

Kimberley Beattie

Chemistry coursework

Aim-

To find out how the concentration of hydrochloric acid affects the rate of its reaction with limestone (calcium carbonate) chips.

Prediction-

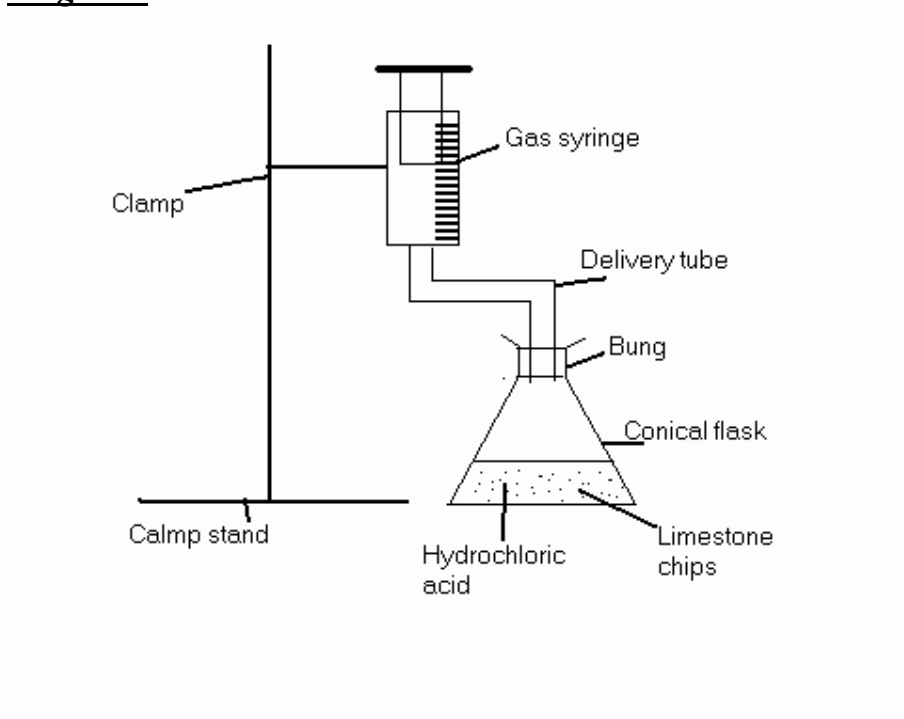
I think that a higher concentration of acid will give a faster rate of reaction. I think that this is because the higher concentration has more particles and therefore there is a higher chance of a collision between the particles in the hydrochloric acid and the limestone chips, as the acid and the chips are reacting, gas is given off. If the reaction happens faster then more gas will be given off in less time. I also think that the reverse of this is also true. The lower concentration of acid has fewer particles and therefore a lower chance of successful collisions between the particles, which results in less gas being given off.

Apparatus-

For my experiment, I will need to use the following equipment -

- Safety goggles,
- Clamp,
- Clamp stand,
- Gas syringe,
- Conical flask,
- Bung,
- Delivery tube,
- Stop watch,
- Measuring cylinder,
- 50cm³ of hydrochloric acid (x15),
- 1 gram of limestone chips (x15),
- Top pan balance.

Diagram-



Fair test-

For my experiment, I have decided to use 50cm^3 of hydrochloric acid. I think that this will be about the right amount. I do not want to use too much acid as it may react too quick and I will then not get very good results, as there may be too much gas to show up on the syringe. I also do not want to use too little acid as this may take too long to react and may not have enough acid to react with the limestone chips for the whole experiment. I will always use the same amount of acid, to make my experiment fair. If I use more acid in one experiment, then there will be more particles to react with. This will increase the chance of a successful collision and will therefore increase the rate of reaction. When I am measuring the acid, I will use a measuring cylinder and I will get down at eye level to it, to make sure that my measurements are accurate.

I have also decided to use limestone chips rather than limestone powder. I have decided to do this as I think that the powder will react too quickly, giving me inaccurate results. The powder will react quicker than the chips as it has a larger surface area and therefore more space for the limestone particles to get to the edge. This will result in more successful collisions and a faster rate of reaction. I am going to use a top pan balance

to measure out my limestone chips. I am going to try to use one gram, in about ten small pieces. This should then keep the surface area the same. If one experiment had a larger surface area than the other, then the rates of reaction would be different. This is because there would be a different amount of limestone particles exposed to the acid and would increase the chance of a collision occurring. This would then increase the chance of a successful reaction taking place. This would then change the rate in which the reaction occurs.

I am going to take the amount of gas produced every thirty seconds for two minutes. I think that this will be about the right amount of time, giving me accurate results and a nice clear graph at the end.

I have decided to use a gas syringe to measure the amount of gas produced. I think that the gas syringe will give me more accurate results than the measuring cylinder filled with water or the top pan balance. I think that the gas syringe is the easiest and most accurate way of getting my results.

The aim of my experiment is to change the concentration of the hydrochloric acid. To do this, I am going to use - 0.1, 0.2, 0.5, 1 and 2 molar acids. I think that this will give me a good range of results. It will show me how the acids have different rates of reactions.

I will also need to make sure that the room temperature is constant. If the temperature changes, then the particles will have a different amount of energy. This will alter the speed in which they move, which can then change the amount of collisions. This can greatly affect the rate of reaction.

Safety precautions-

I am going to be working with a corrosive acid. This means that safety is a big concern throughout my experiment. Before I start my experiment, I will need to make sure that all bags, coats and stools are under the desks. This will ensure that nobody will accidentally trip over them. I will also make sure that I am wearing safety goggles. This will make sure that I don't accidentally get the corrosive hydrochloric acid in my eyes. I will also make sure that anything that contains acid, it in the middle of the desk. This will stop it from being knocked over. When I am not using the acid, I will make sure that the top is on its bottle.

If any acid gets spilt, then I will wipe it up immediately with a cloth. If any glass gets broken then I will ask for assistance from a teacher.

Method-

The first thing that I will need to do for my experiment, is to take in to account all off my safety procedures. I will need to make sure that all items are out of the way and that everybody is wearing safety goggles.

Once I am ready to start, I will get all of my equipment ready. I will set up my clamp on to my clamp stand and place the gas syringe

securely in to the clamp. I will make sure that the gauge on the syringe is facing forwards, so that I can read the results from it easily. I will then measure out 50cm³ of 0.1 molar of hydrochloric acid using a measuring cylinder and 1gram of limestone chips using a top pan balance.

I will then pour the hydrochloric acid into a conical flask. Once my partner is ready, I will place the limestone chips into the conical flask and put the bung onto the top. While I am doing this, my partner will start a stopwatch. After thirty seconds, I will take the reading that is on the gas syringe. I will do this every thirty seconds for two minutes.

Once I have done this once, I will wash out all of my equipment and I will repeat my experiment at least once, if not twice again. This will make sure that my results are reliable. I will then continue to do this experiment for 0.2, 0.5, 1 and 2 molar acids.

Results

Concentration (Molar)	Time taken (Seconds)	Amount of gas produced (Cm ³)			
		Attempt 1	Attempt 2	Attempt 3	Average
0.1	30	0.5	0.5	1	0.6
	60	0.5	0.5	1	0.6
	90	0.5	0.5	1	0.6
	120	0.5	0.5	0.5	0.5
0.2	30	0.5	0.5	0.5	0.5
	60	1	0.5	0.5	0.6
	90	1	0.5	0.5	0.6
	120	1	0.5	0.5	0.6
0.5	30	3.5	2.5	4.5	3.5
	60	4.5	4.5	5.5	4.7
	90	6.5	5.5	7.5	6.5
	120	7.5	7	9.5	8
1	30	8	7	6.5	7.2
	60	13	12	13	12.7
	90	18	17	20	18.3
	120	24	23	27	24.7
2	30	9	8	5	7.3
	60	21	19	16	18.7
	90	35	32	23	30
	120	49	46	40	45

Conclusion-

From my results, I have found out that the concentration does affect the rate of reaction between the hydrochloric acid and the limestone chips. The higher the concentration, the faster the rate of reaction is. This happens because, as the concentration increases, so does the number of

particles in the acid. There is then an increased number of particles in the acid. These particles move around and there is a high chance of a successful collision happening. The more particles, the higher the probability of a collision occurring is. This makes the reaction with the high concentration of acid, faster than that of a lower concentration of acid.

From my graph, I have found out that my results for the acid at 0.2 molar, maybe inaccurate. I have realised this because the line between 0.2 molar and 0.1 molar is a straight line, when it should be a smooth curve. My results for 0.5 molar may also be inaccurate. I can tell this by the way that between my three attempts at the experiment, there is a big difference in numbers. Because of this, I took an average of my three results, to make sure that my graph still looked accurate.

I found a pattern between my results. This pattern is that reaction time nearly doubles between 0.5 molar and 1 molar acid and again between 1 molar and 2 molar. This happens because 1 molar acid has twice as many particles 0.5 molar and 2 molar has twice as many particles as the 1 molar acid. This causes the reaction to happen faster as there is a higher probability of a successful reaction-taking place. I think that this pattern will carry on in the same way through out the different concentrations of acids.

My results show that my prediction was right. The higher concentration of acid has the fastest rate of reaction. I know this because if there is a faster rate of reaction then more gas is given off than in a slower rate of reaction. If you increase the rate of reaction, then the amount of gas given off is also increased.

Evaluation-

I don't think that this was the best way of doing my experiment. I found that a few of my results were inaccurate. There are several reasons of why my results may have been so far out. The first one being that I found it quite hard to know exactly when to start the stopwatch and also with the higher concentrations of acid, some of the gas may have been lost when the limestone pieces were first dropped into the acid and when the bung was placed onto the top of the conical flask. It was difficult to place the bung on the top quickly after dropping the limestone pieces into the conical flask. If I was going to do this experiment again, I think that I would use something with a wider top on it than the conical flask. This would ensure that all of the limestone pieces go into the flask easier.

Another thing that may have made my results inaccurate, was that I found it hard to measure out an exact amount of hydrochloric acid. It was hard to get it exactly onto the 50cm³ using a measuring cylinder. If I was going to do this experiment again, I think that I would use a syringe instead of a measuring cylinder. I think that this would give me a more accurate way of measuring out my hydrochloric acid. I think that I would

also use limestone powder. This is because although it gives me a faster reaction, it would be more accurate, that way I would be able to get the same surface area each time. With the limestone chips, I found it hard getting the same amount of chips each time, this would mean that the surface area might change slightly during my experiment.

For one of my practical lessons, we had to change classroom. This may have resulted in a change in room temperature. We also had a few lessons at different times of the day. This might have meant that there was a class in the lab before we went in. This can cause the room temperature to change slightly, which would alter the amount of energy in which the particles had. I think that a way in which I could have overcome this problem would have been to take the temperature of the room before starting my experiment. I could have then used a heater or a fan to help in altering the temperature of the room.

I think that I should have carried out my experiment for a longer period of time, that way I would have got more readings and I could then have looked to see if the pattern I found carries on throughout my experiment. I also think that it would have been a good idea to time the experiment to see how long it took before the acid and the chips produced 100cm^3 of gas.

While I was carrying out my practical, I noticed that when the gas syringe was higher up the clamp stand, it seemed to collect more gas. This is because the gas is lighter than the air and so it tends to rise upwards. To get around this problem, I should have measured the height in which I place the gas syringe.

If I was going to do this experiment again, I think that I might use some other concentrations of the hydrochloric acid. I would also try using some different types of acid, to see if my pattern also fitted with them. I would also carry out the experiment for a longer period of time and I would alter the amount of reactants that I used. I would do this to ensure that I had the right amount of reactants to last the whole experiment, but not so much that the syringe would get to its end before my experiment had finished.

I think that I used a good procedure with doing my experiment, there were just a few things that I did not control as well as I should have controlled them. If I were to do the experiment again, I think that my experiment's results would be more accurate. I would also test different gases and some different forms of calcium carbonate. This would give me more reliable results and would make them more accurate.