**Bio-Gas** 

#### Abstract

The purpose of this project is to discover ways to produce energy with alternate sources. It is hypothesized that the cow manure will have a higher production of biogas with the eggs. Different types of biomass: eggs, bananas, and horse manure were mixed with cow manure and water and then placed in empty soda bottles with a balloon secured onto the mouth with duct tape. No biomass served as a control. In each of the soda bottles with the balloon, a production of methane was observed, blowing the balloon. In the horse and cow manure (test#1), trial #4 produced the most biogas. On the other hand, trial#1 had the least production of biogas. In the cow manure and bananas (test#2), there was a variation in the most, and least production. Finally, in the Cow manure and eggs (test#3), there was also a variation. At the end of the experiment, test#1 had produced the most biogas. After the completion of these tests, the following conclusions were formulated. The horse manure has a higher impact on the bacteriaproducing biogas. Future experiments may change the types and amounts of biomass. Another type of biogas generator may be used under different environmental conditions. Other further research may also include the variation of animal manure used. Other liquids, rather than water, may be used to see if there is an effect of the production of biogas, and to see if the pH of the substances used kill or help the growth of the biogas-producing gases.

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#### Rationale

The information discovered in this project is very beneficial to society because bio-gas is an environmentally friendly alternative to diesel fuel. The results of this experiment will be very beneficial to bio-gas users around the world because they will know how to produce the most bio-gas they possibly can. There is a possibility of finding out the exact temperature that is too hot to produce bio-gas. This would also be beneficial because then bio-gas users would have a range that they knew would lead to a large amount of bio-gas.

## Research Question

What is the optimal temperature for producing the largest amount of bio-gas?

# Hypothesis

If the temperature around the bio-gas unit increases, then the amount of bio-gas produced will also increase.

### **Expected Outcomes**

The expected outcome of this experiment is that the optimal temperature for producing the largest amount of bio-gas will be determined through experimentation.

#### Procedure

#### Materials

- 10 one-liter bottles
- 5 half-liter bottles
- Pig manure (donated by the Heifer International Ranch)
- Water
- 5, 3 ft. sections of <sup>1</sup>/<sub>4</sub> in. plastic tubing
- 5, <sup>3</sup>⁄<sub>4</sub> x 1 bolts
- Logbook
- 5 tea candles
- Hot glue gun
- 5 thermometers

#### Methods

- 1. Create the biogas units.
  - Drill a <sup>1</sup>/<sub>4</sub> in. hole in all 5 corks.
  - Feed the plastic tubing through each of the 5 corks.
  - Divide the pig manure equally between 5 of the two-liter bottles and add 4 cups of water to each of the 5 bottles and mix with the manure.
  - Plug the 5 bottles with manure in them with the corks and be sure that the tubing stays inside.

- Take the other 5 two-liter bottles and cut the top 4½ inches off of each one. Then fill each bottle with 4 cups of water. This water will serve as a measuring tool for the amount of biogas that is produced. By measuring the amount of water that is displaced, the amount of biogas produced can be determined.
- Take the tubing from each of the manure-filled two-liter bottles and feed it into the tops of the 5 one-liter bottles.
- Place one of the one-liter bottles top-down into each one of the waterfilled two-liter bottles.



• When completed, the units should look like this:

2. Place the biogas units in their assigned positions: the refrigerator, the garage, the backyard, the porch, and the roof of the garage.

3. Leave the units in their respective locations for 3 days.

4. At the end of this time, measure the amount of water displacement caused by biogas production.

5. Compare results.

## Results

# Displacement of Water in Biogas Units over a Period of Three Days

|                | Water Displacement | Temperature |
|----------------|--------------------|-------------|
|                |                    |             |
| Refrigerator   | 1 in.              | 37° F       |
|                |                    |             |
| Porch          | 1.5 in.            | 40° F       |
|                |                    |             |
| Garage         | 1.5 in.            | 39° F       |
|                |                    |             |
| Backyard       | .5 in.             | 35° F       |
|                |                    |             |
| Roof of Garage | 1.75 in.           | 42° F       |
|                |                    |             |

#### Discussion

Many people find it hard to believe that waste is a good source of energy. However, biogas, which is gas produced by bacteria that decompose animal waste, is a newly harnessed source of energy used all over the world. Biogas is extremely efficient because of its availability and many uses. "It occurs in digestive systems, marshes, rubbish dumps, septic tanks and the Arctic Tundra (Beck)." It is used mostly for heating houses and cooking food, though many other uses are known. Another huge advantage for biogas is that it is "a form of renewable energy (Wissman)."

An organization that helps to spread the use of biogas throughout the world is Heifer International. This non-profit organization has a mission to end world hunger and utilize the biogas unit to help them do so. Heifer workers go to third-world countries and teach the local people how to use biogas units. The farmers can simply use the waste from their animals, off of their farm. These poor farmers are then able to cook and to stay warm ("Eyes"). Biogas is a huge resource for the world. Many of the world's more developed countries recently "have been making increasing use of biogas generated from both wastewater and landfill sites or produced by mechanical biological treatment systems for municipal waste ("Bird Vision")." There is also evidence that biogas units produce more methane gas when they are at higher temperatures (Berger).

The results of this experiment show that as the temperature increases in a location, the biogas unit produces more biogas. This shows that temperature directly affects the biogas output of a biogas unit. There defiantly was a problem with the results to my experiment, however. Lately the temperatures have been below or at freezing during the day and at night. Because of

this, all of the biogas units that were placed outdoors froze overnight and only partially thawed during the day because of the freezing temperatures. This defiantly causes the experiment to become flawed. The results were measured at the point that the water was frozen or at the water level.

### Conclusion

The hypothesis for the outcome of this experiment was that as the temperature around the biogas unit increases, the amount of biogas produced will also increase. According to the results of this experiment, the hypothesis was supported. There were, however, complications with the outcome of this project, so further tests should be done to ensure correctness in this assumption.

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