Reaction between sodium thiosulphate and hydrochloric acid biology essay

The aim of this experiment is to study the rate of reaction and the different parameters that affect it. In this experiment, we will be investigating the effect of temperature on the reaction between Sodium Thiosulphate and Hydrochloric Acid.

Theory:

Chemical reactions involve collisions between reactant molecules or atoms to from bonds. For this, the molecules or atoms are required to come close to one another since new bonds can form only when the reactants are close enough to share electrons or facilitate a transfer of electrons. Collisions that lead to products are referred to as effective collisions which results when the collisions occur with enough speed energy and force to break bonds of the reactants.

The minimum energy reactants need to possess to break bonds and cause a reaction is known as activation energy. Therefore there are two ways of increasing the rate of reaction:

increase the number of collisions

increase the amount of movement (kinetic) energy so that more collisions lead to a reaction.

These depend on a number of factors:

Size of particles

Concentration

Temperature

Addition of a catalyst

Pressure of a gaseous reactant

This experiment deals with the effect of one of these factors-concentration of reactants.

Increasing concentration, increases the probability of collisions between the reactant as there are more of them available for interaction in the same amount of the solution mixture. Since the probability of the collisions is higher, the probability of effective collisions increases too.

The aim of this experiment to study and investigate the effect of this factor, on the rate of reaction between sodium thiosulphate and hydrochloric acid.

The reaction between sodium thiosulphate and hydrochloric acid proceeds to the following chemical equation:

Na2S2O3(aq) + 2HCl(aq) ® 2NaCl(aq) + SO2(aq) + H2O(l) + S(s)

This equation can also be represented in the ionic-equation form in the following manner:

S2O32- + 2H+ ® H2O + SO2 + S

The sulphur dioxide thus formed is dissolved in water as sulphurous acid. The partially dissolved sulphur makes the solution turbid due to the formation of a colloid. Because of this, the solution turns more dirty and

opaque as the liberated sulphur increases in quantity. This property is used in the experiment to determine the rate of the reaction.

Hypothesis:

It can be hypothesized that an increase in the concentration of the sodium Thiosulphate would increase the rate of the reaction. Quantitatively, if the concentration of $Na_2S_2O_3$ is increased by a factor of two, then the time taken for the reaction to occur will

decrease by a factor of two. This is equivalent to increasing the reaction rate by a

factor of two.

Variables

Controlled: Factors like pressure, temperature, surface area of particles and the proportion of particles with respect to each other, that affect the rate of the reaction must be maintained.

Independent: Concentration of the reactants

Dependant: The rate of the reaction as the time taken for the reaction to take place would depend on the concentration.

Requirements:

Chemicals:

1 M sodium thiosulfate solution

1 M HCl solution

distilled or deionized water

Equipment:

250-mL beakers

stirring rods

25-mL graduated cylinder

stopwatch

Procedure

Prepare 5 beakers with different concentrations of Sodium Thiosulfate amd Hydrochloric Acid by preparing 25ml solutions in the following manner:

Beaker Number	Volume of Sodium Thiosulfate (mL)	Volume of distilled or deionized water (mL)
1	25	0

2

20

5

3

15

10

4

10

15

5

5

20

Make a small “ x” on a sheet of white paper with a pencil. Place the 1st beaker containing the sodium thiosulfate solution over this “ x” and add 5 mL HCl solution and immediately begin timing the reaction.

Stir the contents of the flask and record the time taken for the cross to be obscured by the sulphur precipitate formed and record this time in your data table.

Repeat this procedure for the remaining samples.

Make a graph of the data obtained by plotting the time (in sec) for each reaction on the y-axis against the volume (in mL) of sodium thiosulfate on the x-axis.

Data Collection:

S. No

Beaker No.

Volume of Sodium Thiosulfate (mL)

Volume of distilled or deionized water (mL)

Time / +0. 01s

Reaction Rate (1/t) / +0. 01s-1

1.

1

25

0

18

0. 0560

2.

2

20

5

23

0. 04340

3

3

15

10

31

0. 03220

4.

4

10

15

56

0. 02000

5.

5

5

20

112

0. 00087

Data Presentation and Analysis

Data Analysis:

The graph above corresponds to our hypothesis as the relation between the rate of reaction and the concentration of reactants is proportional to the concentration of one particular reactant. This is due to the increased chances of fruitful collisions resulting in products. in this case, the reciprocal of the reaction time, 1/time, is being used to measure the speed of the reaction and represents how long it takes for a certain concentration of sulphur to form when the hydrochloric acid is added to the sodium Thiosulphate. The rate of reaction i. e. the time taken for the reaction to occur therefore is seen to increase with an increase in the concentration of one of the reactants.

Limitations:

The graph above is best fitted to our results which means that the experimental results had a degree of inaccuracy. This could have been due to the following reasons:

Impurities in the reactants can affect the rate of reactions and inaccurate time periods.

The least count of the measuring cylinder used to measure solution is 0. 05cm3. the volumes measured are therefore not precise. Due to this, the volumes of solutions measured might be inaccurate leading to inaccurate concentrations.

Since our laboratory was air-conditioned, the reaction mixture could have undergone uneven and sudden cooling.

The reaction time when stopping and starting the stopwatch also added to the inaccuracy especially when the time periods are really small.

Modifications:

To overcome the limitations and give more accurate results, we can modify the experiment in the following ways:

A burette or a pipette could be more accurate in measuring the volumes of solutions.

The experiment must be carried out at a distance from the air-conditioner to prevent rapid cooling of the solutions and maintain a constant temperature.

A purer solution can be made by using better quality of the sodium Thiosulphate.

Every individual's definition of the disappearance of the cross could be different. To overcome this, an indicator could have been used to indicate the completion of reaction.

Precautions:

To minimize inaccuracy, the following precautions were incorporated in the experiment:

The water bath is very hot and so the beaker with the hot acid must be handled extra carefully or it could be dangerous.

The acid must be handled with care.

It is best that one person time during the whole of the reaction to reduce the error due to reaction time.

Conclusion:

At the end of this experiment, it can be concluded that the concentration does have an effect on the time taken for the reaction and consequently on the rate of reaction. More specifically, an increase in concentration leads to an increase in the rate of reaction. The following conclusions can therefore be drawn:

Concentration µ / _____ 1_____

time taken for reaction to be complete

Concentration µ Rate of reaction