Waste to Energy

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Question

Can we produce enough heat to produce electricity?

Abstract

- The principle behind the experiment was the use of biomass as an energy source. In the experiment, organic matter decomposed for 2½ months, allowing for the accumulation of heat energy. During the 2½ month period variables such as moisture, pH, and temperature were periodically measured and recorded. The organic matter was obtained from the food waste generated from our school's cafeteria. The food waste was placed in 3 sets of 1 gallon jars; Jar A, Jar B, and Jar C, which was stored in a science classroom for 2 ½ months. Then, thermoelectric generator will test whether if the compost produced enough heat energy to power the thermoelectric generator. The main results yielded very low voltage; very low heat was generated but not enough heat was generated by our compost as to fully power the thermoelectric generators.

Introduction

- From the research, the hypothesis is that in a small scale, waste can generate sufficient heat to power a thermoelectric generator. With this method, it would create a way of reducing the use of fossil fuels by making use of decomposed organic matter to replenish some of the energy used in their production. The United States produces an incredible amount of waste that can be used as an energy source to generate some of the electricity in households. The small scale research, will only justify that the process has a chance to succeed and could reinforce the idea of waste to energy.

Research

A thermoelectric generator is a heat engine that converts a low amount of heat into electricity (Rowe, 2012). In a generating device large number of thermoelements are connected electrically in series and thermally in parallel and sandwiched between ceramic plates to form a module (D.M.Rowe and C.M.Bhandari, 2005).Thermoelectric generators are a green technology that can utilize a variety heat sources such as: the human body, computer, air conditioning units, and automobiles. Even waste heat from small appliances can power a thermoelectric generator. 5% of a stove's heat energy can be converted into electricity (Killander and Bass, 1996). Thermal pollution created at many industrial sites can be used to partially power the facility through thermoelectric technology (D.M.Rowe and C.M.Bhandari).

Experimental Setup

1) 3 sets of 1 gallon compost were gathered: 2 gallons consisted of wet compost and 1 gallon was dry compost
2) The compost contained organic matter that was stored for a 2 ½ month period
3) Three times a week measurements of temperature, pH, and moisture was recorded from mid-March through May
4) After a 2 ½ month period, thermoelectric generators were used to convert heat from the compost into electricity

Materials

- 3 sets of 1 gallon containers
- Temperature, pH, and Moisture meter
- Organic waste
- 2Thermoelectric generators
- Tape

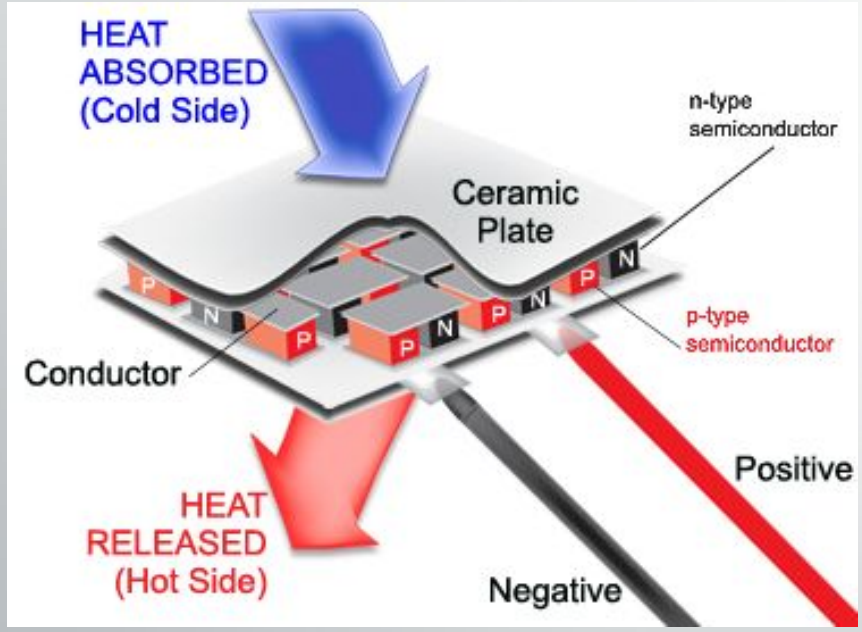
April 3, 2014

Observations

- Independent Variable: temperature, pH, & moisture
- Dependent Variable: Voltage
- Control: Jar B

April 21, 2014

Thermoelectric Generator



May 12, 2014

Data

Jar A	Dates	Temperat-ure (Celsius)	pH	Moistu re
	3-20-14	23	7	5
	4-3-14	21.7	4.7	5
	4-7-14	22	4.89	4
	4-14-14	22.5	4.98	4
	4-16-14	21.8	5.01	4
	4-21-14	21.6	n/a	3
	4-25-14	21.6	n/a	3
	5-9-14	23	n/a	n/a

Jar B	Date	Temperat-ure (Celsius)	pH	Moisture
	3-20-14	23	7	5
	4-3-14	21.7	4.85	4
	4-7-14	22	4.78	5
	4-14-14	22.5	4.94	4
	4-16-14	21.8	4.89	4
	4-21-14	21.9	n/a	4
	4-25-14	21.6	n/a	4
	5-9-14	23.2	n/a	4

Jar C	Date	Temperat-ure (Celsius)	pH	Moisture
	4-3-14	21.8	8.04	2
	4-7-14	22.2	7.85	1
	4-14-14	22.4	8.11	0
	4-16-14	22.4	5.97	0
	4-21-14	21.4	n/a	1
	4-25-14	21.5	n/a	1
	5-9-14	22.5	n/a	n/a

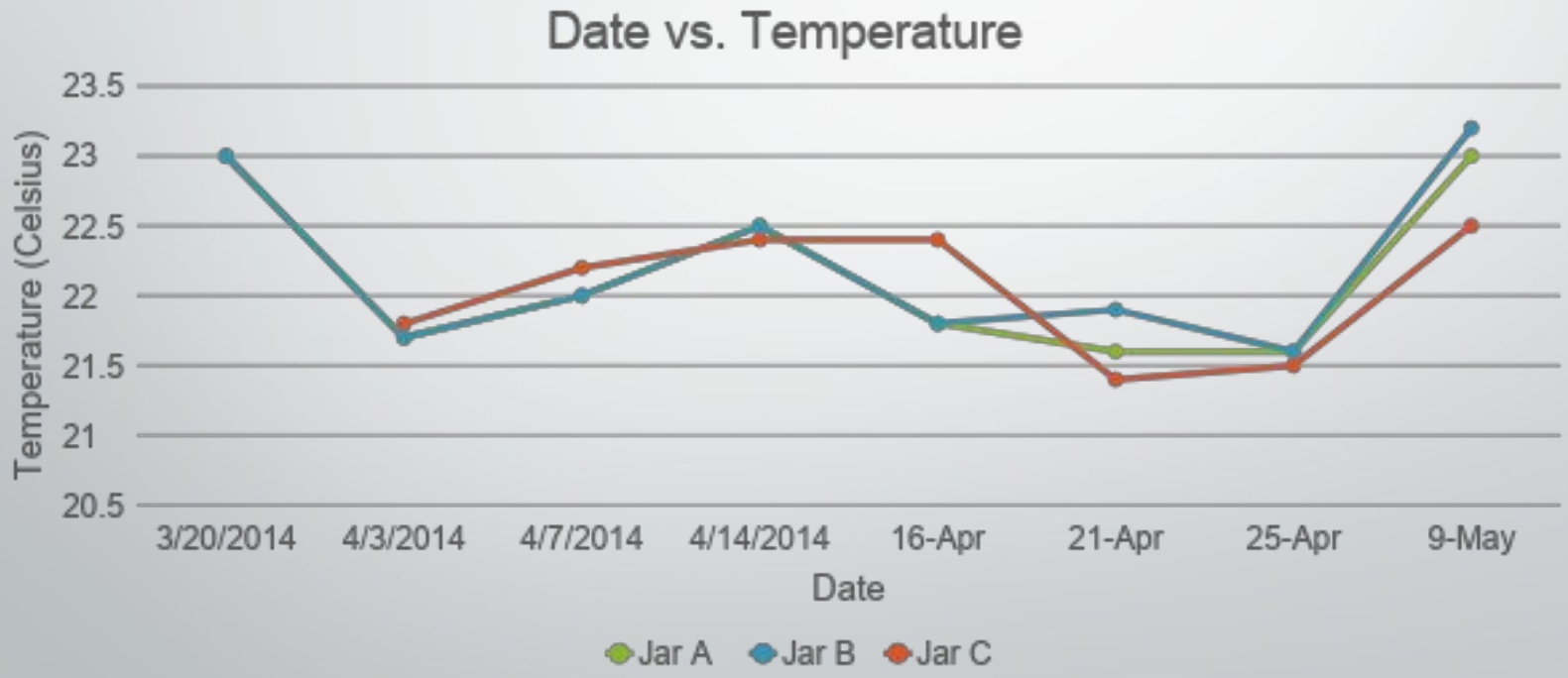
Data 2(The Thermoelectric Generator Test)

COMPOST	Mass(g)	Initial Temperature	Final Temperature
Container 1	207.2	20.4	22.9
Container 2	207.2	21.2	22.6

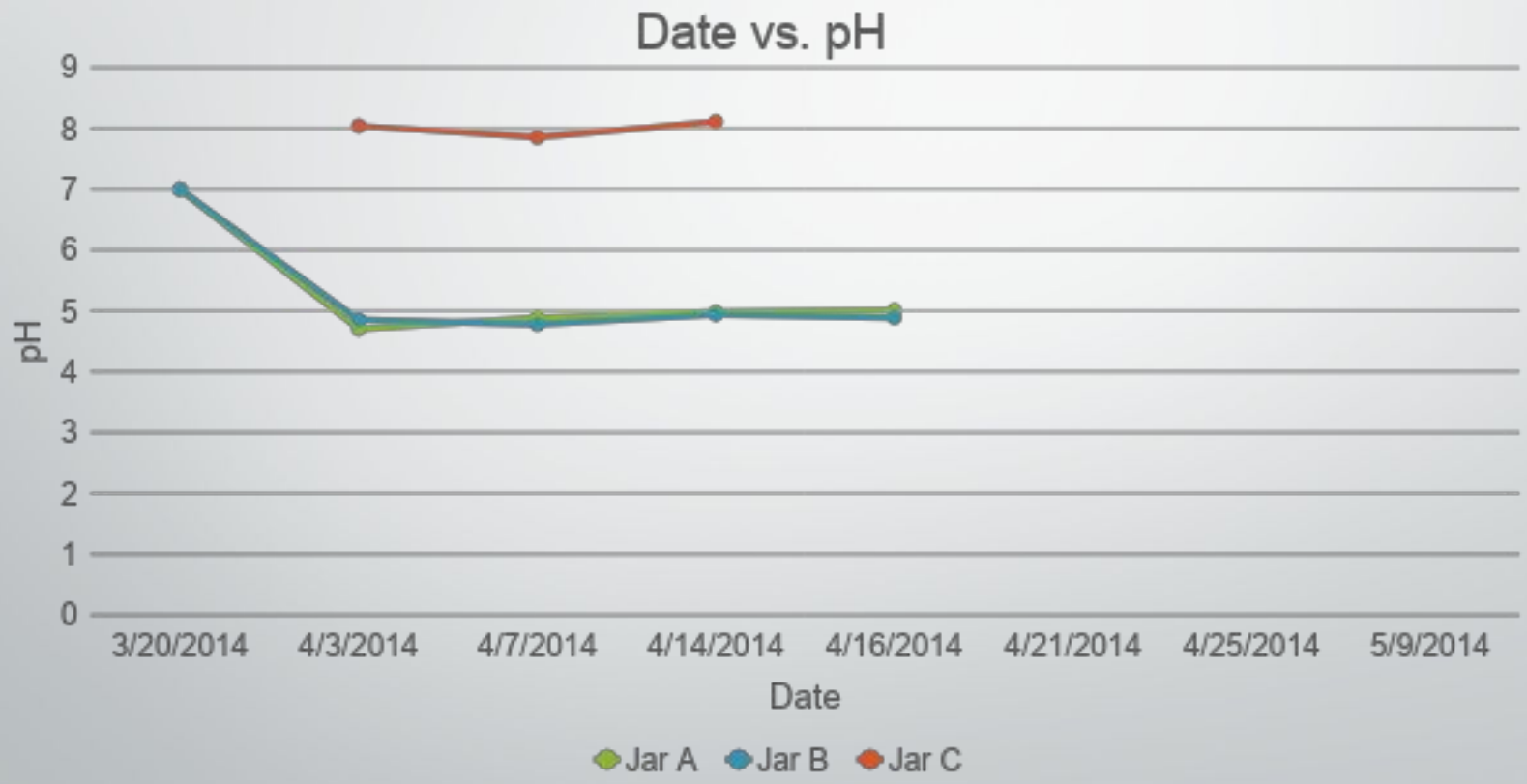
Cold Water	volume(ml)	Temperature
Container 1	500	10
Container 2	500	1.7

Thermoelectric Generators	Initial Voltage	Final Voltage
Container 1	0	-7
Container 2	0	-6

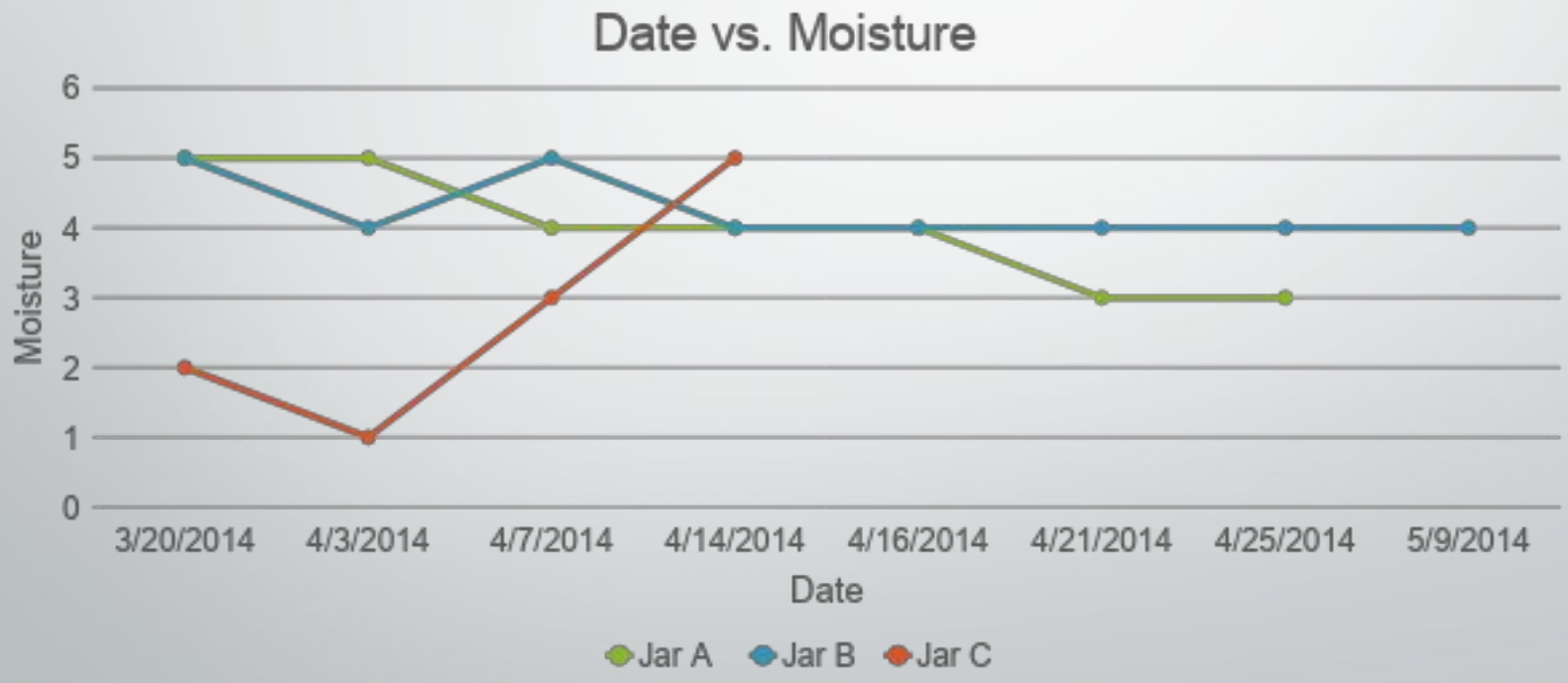
Graph 1


Date vs. Temperature
Temperature (Celsius)
23.5
23
22.5
22
21.5
21
20.5
3/20/2014
4/3/2014
4/7/2014
4/14/2014
16-Apr
21-Apr
25-Apr
9-May
Date
Jar A
Jar B
Jar C

Graph 2


Date vs. pH
9
8
7
6
5
4
3
2
1
0
pH
3/20/2014
4/3/2014
4/7/2014
4/14/2014
4/16/2014
4/21/2014
4/25/2014
5/9/2014
Date
Jar A
Jar B
Jar C

Graph 3


Date vs. Moisture
Moisture
6
5
4
3
2
1
0
3/20/2014
4/3/2014
4/7/2014
4/14/2014
4/16/2014
4/21/2014
4/25/2014
5/9/2014
Date
Jar A
Jar B
Jar C

Results

Jar A

- The temperature would range from 23°C to 21°C.
- The pH in Jar A decreased from 7 to 4.7
- Moisture decreased from 5 to 3

Jar B

- The temperature ranged from 23 to 21.5
- The pH decreased from 7 to 4.78
- Moisture decreased from 5 to 4

Jar C

- The temperature increased by about 0.7°C
- The pH increased from 7 to 8, on April 14, 2014, grass was added to the compost (in hope of adding decomposing bacteria) which decreased the pH from 8.11 to 5.97.
- Moisture decreased, then increased from 1 to 5

Temperature, pH, and moisture remained relatively constant throughout the experiment.

Results

- Since there was no increase in temperature in Jar C, then the soil was producing a low amount of energy. When testing the thermoelectric generator, 1 container contained 207.2g of compost from Jar C, while the other container contained 500ml of cold water. This method was repeated for the other thermoelectric generator. The results of the thermoelectric generator, proved that energy was not produced with the low heat energy in compost C; the voltmeter gave negative readings that decreased as time progressed. Our data from the research proved that the hypothesis could be not be proved due to the limiting factors in the experiment.

Limitations

- Room Temperature
- Volume of Compost
- The Containers
- The Components of the Waste

These were limiting factors that affected the final result of the experiment

May 12, 2014

Conclusion

- The experiment demonstrated that the waste produced a low amount of energy. In result of this, the thermoelectric generator could not be powered and did not make the turbine (attached to the generators) spin. The importance of this conclusion is that with 207.2 grams of waste, a thermoelectric generator will not be powered. The experiment also determine that the compost in the three jars were not generating any heat from the decomposition process because the temperature was not increasing (but that was in part due to the variables stated in the “results” section. This research should be considered because its another sustainable approach of reducing the use of fossil fuels. The important conclusion to draw from this research is that we now know variables (that we did not know before) that must be kept under control in order to make generation of electricity by composting a more viable method for large scale electricity generation.

Acknowledgements

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- D.M.Rowe and C.M.Bhandari, Modern Thermoelectrics, Pub..Holt, Rinehart and Winston,1983.
- D.M.Rowe "General Principles and Basic Cosiderations" in Thermoelecric Handbook Macro to Nano, Pub. Taylor and Francis 2005.