

Problem Statement: Limestone is a key component of road construction in Jamaica. The durability of the road may be affected by the amount of calcium carbonate present in the sample. Jane is a construction engineer and wants to find out which of three deposits (Trelawny, St. Thomas or St. Catherine) will give limestone with the most value for money. Plan and design an experiment to help Jane to decide.

Topic: Rate of Reaction

Title: Investigating the concentration of calcium carbonate in the sample of limestone.

Hypothesis: The sample from St Catherine will have the highest concentration

Aim: To determine the sample with the highest concentration of calcium carbonate by measuring the volume of gas produced.

Apparatus/Materials: 3 deposits of powdered limestone, conical flask, measuring cylinder, gas syringe, rubber bung, glass tube, stopwatch, retort stand, clamp, rubber tubing

Variables

Independent: the sample used

Dependent: the volume of gas produced

Controlled: the temperature, the size of the powdered limestone

Procedure:

1. Get a retort stand and place the gas syringe horizontally in the clamps, tightening them so it is secure.
2. Attach a thin rubber tubing with a rubber bung at the end to the opening of the gas syringe
3. Measure out 20g of limestone from deposit 1 using an electric scale
4. Pour 50ml of 1.0M HCl into a measuring cylinder
5. Pour the contents of the measuring cylinder into a conical flask
6. Empty the 20g of limestone powder into the conical flask, then immediately seal it with the rubber bung attached to the gas syringe.
7. Measure the amount of gas produced every 10 seconds, recording it in the table below
8. Plot your results on a graph of volume against time.
9. Calculate the reaction rate, which is in cm^3 per second, by finding the gradient at the steepest part of the graph.
10. Record the reaction rate in the corresponding part of the table
11. Repeat steps 1 to 8 for the remaining two deposits.

Expected results: The limestone with the highest concentration of calcium carbonate will produce the highest volume of gas and have the highest reaction rate. If the volume gas is the highest, that means that the sample has the most calcium carbonate, and if the reaction rate is the quickest, that means it has the most concentrated calcium carbonate, making it the best with which to build the roads.

Time (s)	Volume(cm^3) Deposit 1(Trelawny)	Volume(cm^3) Deposit2 (St Thomas)	Volume(cm^3) Deposit3 (St Catherine)
10			
20			
30			
40			
50			
60			
70			

Sample	Rate of Reaction (cm^3/s)
Deposit 1(Trelawny)	
Deposit 2 (St Thomas)	
Deposit 3 (St Catherine)	

Precautions:

1. Ensure that the scale is properly calibrated before use
2. Ensure that the rubber bung is properly sealed so that no gas will escape.

Sources of Error:

1. Parallax error in not reading exactly from the bottom of the meniscus

Limitations:

1. Since humans do not have perfect reaction times, the volume may not be recorded exactly 10 seconds apart.
2. A small volume of CO_2 would escape before the bung is put on the conical flask, so the total volume of gas recorded would be off by a small amount.

Assumption:

1. We assume that each deposit has the powder the same size, to avoid discrepancies causing the reaction rate to increase.

Conclusion:

The deposit which produced the highest volume of oxygen and had the steepest gradient would be the most suitable one to build the roads with, as it would have the highest concentration of calcium carbonate and the highest volume.