Experiment No: 5

Observation Table

Table 1. Titration of hypo solution as given $CuSO_4$ solution

Indicator - Starch

Endpoint - Blue to Colourless

Table:

S.No	Volume of $CuSO_4$ soln	Burette Readings		Volume of hypo soln (ml)
		Initial	final	
1	10.0	0.0	9.0	9.0
2	10.0	9.0	18.0	9.0
3	10.0	18.0	27.0	9.0

Concordant Readings: 9.0mL

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Experiment No :→ 05

1.) Aim :→ To determine the strength of free chlorine in given water sample iodometrically. Given standard N/40 $CuSO_4$ solution to standardise $Na_2S_2O_3$

2.) Apparatus Required :→ Burette, Pipette, Measuring flasks, Glass rod,

Chemicals used :→ KI solution (10%), Hypo solution ($Na_2S_2O_3$), Starch solution (freshly prepared), N/40 $CuSO_4$ solution

3.) Theory :→ Chlorine is a powerful oxidising agent & is cheaply available. It is widely used for disinfection of potable & municipal water sample supplies to remove bacteria, fungus & other pathogenic micro-organisms & for deodorization. It is done with the help of bleaching powder or chlorine gas or chlorine dissolved in water in form of concentrated solutions or with chloramines.

Chlorine gas hydrolyses in water almost completely to form hypochlorous acid. (HOCl)

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Table 2:→ Titration of hypo solution vs given water sample.

Indicator :→ Starch

Endpoint :→ Blue to Colourless

Table 2

S.No	Volume of Water Sample taken	Burette Readings		Volume of Hypo soln (in mL)
		Initial	Final	
1	10.0	0.0	3.5	3.5
2	10.0	3.5	7.0	3.5
3	10.0	7.0	10.5	3.5

Concordant Reading = 3.5mL

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$$Cl_2 + H_2O \longrightarrow HOCl + H^{\oplus} + Cl^{\ominus}$$

HOCl dissociates into $H^{\oplus}$ & $OCl^{\ominus}$ (hypochlorite ion) in the reversible reaction

$$HOCl \rightleftharpoons H^{\oplus} + OCl^{\ominus}$$

HOCl is a weak acid with pKa ≃ 7.5 at 25°C HOCl, the prime disinfecting agent, is therefore dominant at pH < 7.5 & is a more effective disinfectant than $OCl^{\ominus}$ ion which dominates at pH > 7.5

In dilute solutions & at pH > 4, very little molecular chlorine exists in soln.

The determination of available chlorine is done by treating the known volume of sample with an excess of a solution of K.I. The free chlorine present in water oxidises the corresponding amount of KI to I_2. The liberated I_2 is estimated by titrating against standard hypo solution, using starch as indicator.

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Calculations

I) N_{CuSO_4} (N_1) = N/40 $\quad$ N_{Hypo} (N_2) = ?

V_{CuSO_4} (V_1) = 10mL $\quad$ V_{Hypo} (V_2) = 9mL

$$N_1V_1 = N_2V_2$$

$$\frac{10}{40} = N_2 \times 9$$

$$N_2 = \frac{1}{36} N$$

II) N_{water} (N_3) = ? = Equivalent to dissolved chlorine

V_{water} (V_3) = 10mL

$$N_3V_3 = N_4V_4$$

(V_{Hypo} (V_4 = 3.5mL)

($N_4 = N_2$)

$$N_3 \times 10 = \frac{1}{36} \times 3.5$$

$$N_3 = 0.00972N$$

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4). CHEMICAL REACTIONS.

☆ $Cl_2 + 2KI \longrightarrow 2KCl + I_2$

☆ $2CuSO_4 + 4KI \longrightarrow Cu_2I_2 + I_2 + 2K_2SO_4$

☆ $I_2 + Starch \longrightarrow Blue$

☆ $I_2 + 2Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + 2NaI$

Sodium thiosulphate — Sodium Tetrathionate.

5). ☆ Procedure.

I) Standardization of Hypo soln with given $CuSO_4$ solution

~> Take 10mL of given $CuSO_4$ soln from pipette in conical flask. Add 1ml of KI soln & titrate with hypo solution till faint yellow colour develops. At this point add 1-2 drops of starch as indicator. The solution will turn blue. Titrate further with hypo to colourless as end point. Note volume of hypo solution as V mL.

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Total Chlorine Residuals = $N_3 \times Eq\ wt\ of\ Cl_2$

$= 0.00972 \times \frac{71}{2}$

$= 0.34506\ g/L$

$= \underline{345.06\ ppm}$ Ans

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D) Titration of given water sample with hypo solution

Take 10 ml of given water sample from pipette in conical flask Add 1 ml of KI soln & titrate with hypo solution till faint yellow colour develops. At this point, add 1-2 drops of starch as indicator The soln turns blue. Add hypo till colourless as end point. Note volume of hypo used

6) Result:

Amount of Residual chlorine in a given water sample = 345.06 ppm Ans

7) Precautions:-

(i) The soln being unstable should be treated immediately after preparation

(ii) The soln should be well shaken before each aliquot is withdrawn from titration

(iii) Chlorine vapours being harmful, the soln should

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not be sucked into pipette with the mouth.

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