CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
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Project Number
38507

Project Title
Biomass to Biogas

Abstract

Objectives/Goals
My problem statement is "Does temperature affect the production of biogas when starting with the same quantity of biofuel?" I hypothesize the floating drum exposed to the most heat will create the most methane in the shortest time. This is because e.coli is more active in warmer temperatures, which results in more biogas.

Methods/Materials
I built four floating drums using plastic bottles of assorted sizes. These floating drums provide a method for accurately measuring the amount of gas produced. Then I filled three floating drums with cow manure. I controlled the temperature of the biomasses by placing the drums on a wire rack at different distances from an electric heater. Twice daily, I used an infrared thermometer to measure the temperature of the floating drums and a square to measure the change in height. I repeated these measurements over the course of twelve days. I also placed a control drum which contained only water at the highest temperature to determine if water vapor was being produced and skewing the results of my experiment.

Results
The floating drum exposed to the highest temperature (95 degrees) produced the most biogas (approximately 300 cubic centimeters of methane.) As the temperature decreased, the amount of biogas produced declined. In my experimental trials, the drum held at 70 degrees F did not produce any methane, whereas the hottest drum produced about six times as much methane as the vessel held at an average temperature of 79 degrees F. The control drum showed no change in height which indcates that water vapor was not produced at a measureable quantity that could influence my data and that the change in volume of the other floating drums could be attributed to the production of methane.

Conclusions/Discussion
My hypothesis was correct. In twelve days, the floating drums showed that the highest temperatures produced the most biogas. According to my data, the hotter the floating drum, the quicker methane gas gets produced. For organizations such as the El Sobrante Landfill, which produce and distribute this biofuel, understanding the environmental conditions that influence the rate and volume of gas production will greatly improve their efficiency. They can use this information to reduce the amount of time it takes for them to convert the organic trash into useable fuel.

Summary Statement
My experiment showed that temperature greatly impacts the rate at which biomasses are converted to biogas when working with manure and e.coli

Help Received
I designed the floating drums based on a large scale diagram I found in my online research. Interviews with biochemists Dr. Boyer and Dr. Moellers along with UCLA Phd candidate Chung Won provided background on the basics of the reaction and environmental parameters required to keep e.coli alive.