Adsorptive CO2 Capture from Ambient Air by Zeolites

Xavier Bonelli, ASU Undergraduate, Chemical Engineering
Advisors: Dr. Shuguang Deng, ASU, Chemical Engineering; Dr. Mai Xu, ASU, Postdoctoral Research Associate

Synthesis of Zeolites

- 1:10 by mass of Bentonite Clay to zeolite
- Packed into Pellets
- Baked in furnace

Breakthrough Experiments

- Pack column with silica and zeolite pellets
- Regenerate zeolites with helium at high temperatures for 12 hours
- Run desired CO2 concentration through column until zeolites are saturated

Figure 1

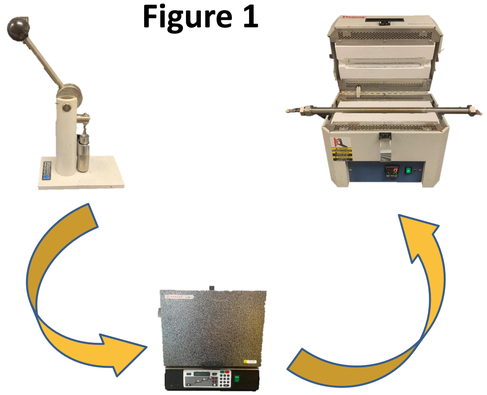
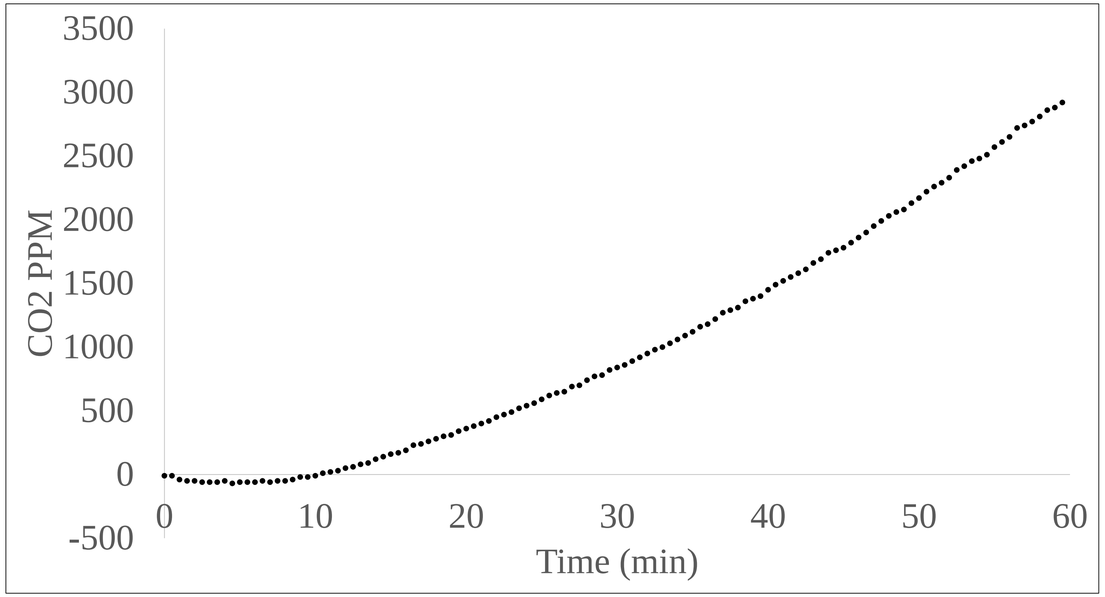


Figure 1 illustrates the process of synthesizing the zeolite pellets and putting them into the breakthrough experiment apparatus.

Abstract

The purpose of this research is to investigate how absorption equilibrium and separation breakthrough behavior of CO2/N2 will deviate at different relative humidity conditions with zeolites. Zeolites were chosen as the material for the separation because prior research shows that they have a high selectivity of CO_2/N_2 and they have a high CO2 capacity. They were also chosen for their cost-effectiveness.

Data



The following data shows the partial breakthrough experiment of CO_2 at 1 atm, 25°C, 200 mL/min, and a CO_2 concentration of ~10,000 PPM. This trial was used to test the effectiveness of the zeolite adsorption after synthesis. The trial did not reach the breakthrough point and was only set to run for an hour.

Conclusion

This semester was primarily used for the synthesis of the zeolites and their effectiveness will be tested in future research. Initial testing however has yielded promising results. Even with an incomplete breakthrough experiment, the zeolites were able to adsorb 26.4 mg of CO_2 per gram of zeolite which is significantly better than the current results that the ASU senior chemical engineering lab could produce under similar conditions (2.11 mg of CO_2 per g of zeolite).

Obstacles

- Pellets had to be created one at a time
- Tests had to be performed in quick succession
- Long deration of tests/ manufacturing

Next Steps

- Collect more adsorption kinetic data
- Conduct isotherm study to determine equilibrium data testing 0-500 PPM and 0°C-300°C
- Conduct Column study to determine breakthrough behavior with humidity levels ranging from 0-100%
- Desorption Study to test the desorption rate
- Simulate CO_2 breakthrough performance of NZX absorbent.

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Ira A. Fulton Schools of Engineering
Arizona State University