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1st Post Combustion Capture Conference

Screening of amino acid salts solutions for application in CO_2 capture from flue gas.

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CO_2 capture; Amino acid salt solution; Flue gas; solvent properties; CO_2 loading capacity; Precipitation; Dynamic flow method

1. Introduction

Reversible absorption of carbon dioxide (CO_2) into a chemical solvent is currently the leading CO_2 capture technology. During contact with the flue gas, the solvent chemically absorbs the CO_2. Heating of the CO_2 rich solvent leads to release of the CO_2 from the solvent, which is hereby regenerated and ready for another round of absorption. The captured CO_2 can now be compressed and transported to a storage location [1]. Available solvents are almost exclusively based on aqueous solutions of alkanolamines, which entail both economic and environmental complications [2]. Because the need to capture CO_2 is gaining relevance, there is an urgent need for the development of new and better solvents. Due to a number of advantages, amino acid salt solutions have emerged as an alternative to alkanolamine solutions. However, only few studies of amino acids in CO_2 capture from flue gas have been performed so far [3]. In order to select appropriate amino acids for the process, we have developed a screening procedure, in which amino acid salts are tested in regard to important solvent properties, such as water solubility, heat stability, CO_2 loading capacity, as well as the ability to form precipitation upon the absorption of CO_2. Results are presented for a number of amino acids subjected to our screening procedure. Based on these results, general conclusions have been made on the use of amino acid salt solutions as solvents for CO_2 capture from flue gas.

2. Steps of the screening procedure

The maximum solubility of the amino acid salt in water will determine the maximal CO_2 loading per kg water. A higher CO_2 loading per kg water will reduce the cost of the capture process, as less energy is lost to the heating of water during stripping of the CO_2 from the amino acid. We started our screening procedure with a solubility study, where the water solubility of selected amino acids was examined. The amino acid salts showing good solubility, were carried on to the next step of the screening procedure, the heat stability study.

As the solution has to be heated in order to release the CO_2, knowledge of the heat stability of the amino acid salt solutions is important. The method used for the heat stability study is a well known biochemical technique, called amino acid analysis, which is developed for determining the amount of different amino acids in a protein sample. By comparing heated and unheated samples, the degree of degradation due to heating was determined.

For the purpose of studying the CO_2 loading capacity of amino acid salt solutions, we developed an experimental set-up based on a dynamic analytical mode, with analysis of the effluent gas (Figure1).

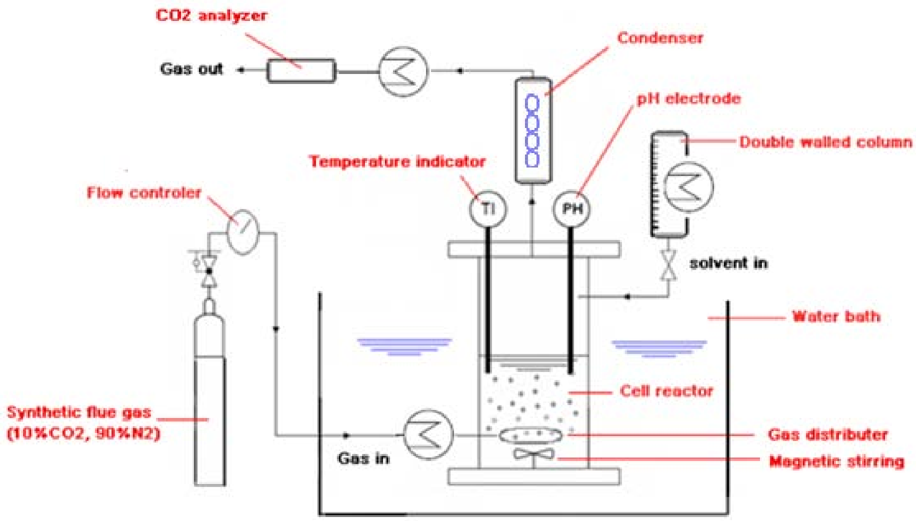

Figure 1: Experimental set-up to study the CO_2 loading capacity of amino acid salt solutions.

Using this set-up, the CO_2 loading capacity of aqueous solutions of the potassium salts of selected amino acids were examined, and the relation between the initial amino acid salt concentration and precipitation ability of each solution were determined. Experiments were performed at a partial pressure of CO_2 close to 10 kPa, and a total pressure around 100 kPa, and a temperature close to 298 K. The chemical nature of the obtained precipitates was determined using X-ray diffraction and infra-red spectroscopy.

3. References

1. IPCC Special Report on Carbon Dioxide Capture and storage. (2005)
2. P.S. Kumar et al. Ind. Eng. Chem. Res. 42 (2003) 2832-2840.
3. Benedicte Mai Lerche, Erling H. Stenby and Kaj Thomsen “CO_2 Capture from Flue Gas using Amino Acid Salt Solutions”. *Proceedings from Risoe International Energy Conference 2009.*