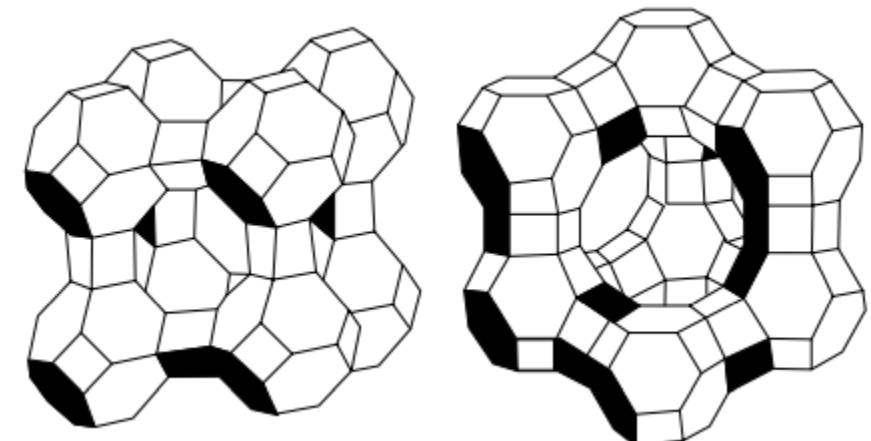
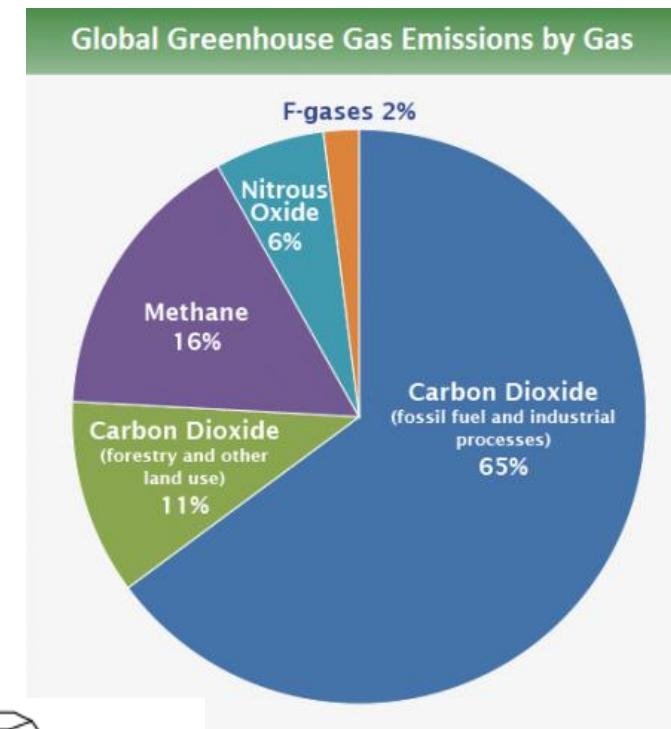
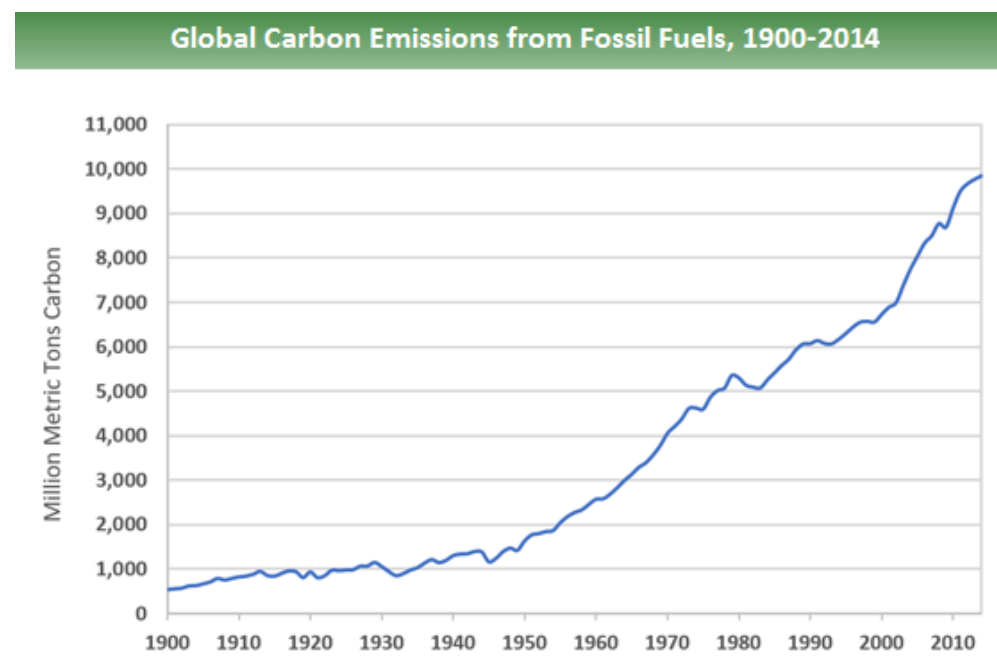


Adsorptive CO₂ Capture from Ambient Air by Zeolites

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

Background



Type A Zeolite Type X & Y Zeolite

Methods

Pelletizing

Synthesis

Desorption

Adsorption

gPROMS Model

Degas

3Flex

Langmuir Model

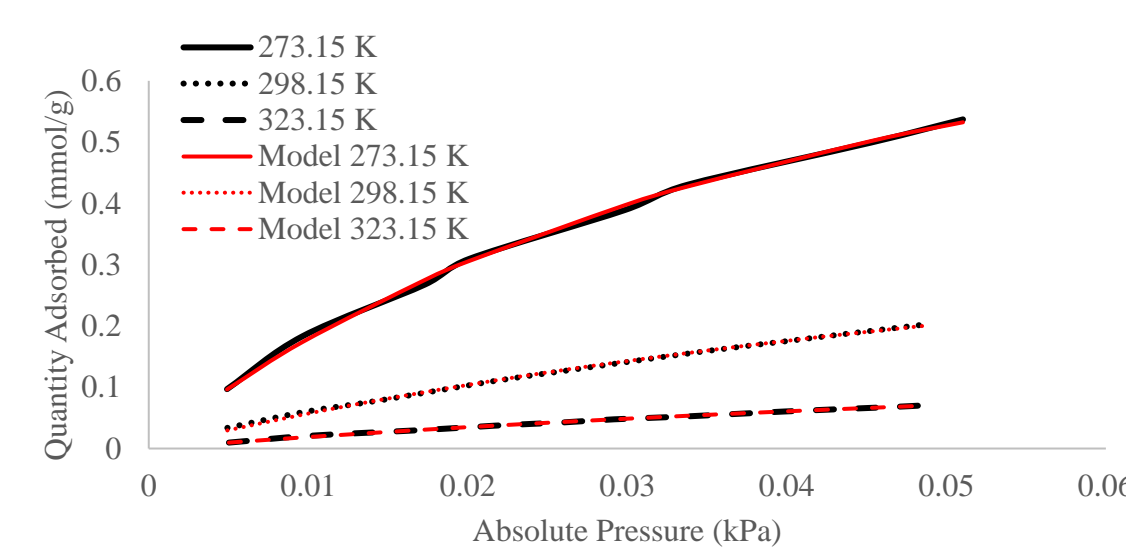
Isotherm Equilibrium Data

Langmuir Isothermal Model

$$q_i = \frac{q_e b P}{1 + b P}$$

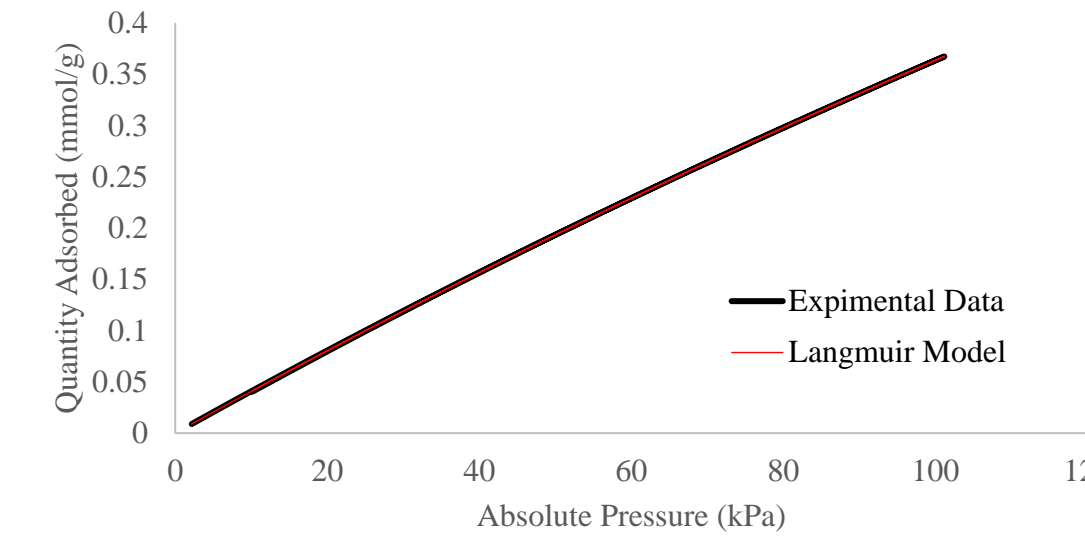
Carbon Dioxide

Temperatures	q_e (mmol/g)	b (1/kPa)
273	1.023032247	21.26600417
298	0.569272236	11.19791372
323	0.228888125	9.029765795

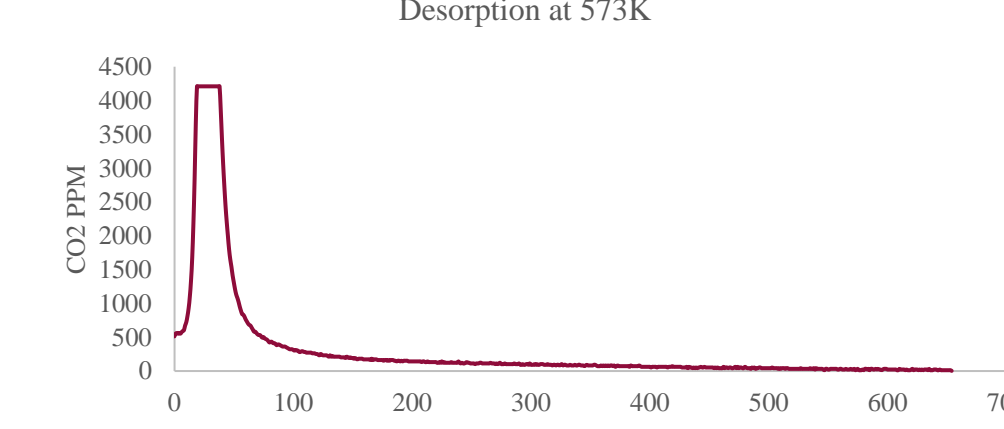
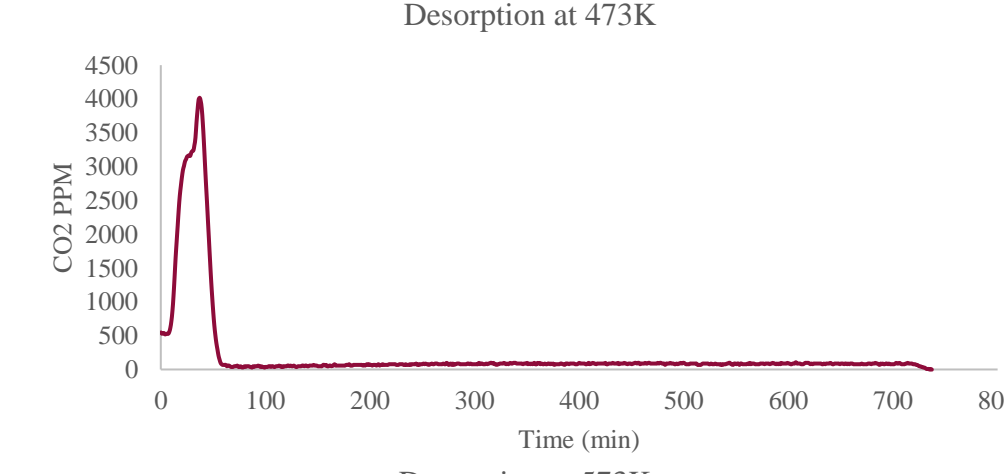
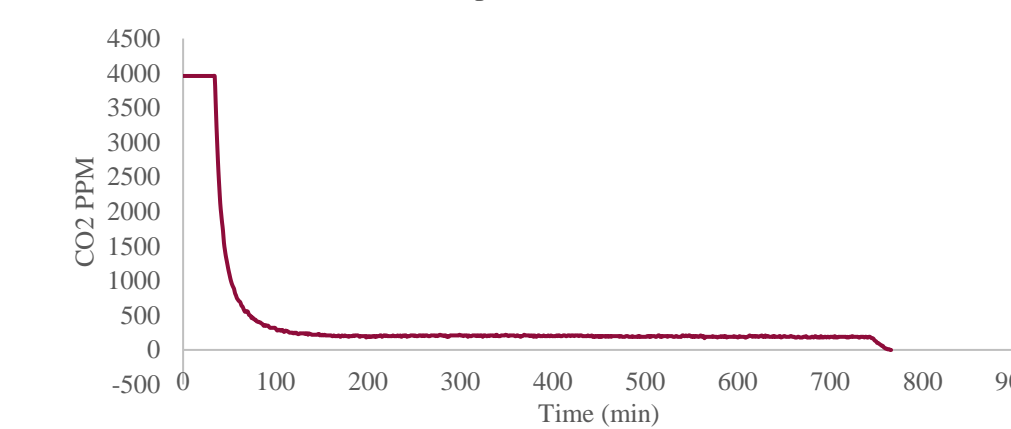
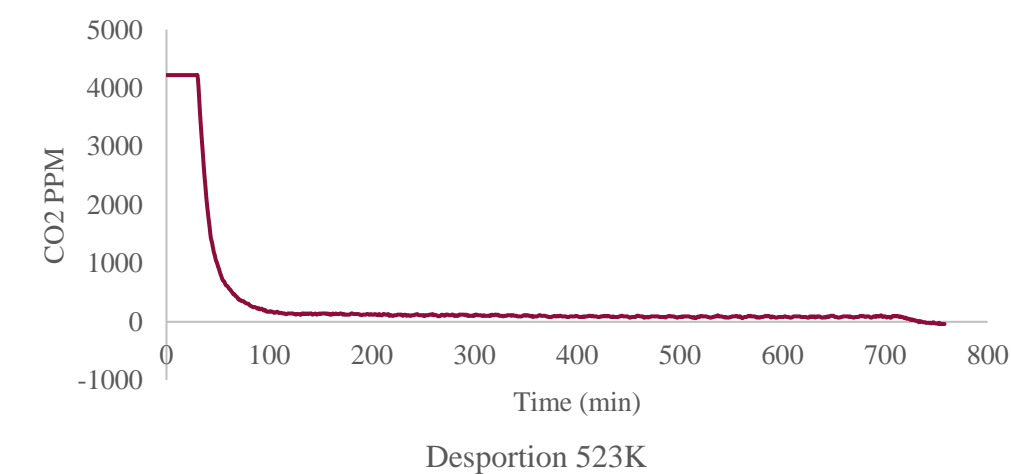
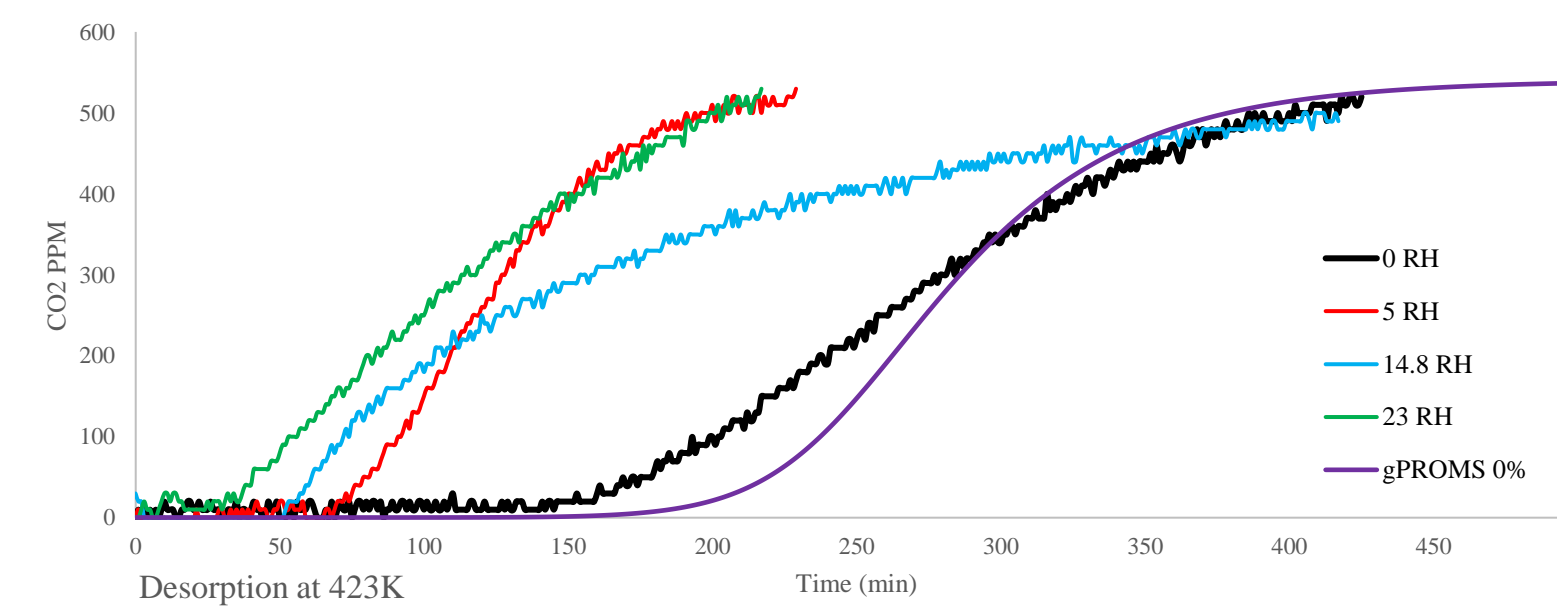


Nitrogen

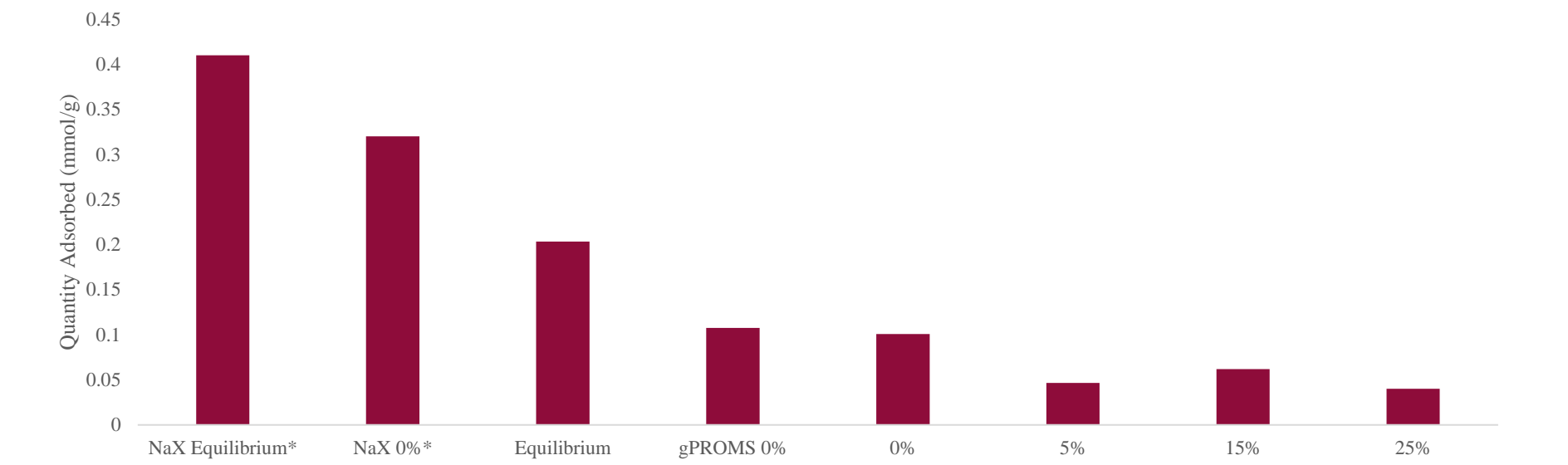
q_e (mmol/g)	b (1/kPa)
3.057501848	0.00134942



Adsorption & Desorption Data



Conclusion



The following data is the maximum quantity adsorbed by the nanostructure NaX in the breakthrough and isothermal equilibrium data at 298.15 K compared to the results done by the University of Michigan with a NaX zeolite. What was determined was that the nanostructure NaX zeolite performed worse overall compared to the NaX zeolite and that maximum carbon dioxide capture decreased linearly with increased relative humidity.

Future Work

Sorbent	Desorption	Adsorption	Over Performance
True Density @STP	Pressure	Pressure	Space Velocity
Bulk Density	Temperature	Temperature	Volumetric
Average Particle Diameter	Equilibrium Loading	Equilibrium Loading	Productivity
Particle Void Fraction	Heat of desorption	Heat of Adsorption	CO ₂ Capture
Packing Density	CO ₂ desorption Kinetics	CO ₂ adsorption Kinetics	Efficiency (single pass)
Solid Heat Capacity @STP			Pressure Drop
Crush Strength			Degradation
Attrition rate			
Thermal Conductivity			

References

Boden, T.A., Marland, G., and Andres, R.J. (2017). [Global, Regional, and National Fossil-Fuel CO₂Emissions](#). Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001_V2017

[IPCC \(2014\) EXIT](#) based on global emissions from 2010. Details about the sources included in these estimates can be found in the [Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change](#).

Yang RT. *Adsorbents Fundamentals and Applications*. Hoboken: Wiley-Interscience; 2003.

Stuckert, Nicholas R, and Ralph T Yang. "CO₂ Capture from the Atmosphere and Simultaneous Concentration Using Zeolites and Amine-Grafted SBA-15." *Environmental Science and Technology*, n.d.