Motivation

Climate change is one of the most critical global challenges. Increasing atmospheric CO₂ concentration brought by anthropogenic emissions is the primary driver of climate change. Capturing CO₂ from emission points and even directly from air provides a potential solution to mitigate the amount of CO₂ emissions and reduce the atmospheric CO₂ concentration. Anion exchange resin (AER), a polymeric material with amine-functionalized groups (Figure 1) usually used in water desalination process, has been proven to be a promising solid amine sorbent for CO₂ capture¹.

Technological challenge

CO₂ capture using ion exchange AERs involves adsorption and desorption steps. CO₂ from CO₂-rich stream can be adsorbed so that the outlet becomes CO₂-lean stream, and pure CO₂ can be produced during desorption. The adsorption process is due to the reaction between fixed amine groups on the resins and CO₂. Since the reaction can be reversed at around 100 °C, conventional desorption process is by heating up the resins. Nevertheless, the regeneration of AERs using a high temperature restricts the application of this material owing to the high energy cost and likely degradation of resins.

In this work, we propose a novel method to combine the conventional adsorption step with a more efficient desorption step. The major challenge is to discover operation conditions that give high CO₂ capture performance at low energy consumption.

Research goals

- Developing a novel system for CO₂ capture based on ion exchange resins
- Investigating the CO₂ capture performance and energy consumption of the system under different current density, CO₂ partial pressure, and initial concentration of the regeneration solution
- Studying the performance of the system with different sorbents
- Developing a mathematical model of the system describing the kinetics and transport of various components

Fig 1. a) VP OC 1065 anion exchange resins used in this study (bead size: 0.315 – 1.25 mm); b) Primary benzyl amine repeat unit in the VP OC 1065 resin