**Biogas practical 3:**

**Experimenting.**

**Part 1:**

**Aim:** To understand the importance of experimenting.

**Objective:** Change and monitor the inputs of the biogas plant in order to make it more efficient

**![MC900334122[1]]()Materials needed:** Fresh dung, waste food material, thermometer, water, meter tape, calculator, pen, paper.

Experiments are great fun, they are also a very useful way of checking if we are using our equipment effectively.

![C:\Users\Hannah\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\IS0AG6O6\MC900434403[1].wmf]()

An experiment is the act of conducting a controlled test or investigation. They are useful because they show the relationship between variables. Variables are just things that vary and change. In every experiment there are 3 types of variables. An independent variable, a dependant variable and many control variables. An **independent variable** is the thing you decide to **change**, a **dependent variable** is the thing that changes as a result so it is the thing you **measure** and **control variables** are the things that you **keep the same**.

But what are experiments? And why are they useful?

![MC900334122[1]]()

![MC900334122[1]]()![C:\Users\Hannah\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\MNDJZCO8\MC900434409[1].wmf]()

Oh OK!

Here are some examples:

**Example 1:**

![C:\Users\Hannah\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\MNDJZCO8\MC900012913[1].wmf]()Investigating how heat affects the rate that an ice cube melts.

**Independent variable** = heat

**Dependant variable** = time taken for ice cube to melt

 **Control variables** = weight of ice cube, water source and surface area of ice cube

**Example 2:**

Investigating how water affects the height a plant grows

![C:\Users\Hannah\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\D4V0HS8B\MC900413636[1].wmf]()

**Independent variable** = water

 **Dependent variable** = height

**Control variable** = type of plant, size container it is in and air temperature

![MC900334122[1]]()

In my examples I have only given the main 3 control variables, in an experiment there can be hundreds of control variables. Control variables are very important as they ensure that we are carrying out a **‘fair test’**. If our experiment is not a ‘fair test’ then the results we get from it are not reliable and therefore any conclusion we make from these results will not be valuable. For example in **Example 1** if I had not kept the weight of the ice cubes the same then this would have affected the dependent variable. We therefore wouldn’t know if the changes in the dependant variable were caused by the change in heat or the change in weight of the ice cube. So we therefore wouldn’t be able to see the relationship between heat and time taken to melt.

Fill in the gaps:

**Now discuss with a partner a list of things that you could change about our previous practical (practical 2), that could affect the volume of gas we produce.**

**These things that we change will be the \_\_\_\_\_\_\_\_\_\_\_\_\_. The things that we \_\_\_\_\_\_\_\_\_\_\_\_\_\_ will be the dependent variable. Then think of the 3 main control variables and put your answers into a table like this one:**

|  |  |  |
| --- | --- | --- |
| **Independent variable** | **Dependent variable** | **Control variables** |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| MC900334122[1]Here is a list of things that I thought of, did you think of some of these too? **Things that we could change (independent variables):**1. Temperature of water added
2. Feed different ingredients into the biogas plant, e.g. waste food products, human excreta.
3. Feed different mixtures of ingredients to the biogas plant , e.g. feed half dung and half waste food.
4. The ratio of water to ingredients added.
5. How regularly you feed the biogas plant.
6. How often you stir the biogas plant
7. How much you mix the water with the ingredients before it is fed into the biogas plant.

Now pick 3 independent variables from your list that you think would be interesting to change. We will now carry out our experiment! **This experiment will take 1 month to complete.** **Week 1:** * Feed the biogas plant in exactly the same way as we did in our previous practical.
* Record the gas produced using the same method as before.

**Week 2:** * Change your first independent variable. Keeping all the other control variables the same.
* Record the gas produced using the same method as before.

**Week 3:*** Change your second independent variable. Keeping all the other control variables the same.
* Record the gas produced using the same method as before.

**Week 4:*** Change your second independent variable. Keeping all the other control variables the same
* Record the gas produced using the same method as before.

Use this table to record your data:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Week  | Date | Independent variable | Dependent variable:Volume of gas generated(m2) | Average volume of gas generated over the week(m2) |
| 1 |  |  |  |  |
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| 4 |  |  |  |  |
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|  |  |  |

At the end of each week you need to calculate the average volume of gas generated over that week. **The average is calculated by adding all of the values together, then dividing by the number of original values.** MC900334122[1]So to do this all you have to do is add up the values of gas produced each day and then divide this total number by 7 because there were 7 original values.Here is an example:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Week  | Date | Independent variable | Dependent variable:Volume of gas generated(m3) | **Average volume of gas generated over the week****(m3)** |
| 1 | 01/07/12 | Add boiling water  | 0.785 | **0.792** |
| 02/07/12 | Add boiling water  | 0.807 |
| 03/07/12 | Add boiling water  | 0.810 |
| 04/07/12 | Add boiling water  | 0.751 |
| 05/07/12 | Add boiling water  | 0.798 |
| 06/07/12 | Add boiling water  | 0.801 |
| 07/07/12 | Add boiling water  | 0.789 |

**0.785 + 0.807 + 0.810 + 0.751 + 0.798 + 0.801 + 0.789 = 5.541****5.541 ÷ 7 = 0.792**After 1 month when you have filled out your table you can move onto part 2 of our experiment.MC900334122[1]Pick 3 to change not at same timeInitial experiment1st experiement – compare to initial2nd3rdConclusion – most efficientMix of 2 changes etc. Temp of water and ingetientsHow much energy is required to heat water > holistic analysisPresent findings > feasible feedback, recommendations, cost, effect of changes, worth it?Suggest future experiments (discussion) |

**Part 2:**

Look at your table of results with a partner and discuss these points:

* Which week gave the highest average gas production?
* On that week what did you change? Or was it the first week where you didn’t change anything at all?
* Do you think we should permanently change how we run the biogas plant?
* Would that change be feasible? For instance would heating the water first take too much time to do every day and would it use too much feul compared to the extra amount that it generated? Or would we have enough food waste every day to feed the plant purely on food waste etc.

![MC900334122[1]]()

After your discussion you can now make a conclusion on whether you think there is a more effective way of using our biogas plant. If you think there is we can test this new way for a month to see if you are correct.

I hope you have enjoyed this practical! You should now have a better understanding of why experimenting is important and how it is useful to make sure that we are using our equipment efficiently.