

What effect does concentration have on the rate of reaction

## **Introduction**

The reaction will be between calcium carbonate (marble chip) and hydrochloric acid.

## **Prediction**

I think that a larger concentration of acid will increase the rate of reaction. I think this will happen because as there are more acid particles in the stronger acid more will collide with the marble chips and more often. Also there is a lower concentration of acid the rate of reaction will be lower.

Calcium carbonate+hydrochloric acid                      carbon dioxide+calcium chloride

## **Trial**

I will perform an experiment similar to the final experiment until a suitable set of variables is found. I am doing a trial experiment to find out how to perform the final experiment with good measures of carbon dioxide, acid and marble chip.

## **Equipment List**

Marble chips  
Hydrochloric acid  
Flask  
Delivery tube  
Container  
Measuring cylinder  
Stop clock

## **Safety**

To keep the experiment safe I will push all stools under desks and make sure not to spill any acid. If any is spilt I will clean it up as soon as it is spilt.

## **Fair Test**

To keep the test fair I will have to keep all the variables the same, I will collect the same amount of carbon dioxide each time. I will always use 50cm<sup>3</sup> of acid. If I use more acid, there will be more acid particles in the solution, therefore increasing the chance of a successful collision. I will use the same weight of marble chips each time so there is always the same amount of marble for the acid to react with, and use the same number of chips each time, as surface area can affect the rate of reaction. If there are more pieces the chances of them being hit increase as they cover more area.

## **Trial Results**

Strength of acid (M)	Weight of marble (g)	Time taken to collect 20cm <sup>3</sup> CO <sub>2</sub> (sec)
2M	0.2g	33.59
0.25M	0.2g	633.00

## **Analysis of Trial**

From my trial experiment I have decided to use 2g of marble chip, collect 10cm<sup>3</sup> of carbon dioxide and use 0.5M acid for the weakest acid strength.

## **Plan**

To perform the experiment I will gather the equipment and set it up as shown in the diagram below. After setting up the equipment I will add 50cm<sup>3</sup> of hydrochloric acid and as quickly as possible place the delivery tube in the flask, and start the timer. After collecting the desired amount of carbon dioxide I will stop timing and record the results. I will then repeat the experiment until all required readings are recorded. I will use the following strengths of acid. 0.5M, 1.0M, 1.5M, 2.0M, 2.5M, 3.0M.

## **Results**

Acid Strength	Time Taken to collect 10cm <sup>3</sup> of CO <sub>2</sub>		Average
0.5M	497.85	272.57	385.21
1.0M	113.92	129.00	121.46
1.5M	57.09	61.80	59.45
2.0M	53.75	40.68	47.21
2.5M	28.02	28.33	28.18
3.0M	27.19	25.08	26.14

## **Analysis**

After completing my experiment I have analyzed the results and found them to be quite accurate, my average results fit the curve, apart from one anomalous result, the result for the 2.0M strength of acid. I think this result could be because of the chips sometimes having a coating on them, sometimes delaying the reaction slightly. If this is the case, if I ever repeat the experiment I will rinse the marble chips before I begin the experiment.

## **Evaluation**

From my results I can see the experiment was quite reliable and I recorded some accurate results. However, if I ever repeat the experiment I will try and make it even more accurate. There are things I could do to make the experiment more accurate than it was. I could rinse the marble chips before putting them in the acid so the protective coating on them is rinsed off, making the reaction begin as soon as the marble enters the acid, instead of having a chance of the reaction being delayed. I could try and keep the temperature of the acid constant before it enters the flask as if the temperature increases, the acid particles will move around faster, causing more collisions, affecting the rate of reaction making the experiment less reliable.