Title:

Carbon dioxide absorption of aqueous amino acids solutions by using membrane contactors

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Abstract:

Introduction:

CO_2 emission of the power plants is one of the main contributor to the global warming. [1]. The most extended post combustion CO_2 capture technologies rely on absorption columns, which includes a variety of operational problems such as fouling, channelling, high capital costs, etc. Membrane technology has been introduced as an alternative to the conventional technology [2], [3]. However, amine-based systems have high energy requirements for solvent regeneration and large solvent losses due to amine vaporization [5],[6]. For this reason, the use of novel absorption solvents has been proposed in membrane contactors. For example, solvents with similar functionality as amines, such as amino acid salts (AAS) [7] [8] are positively characterized by their high surface tension and non-volatility, and their kinetics is defined by zwitterion reaction [9],[10]

In this work, five different amino acids have been studied for CO_2 capture. The feasibility of CO_2 capture is studied in the membrane contactor using the amino acid salts solutions as the solvent, activated with NaOH. The process performance using the amino acids was compared to that using only NaOH in solution.

Results and discussion:

The overall mass transfer coefficient (K_{ov}) and process performance using amino acids and amino acid salts were studied. All amino acids saturated shortly after the start of experiments except arginine. The results could be explained since acid dissociation constant (pKa) for some amino acids is low. However, similar performance of arginine to NaOH is related to their comparable high pKa values.

The amino acid absorption improves after the activation with a base. As all amino acids have a primary amine group, it is expected to observe a similar performance when they are activated. However, not all amino acids showed same absorption rate for CO_2 capture, which is related to the difference in their structure. In addition, the absorption rate is higher when an amino acid is activated with a base that has higher pKa. A stronger base has higher capability of activation of amino acids.

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