CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
S0609

Project Title
Man-made Catalysts for Carbon Dioxide Capture

Abstract

Objectives/Goals
In a world where green house gases are creating global warming, finding a way to capture carbon dioxide is essential. The goal of my investigation was to test a catalytic solution that would speed up the rate of the absorption of carbon dioxide in basic solutions. Catalytic research will inevitably play a role in helping the productivity of solution absorption as catalysts are not used up in the reaction, making them environmentally friendly.

Methods/Materials
The experimental design was to determine the Cu-TETA (1,4,8,11-tetraazacyclotetradecane-1,4,8,11-tetraacetic acid) catalyst complex efficiency by testing a control of potassium carbonate solution and comparing the test to a solution of potassium carbonate and catalyst. To see how much carbon dioxide was absorbed, both solutions were subjected to a flow of Span Gas (14% carbon dioxide) from gas tanks into a round-bottom flask and the resulting pH drop was analyzed using graphical comparison for a significant increase in the rate. This experiment specifically tested the Cu-TETA catalyst complex because of its close resemblance to the naturally occurring enzyme carbonic anhydrase, which has shown to be effective in the hydration and dehydration of carbon dioxide in the body.

Results
The results were that the Cu-TETA catalyst was effective. The Cu-TETA catalyst was able to create a 14% pH decrease which is faster than the control#s 12% pH decrease and was able to increase the rate of the pH drop by 15%. As compared to the enzyme, however, the enzyme was significantly better, creating a 20% pH decrease and an increase in rate of 72%. The Cu-TETA did not completely mimic the enzyme as the enzyme is still much more efficient and there is still a big gap between the man-made catalyst and enzyme.

Conclusions/Discussion
Though the Cu-TETA curve declined at a faster rate, however, the increase was by a smaller amount than expected and is not enough to qualify Cu-TETA for mass production. This, however, could mean that man-made catalysts are getting closer to mimicking enzymes. Since the catalyst was effective in increasing the rate of the pH drop and therefore also the rate of the carbon dioxide absorption, the mimicking of the structure must have had some positive effects and therefore more enzyme and biological catalytic research should be performed to perfect the man-made catalyst.

Summary Statement
My project is on testing man-made catalysts for effectiveness in capturing carbon dioxide in basic solutions.

Help Received
I used the lab equipment at the University of Kentucky under the supervision of Dr. Payal Chandan.