPERATURE SOURCES USING ROOM TEMPERATURE IONIC LIQUIDS

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Introduction: Carbon dioxide (CO$_2$) capture at high temperatures from emission sources generated by power plants has been attracting much attention due to the enhanced greenhouse effect [1]. Therefore, there is a continuing effort to find energy efficient separation technologies for capturing CO$_2$. This works aims to study the potential of using room temperature ionic liquids immobilized in ceramic or polymeric supports for CO$_2$ capture.

Experimental: The first studies carried out consisted on the measurement of solubility and diffusivity coefficients of the pure gases CO$_2$, N$_2$ and CH$_4$ in the room temperature ionic liquid [C$_4$MIM][Tf$_2$N], and in the organic solvent polyethylene glycol (PEG300) at different temperatures (between 30ºC and 100ºC). The experimental setup used to determine both coefficients involved monitoring the evolution of the pressure decay with time, which was related with the absorption of the gas by the solvent thin film [2]. The experimental set-up used to perform this experiments is shown in Figure 1.
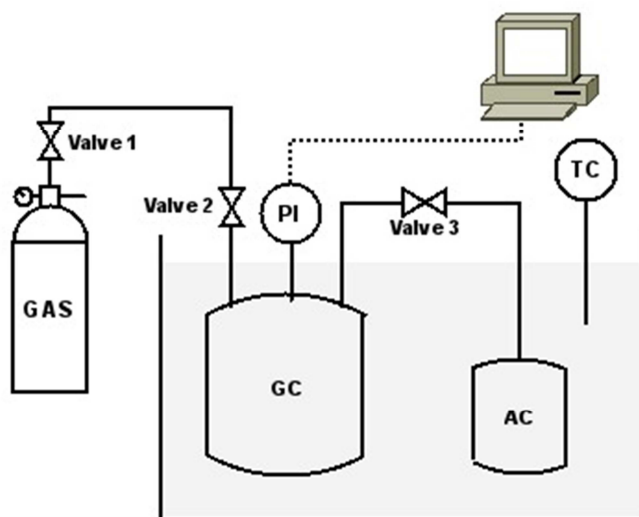

Figure 1. Gas absorption experimental set-up. GC - Gas compartment; AC - Absorption Compartment; TC - Temperature Controller; PI - Pressure Indicator.

The second part of this study consisted on the immobilization of the ionic liquid and the organic solvent PEG in porous polymeric and ceramic supports. After immobilization, gas permeability experiments were carried out at different temperatures (between 30ºC and 100ºC).

Results and discussion: For all the temperatures tested, it has been observed that the ionic liquid and the organic solvent presented a higher solubility coefficient for CO_2 when compared with the other gases (N_2 and CH_4). Additionally, the diffusion coefficient of N_2 is higher than the one obtained for CO_2, and it increases with an increase in temperature, which may be related with a decrease in solvent viscosity.

It has been observed that the supported liquid membranes, impregnated either with the ionic liquid and the organic solvent, are stable at the different temperatures tested, and for a pressure diference up to 0.7 bar. Moreover, CO_2 permeability is higher when compared with N_2 permeability. CO_2/N_2 ideal selectivity of the supported liquid membranes was also calculated, and the results are shown in Table 1. As it can be observed, selectivity towards CO_2 was higher when compared to that of N_2 for the ionic liquid (selectivity values in the range of 7-48), and for the organic solvent PEG (selectivity values in the range of 8-14).

Table 1. CO_2/N_2 ideal selectivity for the SLMs tested.

	α_{CO_2/N_2}	
Temperature (°K)	**[C$_4$MIM][Tf$_2$N]**	**PEG**
303	48	14
323	22	13
353	7	9
373	8	8

Conclusions: The high selectivity values obtained in this work for CO_2 open good perspectives for these supported liquid membranes to be used for CO_2 separation processes.

References:

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