# *How does the temperature on anaerobic decomposition of bovine manure effect on the production of methane?*

**Sunandini Banerjee**

## ABSTRACT

During this experiment what I wanted to find out how temperature has an effect on the production of methane gas. Methane gas is very abundant in our atmosphere and the effects of the production of methane gas in the atmosphere is very bad as well. Too much production of methane causes as a greenhouse gas increases the global warming potentials. Even though methane gas in the environment is relatively low it is ranked on of the worst of the greenhouse gasses. But in this experiment I am testing the production of methane gas from manure and its production levels. Anaerobic lagoons also known as manure lagoons which are man made outdoor earthen basin filled with animal waste. By doing this experiment, it can be used to determine if the anaerobic lagoons have a positive or negative effect on the environment and one specific factor I am looking at is the methane production at different climates.

In this experiment since I cannot use a huge anaerobic lagoon to test its production level of methane in different climates, what I did was go to a nearby city that contains manurer and that will be giving me some samples of their manure. After receiving the manure, I put them in three different cylinders and diluted them so the production of methane would be faster. To see how temperature has an effect on the production. One of the cylinder was put in the refrigerator to see how in the real world how the production of methane gas would be in cold areas, then the other cylinder was put in room temperature which should help me understand the production of methane around the spring time and the last cylinder was placed on a hot plate which is supposed to be correlated with summer because it was out at 34 Celsius which is the same as 93.2 Fahrenheit. After placing I recorded the data during the five day observation period.

After the five day observation period. The production of methane gas was the highest in the environment of 34 Celsius and the least production of methane gas was the one in the refrigerator which was set at a temperature of 14 Celsius. As the days go by the production methane also increases. As I did the experiment, I found that the production of methane happens fast because on the first day the production of methane gas was 17 mm but that is the cylinder that was put on the hot plate, however the cylinder that was placed in the 14 Celsius the production of methane was minimal because after a day it was 3 mm. Also on the fifth day the production of methane gas at 34 Celsius was 98 mm in total while the production of methane gas in the cylinder that was placed in 14 Celsius only had in total 22 mm.

## HYPOTHESIS

The production of methane would be highest at a temperature of 34 Celsius which is equivalent to 93.2 Fahrenheit.This is believed because the ideal production for methane is in the moist and warm environments. As temperature rises, the average kinetic of a substance increases as well which would cause more production of methane at the highest temperature. The temperature 14 Celsius would cause the least amount of production because it causes the molecules to become more restricted which would cause the manure to harden than produce methane gas.

## MATERIALS

- 3 Erlenmeyer flasks
- 3 corks to stopper the flask
- 1 nail
- 3 test tubes
- Cow manure
- Tap water
- 3 measuring cylinders
- 3 basins, refrigerator
- 1 hot plate
- 1 ruler
- Weighing machine.

## METHOD

1.Gather all three cylinders and fill them up with the same amount of manure by checking their weight.
2.Use the nail to make a hole in each cork. Make sure the hole is big enough to let the tube to be inserted into the cork.
3.Fill each cylinder with the same amount of water by use a measuring cup to make sure it is the same amount. (fill up until half of the cylinder is filled with water)
4.Insert the cork with the hole in the cylinder, then seal the flask tightly with the cork.
5.Fill the 3 basins with water (full basin) and invert the cylinders in the basin as well.
6.Set one of the basins in the refrigerator which should have the temperature of 14 Celsius.
7.Leave the second basin at room temperature which should have the temperature of 24 Celsius.
8.Set the third basin on a hot plate which should remain at a temperature of 34 Celsius.
9.Then observe the amount of methane gas release in the cylinder for the next five day.
10.To know how much methane gas is released, look at how much of the water decreased from the cylinder which was filled with water in the beginning.
11.Do this experiment two more times for a total of three trials, to see patterns.

## RESEARCH

Methane gas is a chemical compound with the chemical formula of CH4 and it is the main constituent of natural gas.. Due to the fact that it is known as one of the greenhouse gasses. Man-made anaerobic lagoons which are made out of animal waste can also cause the production of methane. However, the production of methane is all based on its temperature it is around. Methane does not only have effects on the earth's atmosphere but also some beneficial effects.

Methane gas effects on the atmosphere has a direct effect on global warming, which is a huge problem to our world. Global warming has brought up issues on humans and animals especially. Due to these drastic climate changes many of the animals cannot survive.When one animal species goes extinct it causes other species to slowly going extinct as well. Animals are dependent on each other meaning that one animal can be the food source of another so if one animal goes extinct then the animal that depended on it can go extinct as well. Global warming causes intense drought, storms, heat waves, and many more effects. These causes also has an effect on humans as well. One of the gasses that help with this problem is methane gas. Even though methane does not linger as long as the gas carbon dioxide does but it is far more devastating to the climate because of how effectively it absorbs the heat from the sun. After the first 2 decades after the gas is released, methane is eighty four times more potent than carbon dioxide. As reported before, methane can come from many different sources, both natural and manmade. How can we fix the problem of methane? Well not until recently, scientists knew about the leaks and how to fix the leaks. However, in 2016, the EPA finalized the first national rules to directly limit methane emissions from oil and gas operations, which helps unlock new ways to reduce climate pollution.

An anaerobic lagoon is a free of dissolved oxygen, that enhances anaerobic conditions. This process usually takes place in deep earthen basins and ponds that are used as anaerobic pretreatment systems. There are many advantages and disadvantages that the anaerobic lagoons offer. Some of the advantages that the anaerobic lagoons offer are that it is very effective for rapid stabilization of organic wastes and also making higher influent organic loading possible. The production of methane that the anaerobic lagoons release also have an advantage which is that the methane is used to heat buildings, run engines, or generate electricity.These lagoons don't require any additional energy because they are not aerated, heated, or mixed. For example, lagoons are very sensitive to temperature fluctuations.Temperature has many effects on the production of methane gas. Methane gas production is very high at warm and moist temperatures while when it is in the cold environment the methane production is very limited. That is why many anaerobic lagoons are created in areas where it cannot get very hot or else the production of methane gas would be extremely high and it would have a bad effect on the atmosphere. Methane contributes to our planet a lot even though some are not as effective as other and can ruin our planet in the long run it still helps human activity like provide us electricity. The temperature has a huge role in the production of methane gas which is very important to know about because by determining which area will have the least amount of methane gas should be the ideal place to build an anaerobic lagoon so there would be not as much of methane gas production. Places where there is a lot of cows like India should find ways to control the amount of methane produced because the cows can produce methane gas just by passing gas.

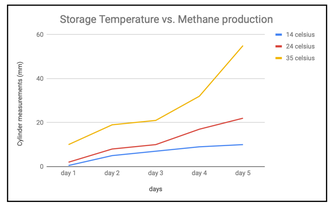
## RESULTS

| Storage temperature (Celsius) | Methane gas produced by anaerobic process in manure (mm) | | | | |
|---|---|---|---|---|---|
| Trial 1 | DAY 1 | DAY 2 | DAY 3 | DAY 4 | DAY 5 |
| 14 | 0.5 | 5.0 | 7.0 | 9.0 | 10.0 |
| 24 | 2.0 | 8.0 | 10.0 | 17.0 | 22.0 |
| 34 | 10.0 | 19.0 | 21.0 | 32.0 | 55.0 |

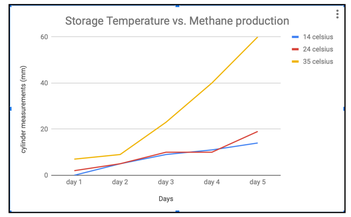
| Storage temperature (Celsius) | Methane gas produced by anaerobic process in manure (mm) | | | | |
|---|---|---|---|---|---|
| Trial 2 | DAY 1 | DAY 2 | DAY 3 | DAY 4 | DAY 5 |
| 14 | 0.0 | 5.0 | 9.0 | 11.0 | 14.0 |
| 24 | 2.0 | 5.0 | 10.0 | 10.0 | 19.0 |
| 34 | 7.0 | 9.0 | 23.0 | 40.0 | 60.0 |

| Storage temperature (Celsius) | Methane gas produced by anaerobic process in manure (mm) | | | | |
|---|---|---|---|---|---|
| Trial 3 | DAY 1 | DAY 2 | DAY 3 | DAY 4 | DAY 5 |
| 14 | 1.0 | 3.0 | 7.0 | 10.0 | 15.0 |
| 24 | 5.0 | 4.0 | 9.0 | 15.0 | 15.0 |
| 34 | 4.0 | 7.0 | 16.0 | 35.0 | 45.0 |

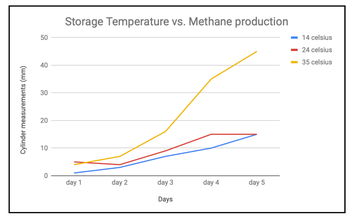
Trial 1




Trial 2




Trial 3




## CONCLUSION

Throughout this experimentation, my goal was to find an answer for the question; How does the temperature on anaerobic decomposition of bovine manure effect on the production of methane? As the experiment came to an end, I found an answer for this experiment. As the temperature increases the production of methane gas increases as well. The first trial showed that has days went by the production of the methane gas increased along with the temperature. However for the trails 2 and 3 the pattern were not the same as the first trial. In trail 2 the production was slow at first and then increased rapidly at the end. While in train 3 on day one the basin that was placed in 24 celsius has more production than that was placed in 34 celsius. Also in trial three the production of methane in total, the cylinder that was placed in 34 celsius, had the least amount compared to the other trails. In trail 1 the cylinder that was placed in 24 celsius had the most production and in trial 2 the production of methane was the most. When the cylinder was placed in the area that was set to 14 celsius, Overall the 14 celsius has the least production of methane however in trial 3 the cylinder placed in 14 and 24 celsius has the same amount. So, the anaerobic lagoons have not as much effect on the atmosphere if they are created in cooler areas. The reason I chose this topic is because global warming is one of the major conflicts our world is going through, due to global warming many animals are dying and our world is losing many of its valuable resources. This question addresses on of the greenhouse gas; methane. Currently methane gas's production and contribute to the atmosphere is not that high, however, if the anaerobic lagoons are built in areas where the temperature is warm then the production of the gas would increase and the conflict of global warming would increase.The process to achieve this conclusion is by filling up cylinders with the manure and placing them in the basins inverted and placing them in three different areas with three different temperatures. One of them was placed on a hot plate which kept the basin at 34 celsius t all times, The other one was placed at room temperature, and the third one was placed in the refrigerator at 14 celsius. After the experiment was over, my hypothesis was supported. The data showed that the high temperature environment caused for the methane as production to increase. The possible errors of this experiment is that since I have done this experiment in the winter and the room temperature basin produced more methane than it was supposed to because we had the heat on most of the time.Other possible error of this experiment is that sometimes the basin and the cylinder were moved from their original position which may have caused a shift in the water causing oxygen getting in than only the methane gas. This experiment can be fathered by using other types of greenhouse gasses and see its effect on temperature as well.

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