

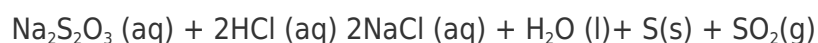
Investigate the Rate of Reaction of Sodium Thiosulphate and Hydrochloric Acid

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Lab report

Introduction

1. Sodium thiosulphate reacts with Hydrochloric acid to form a yellow precipitate of sulfur. The equation is:



1. The time taken for the same amount of yellow precipitate to be produced provides a method of measuring the rate of reaction at different concentrations. (Connors, 1990)

The reaction of sodium thiosulphate and hydrochloric acid can be easy to study the effect of concentration on the rate of reaction. Hydrochloric acid is colorless; sodium thiosulphate is a white crystal. The two will react to form sodium chloride salt, sulfur, water, and sulfur dioxide gas. Sulphur is solid with an intense yellow color. The reaction is marked to an end by the formation of this product. This can be observed by the change in color and the disappearance of the red mark as the products are being formed. Adding water to the sodium thiosulfate is in order to reduce the concentration and study the reaction under different reactant concentrations. (Connors, 1990)

Aim: to investigate the rate of reaction of sodium thiosulphate and hydrochloric acid.

The aim of the experiment is to study the effect of concentration on the rate of reaction using a reaction between sodium thiosulphate and hydrochloric acid.

Prediction: (*What do you think you will find out from the experiment*)

When both concentrations are high, the rate of reaction will be fast, and the time taken to the end of the reaction will be minimal. Adding more water lowers the concentration of sodium thiosulfate against a constant concentration, and the time to the end of the reaction increases as the hydrochloric acid is being added. (Connors, 1990)

Safety Precautions: (Give at least three more safety precautions that are important and appropriate

for reasons)

SAFETY PRECAUTION	REASON(S)
1. Wear laboratory glasses	To protect eyes from chemical splashes. Hydrochloric acid is a hazardous liquid Which can be irritating or damage the eyes if it splashes in the eyes
2. Wear a gas mask	To prevent inhaling the sulfur dioxide gas. One of the products formed by the reaction is sulfur dioxide gas, which is a colorless gas with a strong, pungent, suffocating odor. It is toxic when inhaled, especially to Asthmatic people. It easily dissolves in water to form sulfurous acid. There is hence a need to prevent inhaling the gas.
3. Wear a lab coat and a protective suit, and wear hand gloves and closed shoes to protect your legs. Long hair should be well tied, and probably wear a cap.	This is to prevent getting your skin into contact with the chemicals. The chemicals used can be dangerous and corrosive, and cause burns when they come into contact with your skin.
4. Dispose of the chemicals appropriately after the experiment. And clean the used glassware apparatus.	To prevent future risks of the chemicals. The chemicals can also be mistakenly used if wrongly disposed of. Corrosive HCL can react with working benches and places of contact if carelessly spilled.

Materials and Methods:

Variables: (*independent, dependent, and controlled*)

The time taken to the end of the reaction is dependent on the concentration of the reactant. Time is indirectly proportional to concentration since, as the concentration increases, the time taken to the end of the reaction decreases. The concentration of reactants can be controlled. Hydrochloric acid concentration is constant, whereas else adding distilled water in portions of the conical flask with the sodiumthiosulphate reduces its concentration controllably. The burette is used since it is precise in measuring the amount of distilled water and sodium thiosulphate being added. A conical flask is clear and made of glass, hence easy to see the progress of the reaction. It is made of glass and hence cannot be corroded easily by the reacting chemicals. The white tile facilitates easier observation as the reaction becomes cloudy enough to make the making invisible. This marks the end of the

reaction. The stopwatch measures the time taken to the end of the reaction. (Connors, 1990)

Results Table:

Flask No.	The volume of $\text{Na}_2\text{S}_2\text{O}_3$ solution (ml)	The volume of water (ml)	The total volume of solution (ml)	Conc. of $\text{Na}_2\text{S}_2\text{O}_3$ solution (M)	The volume of 1M HCl (ml)	Time (t) taken for the cross to become just invisible (s)	$1/t$ (s^{-1})
A	10	40	50	0.02	10	640 s	1.6×10^{-3}
B	20	30	50	0.04	10	210 s	4.8×10^{-3}
C1	30	20	50	0.06	10	110 s	9×10^{-3}
C2	30	20	50	0.06	10	105 s	9.5×10^{-3}
C3	30	20	50	0.06	10	106 s	9.4×10^{-3}
D	40	10	50	0.08	10	79 s	12.7×10^{-3}
E	50	0	50	0.1	10	56 s	17.9×10^{-3}

The average for flask C will be the average of the three flasks, which will be

$$= (9 + 9.5 + 9.4) / 3 = 9.3 \times 10^{-3}$$

The concentration of sodium thiosulphate increases as we add less water to the successive flasks with the increasing sodium thiosulphate crystals. The time taken to the end of the reaction reduces down each flask. When we calculate the reciprocal of the time taken, it becomes directly proportional to the concentration of the reactants. (Connors, 1990)

Processing results

Provide a graph of the concentration of sodium thiosulphate solution against 1/time.

The graph forms a straight line after joining the point of best fit. From the graph, we can see that the 1/ time taken for the disappearance of the red mark increases proportionally as the concentration increases. As concentration increases, the rate of reaction increases, and the time taken decreases; as the concentration reduces, the rate of reaction slows, and the time taken increases. An equilibrium is reached when the solution turns yellow. (Connors, 1990)

(The graph is attached at the end of this document)

Evaluation:

Include answers to the following questions, and also cover the topics listed in the mark scheme.

1. *Why was water added to the sodium thiosulphate in the conical flask before adding the hydrochloric acid during the reaction?*

Water is a universal solvent. It helps in dissolving the sodium thiosulfate to form the solution, which makes the reaction easier. Distilled water also plays the role of changing the concentration of the solution to the desired molar concentration to form part of the solution to be used.

Anomalies are the values that do not correspond to the rest of the data. This is due to the accuracy of the measurement of the reactant. There can be errors in the measurement, which will add more or fewer reactants. This affects the rate of the reaction; hence, the final data also gets corrupted, leading to anomalies. There can also be other factors affecting the rate of the reaction other than the concentration. These include physical factors such as temperature, which affects the rate of reaction, leading to anomalies. The apparatus can also be contaminated with other impurities. (Connors, 1990)

The experiment can be relied on since it provides relatively correct data to investigate the aim of the experiment.

The reaction can first-order reaction since the rate of reaction depends on one concentration factor, which is the concentration of sodium thiosulphate. The concentration of hydrochloric acid is constant. The rate of reaction becomes directly proportional to the concentration of the reacting substance. (Connors, 1990)

Conclusions: (What did the experiment show you? Check your Aim and make sure that each Conclusion is clear)

The practical had some anomalies, but was perfect and accurate enough to allow us to observe and

study the effect of concentration on the rate of the reaction. The practical was a success as it helped in the kinetic study of concentration and its effect on the rate of the reaction. In a practical feature recommendation, there are other factors affecting the rate of the reaction, such as temperature. The experiment can be carried out at temperature-controlled conditions to avoid interference with the observation. The factor can also be incorporated into the practice and study of how the effect of heat will affect the behavior of the reaction. (Connors, 1990)

Reference

Connors, K. A. (1990). *Chemical kinetics: the study of reaction rates in solution*. John Wiley & Sons.