Amino acid salt solutions as solvents in CO2 capture from flue gas
CO2 loading capacity and precipitation.

Lerche, Benedicte Mai; Thomsen, Kaj; Stenby, Erling Halfdan

Publication date:
2011

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):
Amino acid salt solutions as solvents in CO₂ capture from flue gas; CO₂ loading capacity and precipitation

Benedicte Mai Lerche, Erling H. Stenby and Kaj Thomsen
CERE (Center for Energy Resources Engineering), Department of Chemical and Biochemical Engineering, Technical University of Denmark. In collaboration with DONG Energy & Vattenfall

CO₂ absorption into amino acid salt solutions is a bio-mimetic approach to CO₂ capture, because of its similarity to CO₂ binding by hemoglobin and other proteins present in the blood.

The reactions taking place between CO₂ and amino acid salt solutions are as follows:

\[
\text{OOC-R-NH2 + CO}_2 \rightarrow \text{OOC-R-NHCOO}^{-} + \text{H}^+ \quad \text{Carbonate formation}
\]

\[
\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \quad \text{Hydrogencarbonate formation}
\]

In comparison to alkanolamine solutions, amino acid solutions have desirable properties including:

- High stability towards oxidative degradation
- Low volatility
- Environmental friendly (as they are naturally present in plants, animals, humans, etc.)

Using the dynamic flow set-up the CO₂ absorption ability of 4 amino acids were studied

Figure 1-4: CO₂ loading capacity of aqueous solutions of the potassium salt of lysine, glycine, taurine and proline. The experimental conditions were: 40°C, partial pressure of CO₂ = 10 kPa, and total pressure = 100 kPa. Yellow points indicates that precipitation occurred during the CO₂ loading experiment. According to literature, precipitation has the ability to increase the CO₂ loading capacity of the solution[2-3].

Figure 5: The results from figure 1-4, together with similar results for MEA, obtained at the same experimental conditions.

Validation of the set-up with MEA

The dynamic flow set-up was validated using aqueous solutions of monoethanolamine (MEA) with concentrations between 2 - 8 molal, at a partial pressure of CO₂ = 10 kPa, at 40°C and a total pressure of 100 kPa. The obtained data were validated against calculations of the Extended UNIQUAC thermodynamic model [1].


[2] M. Majchrowski et al. GHGT8 Trondheim

Conclusions

The amino acids tested showed good CO₂ loading capacities when compared with MEA.

With increased amino acid salt concentration precipitation was observed for glycine, taurine and proline.

There is no increase in CO₂ loading capacity due to precipitation under the experimental conditions used.

Lysine offers high CO₂ loading capacity without precipitation.