To study the kinetics of Iodide Persulphate reaction by

8/10/2020 Initial Rate

Aim :- To study the kinetics of the reaction between Potassium Iodide (KI) & potassium peroxodisulphate (persulphate) solution. $K_2S_2O_8$.

Requirements :- (1) 4 conical flasks of 250 ml capacity
(2) 3 Measuring flasks 250 ml capacity
(3) 3 Measuring flask of 100 ml capacity
(4) 10 ml pipettes.

Chemical Required :- (1) 0.05M $K_2S_2O_8$ sol.
(2) 0.1M KI sol.
(3) 0.01M $Na_2S_2O_3$ sol.
(4) 2.0M CH_3COOH.
(5) Starch solution
(6) Crushed ice

Theory :- The reaction bet^n Potassium Persulphate and Potassium Iodide.

$$K_2S_2O_8 + 2KI \longrightarrow 2K_2SO_4 + I_2 \quad \text{— (1)}$$

$$S_2O_8^{2-} + 2I^- \longrightarrow 2SO_4^{2-} + I_2$$

In acid medium.

$$S_2O_8^{2-} + 2I^- + 2H^+ \longrightarrow S_2O_7^{2-} + H_2O + I_2$$

$$S_2O_7^{2-} + H_2O \longrightarrow 2SO_4^{2-} + 2H^+$$

This is second order reaction since concentration of both reactants are in rate equation of the reaction.

During the reaction I_2 is liberated therefore progress of reaction can be determined by titrating the liberated I_2 in 10 ml of reaction mixture against standard thiosulphate

Solution at different intervals of time. The titre values are proportional to iodine formed & to the amount of Peroxodisulphate which has disappeared from 10ml of reaction mixture. At given value of the 'x' at different intervals of time.

Procedure :-

(1) 0.05 M $K_2S_2O_8$ Molar Mass = 270 g/mole
For 1000 ml 0.05 M × 270 = 13.5g of $K_2S_2O_8$
We need 100ml so. for that 1000ml → 13.5g
13.5g. ∴ 100ml → $\frac{13.5 \times 100}{1000}$

(2) 0.1M KI, Molar Mass = 166 g/mol
For 0.1M → 16.6g (1000ml). For 100ml → 1.66g KI

(3) 2M CH_3COOH → Dissolve 11.6ml of CH_3COOH in 100ml H_2O

I Keep solutions in ice $K_2S_2O_8$ (100ml) & KI (100ml) + 10ml CH_3COOH in two 250 ml conical flasks. Loosely the solutions are corked & then kept in thermostat ie water bath. to maintain room temperature

After half an hour pour, KI solution into 250ml flask of $K_2S_2O_8$ sol. & stopwatch is started at same time Cork the solution & shake it gently

I After interval of 5 mins, withdraw 10ml of reaction mixture from conical flask & transfer it into 25ml conical flask containing ice cold water. so that reaction is freezed at that time only.

(Ground)

III. Titrate the conical flask solution having liberated I_2 at 5th minute of reaction mixture against 0.01M sodium thiosulphate solution ($Na_2S_2O_3$) using starch as an indicator. Add 1ml of starch solution is added when solution becomes pale yellow in color. The end pt is noted when solution disappeared its violet colour. The violet color again reappears because the reaction is not completely stopped on cooling with ice cold water

IV. Continue to extract 50 ml of mixture from conical flask (250ml) capacity at interval of 5 mins

V. After this take, 50ml of reaction mixture into clean flask & add 4g of KI & stopped. the conical flask & keeps the stoppered flask in a beaker of hot water maintained at 60°C for ~~done~~ & heat it for ½ hr & Cool this mixture & maintain its temp for at least 15 min & in a thermostat. Withdraw 10ml of reaction mixture & titrate it against 0.01M Sodium thiosulphate sol. This corresponds to initial conc^n of $K_2S_2O_8$ Results are to be recorded.

Initial concentration of $K_2S_2O_8$ & KI.

Since 100 ml of 0.05M $K_2S_2O_8$ 100ml of 0.1M KI & 1ml of 2M CH_3COOH are mixed, hence the concentration of $K_2S_2O_8$ of the mixture is

$$\frac{0.05 \times 100}{2 \cdot 10} = 0.0238\ M$$

10ml of 0.0238M is taken of the reaction mixture.

$$10 \times 0.0238\ M = V \times 0.01M$$

$$V = 47.6\ ml$$

This is initial concn of $K_2S_2O_8$ in the resultant 10 ml of reaction mixture & it is obtained by titrating with 0.01M $Na_2S_2O_8$

Initial concentration $a = 47.6$ ml

Time in mins	x Titre values			$a-x$	$\frac{1}{a-x}$	$k = \frac{1}{t}\frac{x}{a(a-x)}$
	IR	FR	Vol of $Na_2S_2O_8$			
5						
10						
15						
20						
25						
30						

Formula used

$$kt = \frac{1}{a-x} - \frac{1}{a}$$

$$t = \frac{1}{k}\left[\frac{1}{a-x} - \frac{1}{a}\right]$$

$K_2S_2O_8$ 13.5g

KI = 16.6g

$Na_2S_2O_8$ 5M = 2.48

1000ml → 18.5g

100ml → 1.85g

Interpretation of Result

(1) The value of k should be constant

(2) Graph between t & $\frac{L}{a-r}$ should be a straight line.