

Diffusion investigation



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Aim: The aim of this investigation is to discover if different variables affect the rate of diffusion. My aim is to discover if the concentration of the acid affects the rate of diffusion.

Preliminary Work: For my preliminary work I looked at different types of diffusion. First I sprayed an air freshener across the classroom, it slowly diffused through the air until the smell of it was not so strong but it covered the whole room.

I also set up an experiment with a glass tube which had some cotton wool soaked in ammonia placed at the end. Litmus paper was placed along the side of the tube at certain points to see how long it took the ammonia particles to diffuse through the air in the tube. The litmus paper nearest the ammonia end turned colour quickly, it took longer further up the tube. This shows that the ammonia particles slowly diffuse through the tube, from one end to the other.

From my preliminary work I can see that diffusion takes part between liquids and gases.

Background on diffusion: Diffusion is the natural tendency of molecules to flow from higher concentrations to lower concentrations. Diffusion occurs quicker in hotter areas, this is because there are more collisions between the particles making them spread out more. More concentrated substances diffuse more quickly. Diffusion cannot take place in solids, only between liquids and gases. When the barrier between two substances is removed (as shown below), the molecules will redistribute themselves, or diffuse, throughout the entire container. Eventually, the mixture reaches a state of

equilibrium, in which the molecules of both substances are evenly mixed in the container. While the number of molecules in the container is the same as it was before the barrier was removed, the substances are now at lower concentrations. The rate of diffusion depends on how heavy the molecules are. Heavy molecules diffuse more slowly than light molecules. This process is used to separate U235, the isotope of uranium used in nuclear reactors, from U238.

Diffusion

The molecules are all separate

The molecules have diffused

Variables in my investigation: The following are variables in my investigation. All these experiments show different ways of finding out about the rate of diffusion.

The temperature of the agar For this experiment you would change the temperature of the acid so that one agar block was diffused at 0° C, another at 10° C and onwards, changing by 10° C each time.

The surface area of the agar For this experiment you would change the surface area of the agar so that the size varied. You would then investigate and see if the diffusion rate changed.

The concentration of the HCL For this experiment you would change the concentration of the acid by adding more or less water: for example:

water acid

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0 10

2 8

4 6

6 4

8 2

The variable I will be changing is the concentration of the acid.

Prediction: I predict that the higher the concentration of acid in my experiment, the quicker diffusion will take place. My reasoning for this is that diffusion takes place quicker with stronger substances, hence, the stronger, or the higher the concentration of acid, the quicker diffusion will occur.

Apparatus: The apparatus I will be using is listed below:

Test tubes – I will put the agar and HCL in these

Test tube rack – These are to hold the test tubes

HCL – This stands for hydrochloric acid, the acid I will be using

Water – This is to dilute the acid

Measuring cylinder – I will use this to measure the volume of acid

Stopwatch – This will be used to time the diffusion rate

Forceps – I will use the forceps to pick up the agar

Agar – Agar is the substance we will be using to see how quickly diffusion takes place. Agar is a jelly-like substance, it is orange but as acid slowly diffuses through it, it turns orange. This is a very useful property of agar as it means it is easy to spot when diffusion has finished. If the agar is touched by hands it will become heated and contaminated, it must also not be exposed to acid before the actual test.

My method: Below is the method I will use to complete my investigation.

* Firstly I will pour the correct amount of acid and water (using the measuring cylinder to get the amount accurate) into the test tube. water
acid

0 10

2 8

4 6

6 4

8 2

* Next I will put the agar into the test tube filled with acid, using the forceps.

* When the agar is in acid I will start a stopwatch and record the time accurately.

* I will continue to do this with different concentrations of acid.

* I will record each 5 times to get a fair result and average.

Safety points: Below are some points I must take notice of when carrying out my investigation.

- * Wear safety goggles
- * If the agar is touched by hands it will become heated and contaminated, it must also not be exposed to acid before the actual test.
- * Use forceps to move the agar
- * Have a blackboard behind the test tube to see when the colour change, and diffusion, takes place.
- * Measure the acid and water carefully.

Setting up a fair test: To make sure my test is fair I will record each result 5 times, to be able to make an average for my graph and to be able to analyse my results. My agar blocks will also be the same size (1cm³) and the temperature of the experiment will be the same, room temperature (roughly 27°C).

Results: Below are my results table and the results I gathered from my investigation.

For my results in a graph look at the next page.

acid water TIME minutes average

10 0 4: 30 4: 41 4: 42 4: 37 4: 35 277secs

8 2 5: 37 5: 44 5: 35 5: 32 5: 41 335secs

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6 4 *5: 16 *5: 18 *5: 09 *5: 12 *5: 15 314secs

4 6 6: 23 6: 33 6: 27 6: 25 6: 35 388secs

2 8 8: 08 8: 05 8: 10 8: 02 8: 12 487secs

*This shows that these results may not be reliable, as they are a shorter time than the result row before, but according to the rest of the table, should be longer than the results before. I am not sure these results are correct.

Analysis of Data: My results seem to be accurate and turned out as I expected although the results for the '6 acid 4 water' were anomalous, these results were anomalous because they did not correspond with the rest of the results in any way. I think the reason for this anomaly could have been that the size of the agar was not quite accurate or that the concentration of the acid was not correct.

Conclusion: I can prove from my results and research that diffusion takes place quicker if the concentration of acid is higher. I therefore conclude that the lower the concentration of HCL, the time taken for diffusion to occur will be longer. The molecules moved faster the higher the concentration of acid, making more collisions. Because of this the rate of diffusion is quicker, this means that the acid diffused through the agar.

Evaluation: I feel that my experiment went well though if I had had a chance I would have spent more time on it making sure my results more accurate and my practical better. I think my data was reliable because there was one anomaly, it was sufficient enough for me to draw a conclusion. To see if diffusion happens with different variables I could test:

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The temperature of the agar For this experiment you would change the temperature of the acid so that the agar blocks were diffused at different temperatures, increasing by 10° C each time.

The surface area of the agar For this experiment you would change the surface area of the agar so that the size varied.