# Factors affect the rate of the decomposition of hydrogen peroxide essay sample

Science, Chemistry

Aim:

Our aim is to detect which factors affect the rate of the decomposition of hydrogen peroxide with a fixed mass of catalyst. A catalyst is a substance, which alters the speed, or rate of a chemical reaction but is chemically unchanged at the end of the reaction. The two factors that we can change are the temperature and the concentration.

We chose to vary the concentration of hydrogen peroxide. The catalyst to speed up the reaction without affecting the result will be manganese oxide.

Prediction:

I predict that the higher the concentration of hydrogen peroxide, the faster hydrogen peroxide and manganese oxide decomposes. Therefore the lower the concentration of hydrogen peroxide, the lower the rate that hydrogen peroxide and manganese oxide decompose.

The prediction we have just made has been based on the collision theory-' Chemical reactions occur when particles of the reactant collide with enough energy' (John Holman page 225). If the concentration of the solution is high then there is more chance of the particles colliding. This is because if the concentration increases then so does the number of particles. The more particles there are, the greater the chance of the particles colliding so therefore that gives reason to believe that the rate of the reaction increases.

Pre-test

During our pre-test lesson we needed to find the ideal mass of catalyst. We began with 1g of manganese oxide, which we weighed on a top-pan balance and added it to 100cm” of hydrogen peroxide. We used 100% concentration because we thought that to ensure our catalyst mass was suitable we needed to see what the most reactant experiment would be like. However, 1g of manganese oxide seemed to be too much as the amount of gas was produced too quickly and we were unable to record any results. Next, we used 0. 1g of manganese oxide, however this seemed to be too much as again we were unable to record any results. Lastly we used only 0. 05g of manganese oxide and this seemed to be the right amount. During this pre-test we felt we were able to record results at a steady speed and we were able to do this accurately.

Also from our pre-test lesson it became clear that to keep the experiment as accurate as possible, we should place the manganese oxide in the conical flask and then add the hydrogen peroxide. This is because if we add the catalyst afterwards the reaction starts to take place and yet all the catalyst has not yet been put in. We have decided to see how much gas has been released in 90 seconds.

Here are our pre-test results:

Time(Secs) Test 1Volume of gas (cm”) Test 2Volume of gas (cm”)

0 0 0

5 10 11

10 19 17

15 24 26

20 35 37

25 45 44

30 50 51

35 58 59

40 65 66

45 72 74

50 78 78

55 84 82

60 90 91

65 96 97

70 100 100

75

80

85

90

Equipment

Here is a list of the equipment we will be using throughout the experiment;

§ Gas syringe

§ Top-pan balance

§ Conical flask

§ Measuring cylinder

§ Spatula

§ Goggles

§ Clamp stand

§ Stop watch

§ Hydrogen Peroxide

§ Manganese oxide

Method

1. Take out the clamp stand and place the gas syringe into the clamp at a suitable height.

2. Measure out 100cm” of Hydrogen Peroxide into a measuring cylinder.

3. Using the top-pan balance weigh out 0. 05g of manganese oxide.

4. Place the manganese oxide into the conical flask.

5. Pour the hydrogen peroxide into the conical flask.

6. Quickly place the bung at the top of the flask and start to record the amount of gas produced every second.

Fair Test

To ensure that this experiment is constant we will repeat the experiment. If the two results vary widely then it will be re-done.

Every time the experiment is done I shall only use 100cm” of hydrogen peroxide and water in total. Also the fixed mass of catalyst will stay the same throughout the experiment and will be accurately weighed out every time using the top-pan balance. To ensure that all readings will be as accurate as possible we will try to start the timer as soon as the bung is placed at the top of the conical flask. Volume readings will be as accurate as possible as well.

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BTAINING

Safety

Throughout this experiment, we are using highly reactive substances; therefore it is useful for us to have some sort of safety knowledge about them so we know how to handle such chemicals.

Manganese Oxide (MnO )

· It is very harmful if it is swallowed or inhaled.

· Can be irritating to the eyes and skin.

· It is dangerous with; Aluminium and other metal powders

Powerful oxidants; Potassium chlorate

Hydrogen Peroxide (H O )

· It is corrosive and can cause burns.

· It can irritate the eyes and skin.

· It is dangerous with; Organic compounds; Ethanol, glycerol

Metals and metal oxides

As both substances are quite dangerous, for safety precautions I will be wearing goggles to protect my eyes. I will keep all my bags under my desk along with my stool; this is so no one is able to trip over them. Also my hair will be tied back and my tie will be tucked into my shirt.

My results

Time(Secs) Concentration of H O and H OTotal of 100cm”

100% H O0% H O 75% H O25% H O 50% H O50% H O 25% H O75% H O 1% H O99% H O

Volume of gas produced(cm”)

Test 1 Test 2 Av. Test 1 Test 2 Av. Test 1 Test 2 Av. Test 1 Test 2 Av. Test 1 Test 2 Av.

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

5 8. 6 9. 2 8. 9 7. 2 7. 1 7. 2 4. 5 4. 5 4. 5 2. 5 2. 6 2. 6 0 0 0

10 19. 3 20. 6 20. 0 15. 5 15. 7 15. 6 9. 2 9. 6 9. 4 4. 7 4. 3 4. 5 0 0 0

15 26. 1 29. 7 25. 7 24. 3 24 24. 2 16. 4 14. 7 15. 6 7. 3 8 7. 6 0. 3 0. 2 0. 3

20 32. 6 40. 6 36. 6 34. 2 33. 1 33. 7 18. 2 19. 1 18. 7 9. 1 9. 2 9. 2 1. 1 1 1. 2

25 48. 7 52. 1 50. 4 45. 7 42 43. 9 24. 7 24. 5 24. 6 12 11. 9 12. 0 1. 5 1. 9 1. 7

30 56. 2 60. 5 58. 4 55. 6 49. 2 52. 4 28. 7 29. 5 29. 1 14 15 14. 5 2. 5 2. 5 2. 5

35 71 72. 1 71. 6 62. 1 55. 7 58. 9 33. 9 34. 2 34. 1 16. 5 16. 9 16. 7 2. 6 2. 7 2. 7

40 79. 7 82 80. 9 71 63. 4 67. 2 41. 6 39. 7 40. 7 20 19. 5 19. 8 3. 2 3 3. 1

45 92. 3 90. 4 91. 4 78. 5 72. 1 75. 3 46. 1 46. 3 46. 2 21. 2 20. 5 20. 9 4. 4 3. 5 4. 0

50 98. 7 100 99. 4 85. 7 76. 9 81. 3 50. 5 49. 8 50. 2 24. 5 24. 7 24. 6 5. 3 3. 5 4. 4

55 100 100 96. 2 85. 3 90. 8 55 53. 5 54. 3 27 26. 7 26. 9 5. 8 3. 6 4. 7

60 100 97. 1 98. 6 61. 5 66. 2 63. 9 29 30. 1 29. 6 6. 5 5. 6 6. 1

65 100 100 67 66. 5 66. 8 30. 3 30. 6 30. 5 6. 5 5. 8 6. 2

70 73. 2 72. 5 72. 9 32. 4 32. 8 32. 6 6. 9 6. 3 6. 6

75 79. 7 80. 1 79. 9 33. 9 33. 5 33. 7 7. 2 6. 5 6. 9

80 83. 9 84. 2 84. 1 34. 2 34. 5 34. 4 7. 4 7 7. 2

85 87. 2 88 87. 6 34. 6 35 34. 8 8. 9 7. 4 8. 2

90 92. 5 93 92. 8 35 35. 2 35. 1 9 7. 8 8. 4

Using the data from the previous table, I have decided to do another graph, this time showing the rate of reaction during the first 40 seconds. To determine the rate of reaction I have used this formula:

Concentration Rate of reaction (cm”/s)(Gas produced/ time taken)

1% H O99% H O = 3/40= 0. 08

25% H O75% H O = 19. 5/40= 0. 49

50% H O 50 % H O = 40/40= 1. 0

75% H O25% H O = 67/40= 1. 68

100% H O0% H O = 81/40= 2. 03

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NALYSIS

On the first graph it can be seen that the volume of gas was produced at a steady speedy throughout all 90secs. The lowest concentration of hydrogen peroxide took longest to decompose, whereas the experiment with the highest concentration of hydrogen peroxide took the fastest to decompose.

On the second graph, which indicates the rate of reaction, we are able to ascertain that more or less all the experiments occurred at a steady pace. The amount of gas released was released at an even speed.

Conclusion:

Looking back at my results I am confident in saying that my prediction was correct, ‘ the higher the concentration of hydrogen peroxide, the faster it takes to decompose. The lower the concentration of hydrogen peroxide, the slower it takes to decompose.

When the concentration of hydrogen peroxide was 100%, it took 55 seconds to produce 100cm” of gas, when the concentration was 75%, it took 65seconds too produce 100cm” of gas. When the concentration was 50% it wasn’t able to produce 100cm” in 90 seconds, it only produced 92. 8cm” of gas. In the fourth experiment, where the concentration of hydrogen peroxide was 25%, it only produced 35. 1cm” of gas in 90 seconds. In the last

experiment where the concentration was 1%, in 90 seconds it was only able to produce 8. 4cm” of gas.

Also, you can see that our prediction was correct by looking at the first graph, the steeper the gradient of the line; the faster it took to decompose. Which therefore means that the shallower the gradient of the line; the slower it took to decompose. The line which shows 100% concentration is much more steeper than the line which shows 1% concentration. The line is steeper at the start because there are more reactant particles for the reaction to take place. Towards the end a straight line seems to be evolving particularly with the experiment with 100%, 75% and 25% concentration. This is because there are no more reactant particles so therefore no more gas is being produced.

The rate of decomposition is increased when the concentration is increased. This is because when the concentration is increased there are more particles which means there is more of a chance of them colliding which therefore means the faster a chemical reaction takes place.

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VALUATION

Looking at the graphed results there appears to be a hardly any significant anomalous results. They could be anomalous for a few reasons. The timing of the result may not have been correct or the reading of the amount of gas released may not have been accurate.

Throughout the experiment there were a few flaws. Firstly, the fixed mass of catalyst was always measured accurately; a few times people were leaning on the table, which could have triggered the weight to be inaccurate. To prevent this from happening, I should have made sure the table was clear and should have perhaps checked the mass of the catalyst on another top-pan balance. Some of the readings could have been inaccurate which would have caused an anomalous result because hydrogen peroxide decomposes by itself in a period of time. This may have happened during our experiment, because whilst we were performing one experiment, the hydrogen peroxide was waiting in a conical flask for the next experiment. During this time the hydrogen peroxide could have decomposed. To prevent this from happening, we should have poured the hydrogen peroxide as and when we needed it. Also we should of used form the same bottle instead of different ones, as this could also have triggered our results.

If we could do this experiment again, I would have tried to be more accurate when weighing out the catalyst, timing the experiment and reading out the readings.

Instead of changing the concentration, we could have done a weight loss. This would involve weighing the mass of H O + O , and then weighing the mass again about 90 seconds afterwards. By doing this experiment we could have been able to determine whether hydrogen peroxide and a fixed mass of catalyst would decrease or increase its weight after 90 seconds.