Abstract

Our preliminary process modelling showed that amine-based liquid capture technology can be the way toward low cost, large scale Direct Air capture of CO2 (DAC). It also indicated that lower capital cost by using low-volatile absorbents like amino acid salts in readily available cheap gas-liquid contactors like cooling towers, reducing energy cost by process optimization and energy integration, and scale up can potentially reduce the capture cost to below $100/tCO2.

The use of amino acid salts for DAC has been explored through experimental assessments of their robustness and their mass transfer performance. In addition, various gas-liquid contacting devices were characterised for capture of CO2 from the air. An amino acid salt (named here AAP1) was found to be a suitable candidate for DAC, due to its low volatility, high stability, and reasonably high CO2 capture capacity and mass transfer rate. The results also indicated that simple “off the shelf” cooling towers are effective in providing sufficient contact area for the reaction between ambient CO2 and the absorption liquid. Next, the thermodynamics and mass transfer data collected for AAP1 were used to develop a simple model and preliminary design for a demonstrator that is capable of capturing around 100 tCO2/a. The effect of capture rate, rich and lean CO2 loadings, ambient air temperature and liquid to gas ratio (L/G) on equipment size and energy requirement were investigated.

Keywords: Direct Air Capture, Liquid amine, Amino acid salt, Demonstrator, CO2 loading