PROJECT GOALS

The goal of this research project is to understand how the commercially used catalyst Zeolite Socony Mobil–5 (ZSM-5) performs under changes in temperature and concentrations of reactants. *ZSM-5* is an aluminosilicate zeolite widely used in the petroleum industry as a heterogeneous catalyst for hydrocarbon isomerization reactions.

This project focused on the effects of temperature and reactant concentration variations on the rate of the reaction

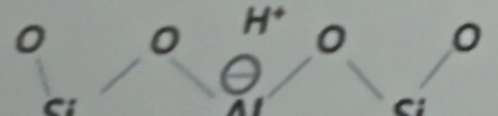
$$4\ NH_3 + 4\ NO + O_2 \rightarrow 4\ N_2 + 6\ H_2O,$$

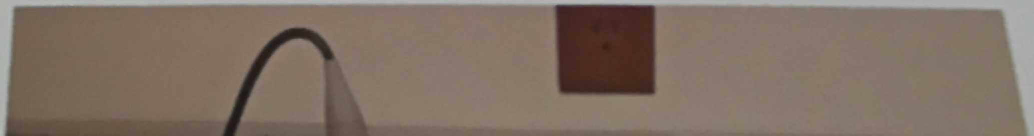
with *ZSM-5* present, in accordance with the Ideal Gas Law,

$$PV = nRT$$

or

$$dn/dt = d/dt\ [PV/RT].$$

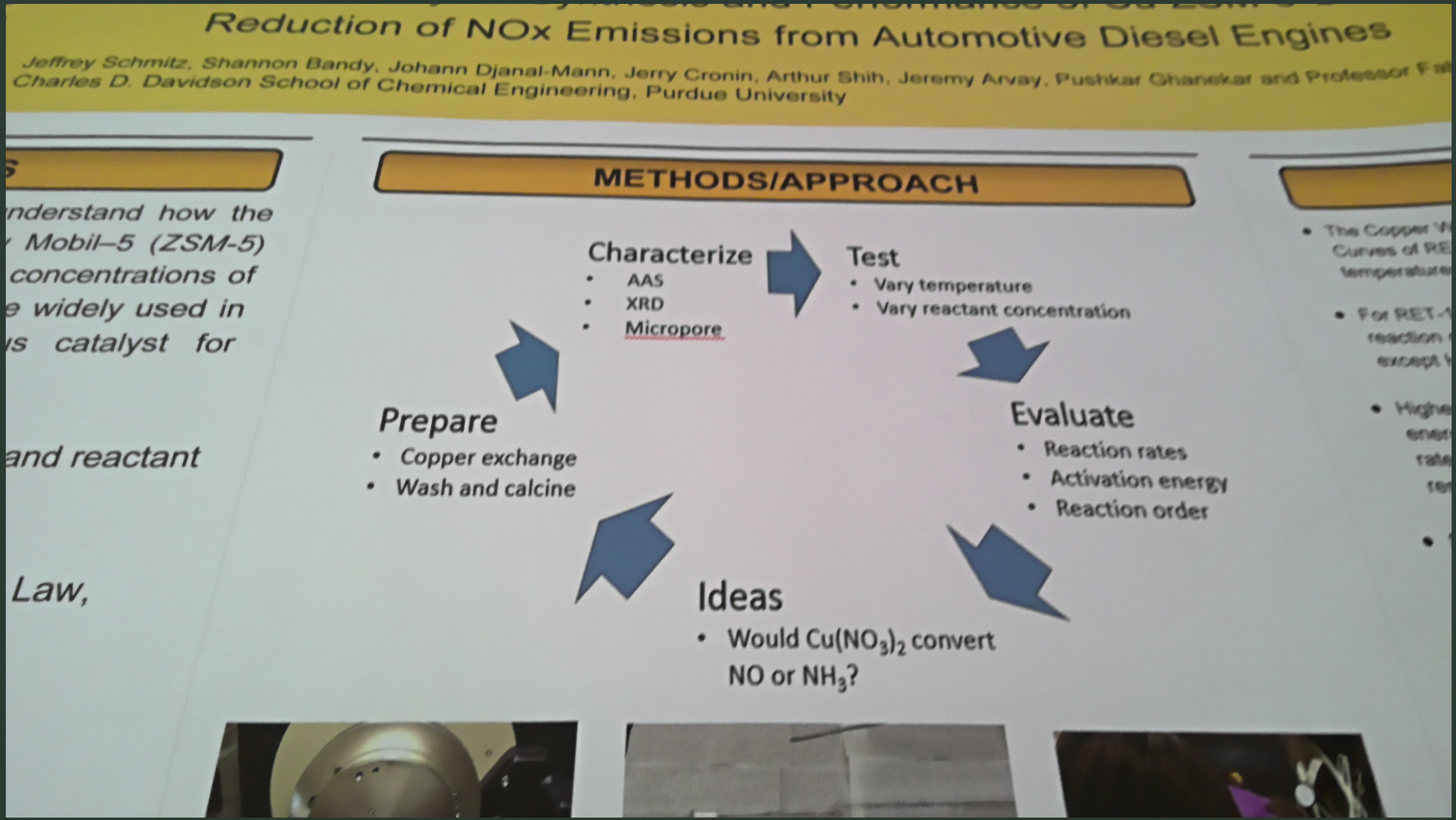




Pre

Goals and Objectives

Process


Reduction of NOx Emissions from Automotive Diesel Engines
Jeffrey Schmitz, Shannon Bandy, Johann Djanal-Mann, Jerry Cronin, Arthur Shih, Jeremy Arvay, Pushkar Ghanekar and Professor
Charles D. Davidson School of Chemical Engineering, Purdue University
METHODS/APPROACH
Characterize
AAS
XRD
Micropore
Test
Vary temperature
Vary reactant concentration
Evaluate
Reaction rates
Activation energy
Reaction order
Ideas
Would Cu(NO3)2 convert NO or NH3?
Prepare
Copper exchange
Wash and calcine

Data

structures of RET-0, RET-1 or RET-2.

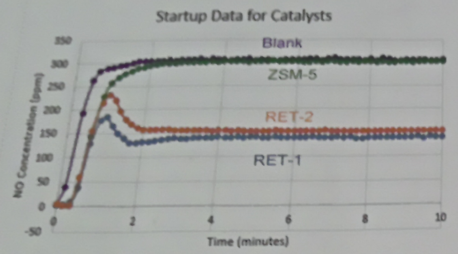


Figure 1: Startup Data

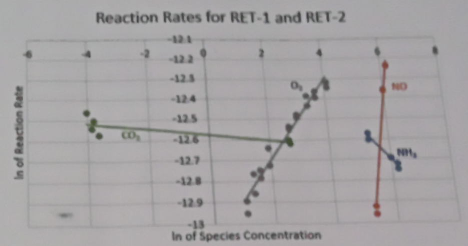


Figure 2: Reaction Rates

	RET-1	RET-2
Cu wt%	3.3	2.8
SCR rate * 10^8	323	319
Eapp (kJ/mol)	46	41
NO	0.8	0.8
NH3	-0.2	-0.2
O2	0.2	0.2
H2O	0	-0.1
CO2	0	0

Figure 3: Comparison of RET-1 and RET-2

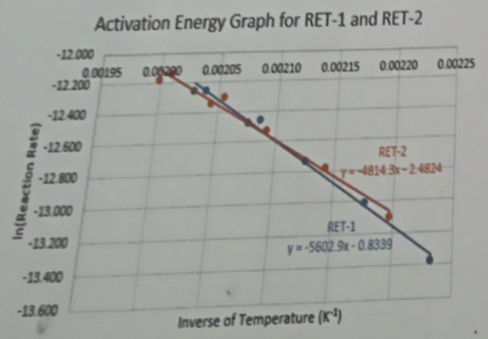


Figure 4: Activation Energies

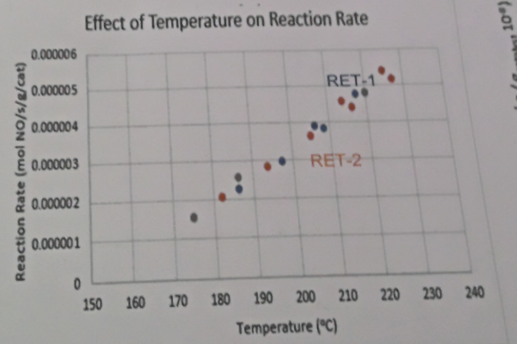


Figure 5: Effect of Temperature on Reaction Rate

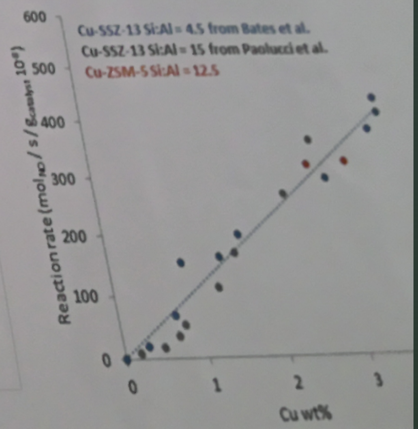
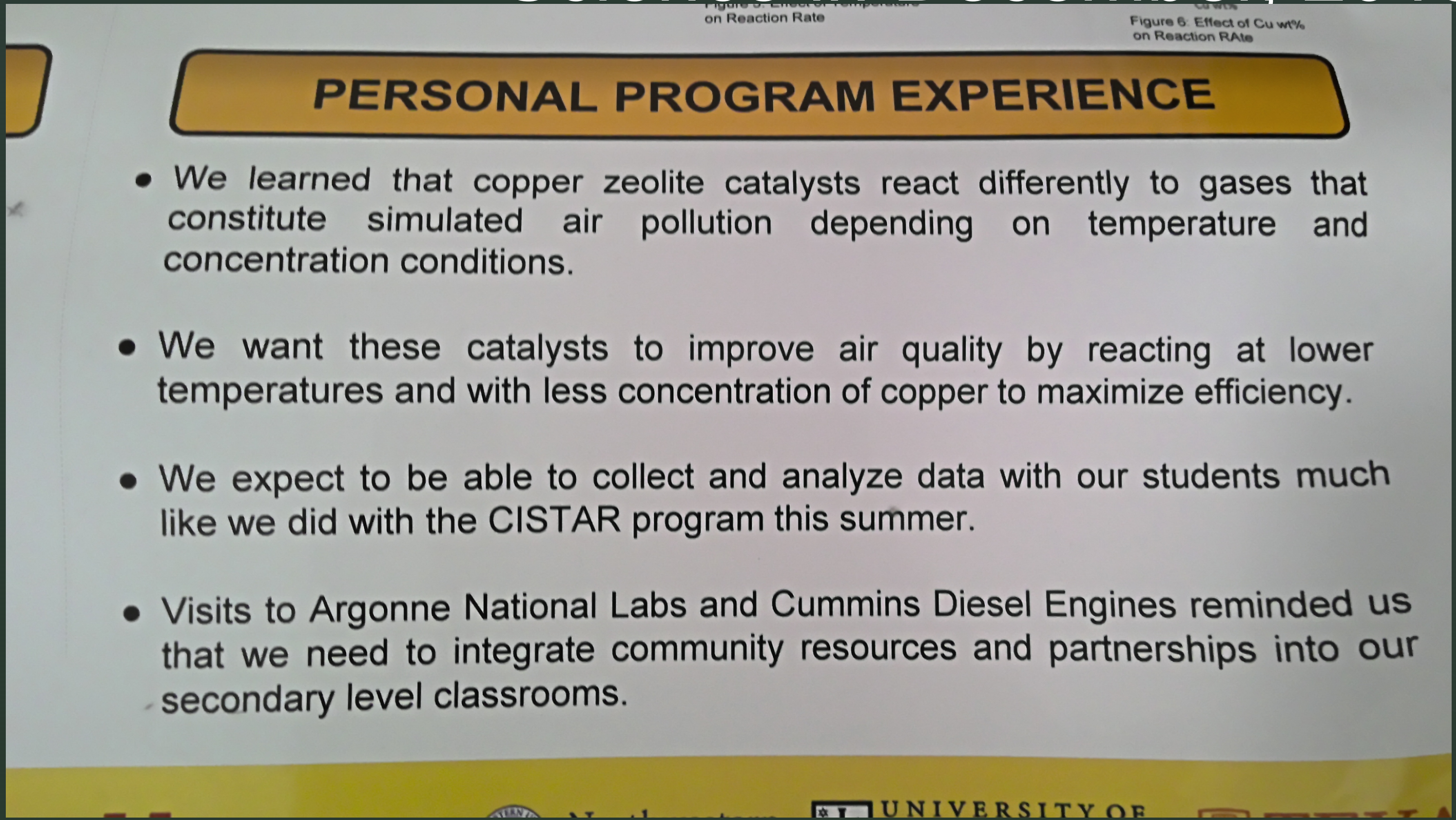
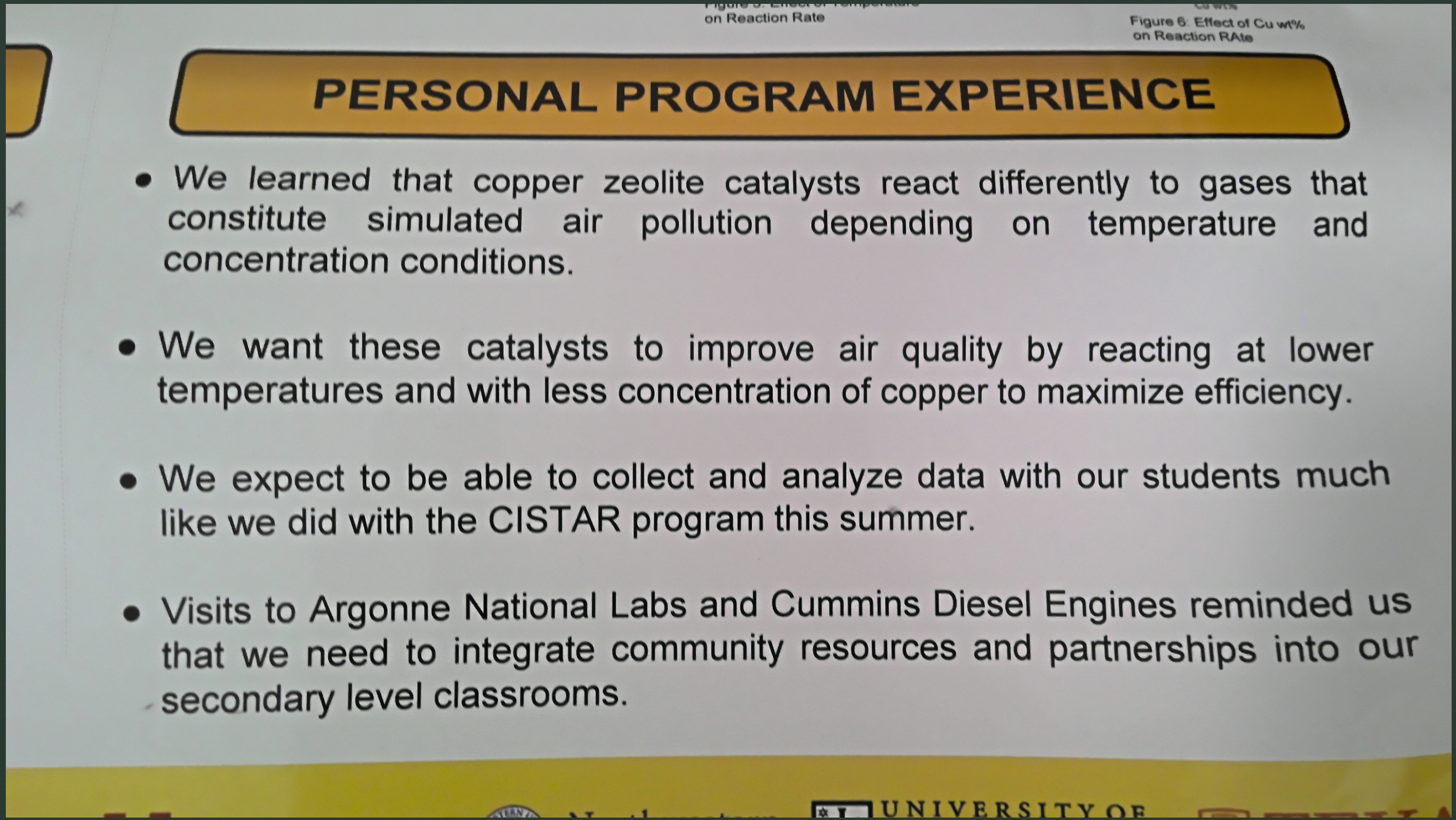


Figure 6: Effect of Cu wt% on Reaction RAte

Publishable results- I presented this research at the New Mexico Academy of Science in December, 2019!



What I learned as a practicing Teacher/Researcher



on Reaction Rate

Figure 6: Effect of Cu wt% on Reaction RAte

PERSONAL PROGRAM EXPERIENCE

- We learned that copper zeolite catalysts react differently to gases that constitute simulated air pollution depending on temperature and concentration conditions.
- We want these catalysts to improve air quality by reacting at lower temperatures and with less concentration of copper to maximize efficiency.
- We expect to be able to collect and analyze data with our students much like we did with the CISTAR program this summer.
- Visits to Argonne National Labs and Cummins Diesel Engines reminded us that we need to integrate community resources and partnerships into our secondary level classrooms.