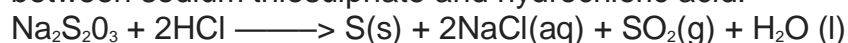


# To Study the Effect Of Concentration On the Rate Of Reaction Between Sodium Thiosulphate & Hydrochloric Acid

## Theory

According to the law of mass action, rate of a chemical reaction is directly proportional to the product of the molar concentrations of the reactants. In other words, the rate of reaction increases with the increase in the concentration of the reactants. The effect of concentration of reactants on rate of a reaction can be studied easily by the reaction between sodium thiosulphate and hydrochloric acid.



The insoluble sulphur, formed during the reaction, gives a milky appearance and makes the solution opaque. Therefore, rate of reaction can be studied by measuring the time taken to produce enough sulphur to make some mark invisible on a paper kept under the conical flask in which the reaction is carried out.

## Apparatus

Pipette (10 ml), stop-watch, two burettes and five conical flasks (100 ml).

## Materials Required

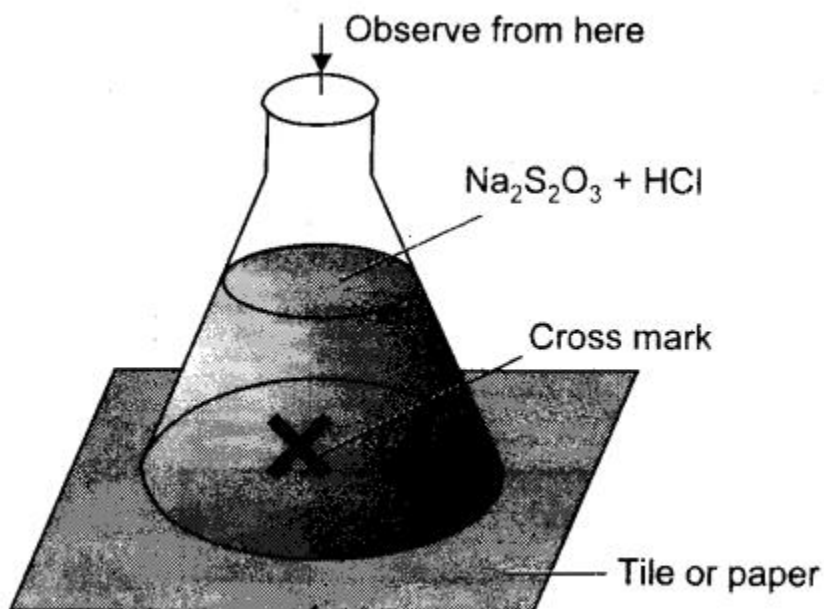
0.1 M  $\text{Na}_2\text{S}_2\text{O}_3$  solution and 1 M HCl solution.

## Procedure

1. Wash the conical flasks with water and label them as 1, 2, 3, 4 and 5 respectively.
2. With the help of a burette, add 10, 20, 30, 40 and 50 ml of 0.1 M  $\text{Na}_2\text{S}_2\text{O}_3$  solution to the flasks 1, 2, 3, 4 and 5 respectively.
3. Now add 40, 30, 20 and 10 ml of distilled water to the flask 1, 2, 3 and 4 respectively so that volume of solution in each flask is 50 ml.
4. Take 10 ml of 1M HCl in a test tube with the help of a burette.
5. Add 10 ml of hydrochloric acid taken in a test tube to the conical flask No. 1 containing 10 ml of 0.1 M  $\text{Na}_2\text{S}_2\text{O}_3$  and 40 ml of distilled water and start the stop-watch.

When half of the hydrochloric acid solution has been added. Shake the contents of

the conical flask and place it on the tile with a cross mark as shown in Fig.



**Fig.** Study of rate of reaction.

6. Go on observing from top to downwards in the flask and stop the stop-watch when the cross mark just becomes invisible. Note down the time.
7. Repeat the experiment by adding 10 ml of 1M HCl to flasks 2, 3, 4 and 5 and record the time taken in each case for the cross to become just invisible.

### Observations

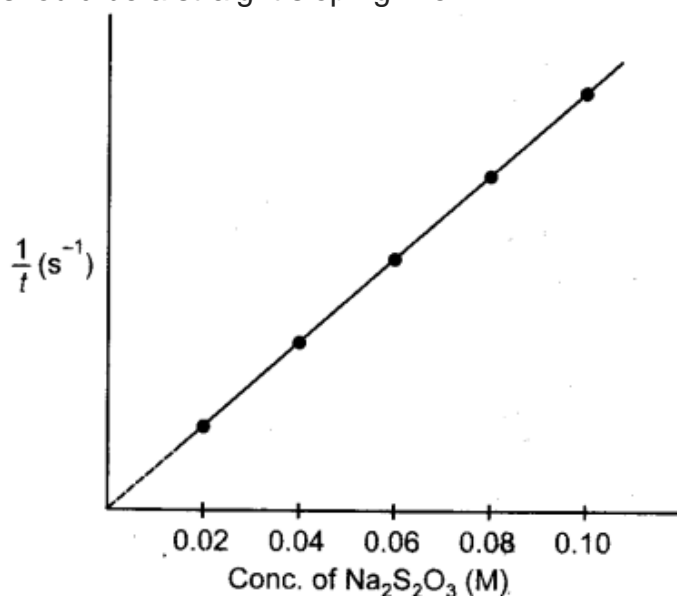
Record the observations in a tabular form as given below :

Flask No.	Volume of $\text{Na}_2\text{S}_2\text{O}_3$ solution in ml	Volume of water in ml	Total volume of solution in ml	Conc. of $\text{Na}_2\text{S}_2\text{O}_3$ solution	Volume of 1M HCl (ml)	Time taken for cross to become just invisible t	$\frac{1}{t}$ ( $\text{s}^{-1}$ )
1.	10	40	50	0.02 M	10	..... s	
2.	20	30	50	0.04 M	10	..... s	
3.	30	20	50	0.06 M	10	..... s	
4.	40	10	50	0.08 M	10	..... s	
5.	50	0	50	0.10 M	10	..... s	

### Plotting of Graph

Plot a graph between  $1/t$  (in seconds) and the cone, of sodium thiosulphate by taking  $1/t$  along ordinate (vertical axis) and cone, of  $\text{Na}_2\text{S}_2\text{O}_3$  along abscissa (horizontal axis). It

should be a straight sloping line.



**Fig.** A graph of conc. of  $\text{Na}_2\text{S}_2\text{O}_3$  vs.  $\frac{1}{t}$ .

### Result

From the graph, it is clear that  $1/t$  is directly proportional to the conc. of  $\text{Na}_2\text{S}_2\text{O}_3$  solution. But  $y$  is a direct measure of rate of the reaction, therefore, rate of the reaction between  $\text{Na}_2\text{S}_2\text{O}_3$  and  $\text{HCl}$  is directly proportional to the conc. of  $\text{Na}_2\text{S}_2\text{O}_3$  solution taken. Hence, rate of this reaction is directly proportional to the concentration of  $\text{Na}_2\text{S}_2\text{O}_3$ , which is one of the reactants.

Note. It may be noted that the reaction rate also increases when the amount of sodium thiosulphate is kept constant but the concentration of hydrochloric acid is increased.

### Precautions

1. The apparatus must be thoroughly clean. If the same conical flask is to be used again and again, it should be thoroughly washed with cone.  $\text{HNO}_3$  and then with water.
2. Measure the volumes of sodium thiosulphate solution, hydrochloric acid and distilled water very accurately.
3. Use the same tile with the same cross-mark for all observation,
4. Complete the experiment at one time only so that there is not much temperature variation.
5. Start the stop-watch immediately when half of the hydrochloric acid solution has been added to sodium thiosulphate solution.
6. View the cross-mark through the reaction mixture from top to bottom from same height for all observations.