Promoted sodium carbonate solution by amino acids for post combustion CO2 capture using membrane contactors

Vida Sang Sefidi[a,b], Alissa Pirson[a], Patricia Luis[a,b]

[a] Materials & Process Engineering (iMMC-IMAP), UCLouvain, Place Sainte Barbe 2, 1348 Louvain-la-Neuve, Belgium

[b] Research & Innovation Centre for Process Engineering (ReCIPE), Place Sainte Barbe, 2 bte L5.02.02 - B-1348 Louvain-la-Neuve (Belgium)

Introduction:

Burning the fossil fuels for energy and transport has caused a significant increase in the CO_2 emission leading to catastrophic problems for the environment. One of the presented solution to reduce CO_2 emissions from power plants is using CO_2 capture and storage/utilization technologies.

One of the newest studied technologies is membrane gas absorption (MGA) where the membrane contactor acts as a non-selective barrier providing the contacting surface for gas and liquid. Carbonate solutions are studied as a green solvent in MGA. However, due to low absorption rate of the solvent which increases the capital cost of the process, a promoter such as amino acids are introduced to increase absorption rate. In this study, arginine and sarcosine are studied as promoters. Moreover, several operational parameters are studied to find the optimal condition.

Material and method:

Arginine (Sigma Aldrich,99%), Na_2CO_3 (sigma aldrich, Germany) enters membrane contactor in recirculation in lumen side of a hollow fiber membrane contactor (MiniModule 1x5.5 G543, liquid-Cel, Membrane GmbH, Germany) and 15% of CO_2 and air is entering shell side. CO_2 percentage of outlet gas is analyzed via a CO_2 gas analyzer (Rosemount™ X-stream enhanced XEGK countinuous gas analyzer, Emerson, Germany). The below formula is used to calculate total mass transfer coefficient (Kov) is calculated as follows:

$$K_{ov} = \frac{v_g(C_{i,g,in} - C_{i,g,out})}{A_m \Delta C_m} \qquad (1)$$

Results:

Several operational parameters such as liquid and gas flow rates, amino acids concentration, CO_2 concentration, presence of impurities, and temperature of the solution, are studied. It was found that with increase of gas and liquid velocity, Kov will increase due to a reduction in gas boundary layer resistance. The liquid temperature influence on Kov is negligible. However, effect of impurities in the solution cannot be overlooked. As there is a significant decrease in Kov when concentration of impurities decreases in the solution. In general, optimal condition are found to have a higher Kov.

Conclusion:

In general, the addition of the amino acids promotes the mass transfer coefficient. In this study the operational condition to have an economical process, are studied and optimal condition were chosen for further studies.