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REDOX TITRATION

(Estimation of Fe^{2+} in Mohr's salt using permanganomerty)

Theory:

The reaction between Mohr's salt solution and potassium permanganate solution in acid medium is oxidation–reduction or redox reaction where potassium permanganate solution is the oxidizing agent and Mohr's salt solution is the reducing agent.

Reaction:

$MnO_4^- + 8H^+ + 5e = Mn^{+2} + 4H_2O$

$5Fe^{+2} = 5Fe^{+3} + 5e$

$MnO_4^- + 5Fe^{+2} + 8H^+ = 5Fe^{+3} + Mn^{+2} + 4H_2O$

PROCEDURE:

A. <u>Preparation of 100ml (N\10) standard oxalic acid solution.</u>

Equivalent weight of oxalic acid =63

1000ml of 1(N) oxalic acid solution contain 63gm oxalic acid.

Hence 100 ml (N/10) oxalic acid contain 0.63 gm oxalic acid.

About 0.63gm of oxalic acid is weighed from a weighing bottle by difference and is poured into 100ml volumetric flask, dissolved in small volume of water by shaking and the volume is made up to the mark with distilled water and thoroughly shaken.

Therefore, Strength = x/0.63 (N\10) = S_1 (N).

B. <u>Standardization of given permanganate solution against standard oxalic acid solution</u>.

The reaction between $KMnO_4$ and oxalic acid is an example of redox reaction. Here acidified $KMnO_4$ acts as an oxidizing reagent while oxalic acid is a reducing agent.

Reaction:

$2KMnO_4 + 3H_2SO_4 = K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$

$5COOH\text{-}COOH + 5[O] = 10CO_2 + 5H_2O$

C. <u>Titration of given $KMnO_4$ solution with standard oxalic acid solution</u>

10 ml of standard oxalic solution are pipetted into a 250ml conical flask. Now 10 ml of (1:4) H_2SO_4 solution is added, the solution is warmed to 60 - 70^0 C and then titrated with the permanganate solution from the burette till first permanganate pink color is seen. And the process is repeated twice.

4. Estimation of Fe^{2+} in Mohr's salt.

5ml of Mohr's salt solution is pipetted out into a 250ml conical flask. Now 2 ml of $H_2SO_4$and H_3PO_4 (1:4) and 20ml of distilled water is added to the solution. The solution is titrated with standard $KMnO_4$ solution till the first permanent pink color is seen.

RESULT:

1. Recording of temperature:

Initial temperature(^{0}c)	Final temperature(^{0}c)	Mean temperature(^{0}c)

2. Preparation of 100 ml (N/10) Oxalic Acid solution

Weight taken (gm)	Weight to be taken (gm)	Strength (N)
	0.63	

3.Table: Titration of oxalic acid with $KMnO_4$

Sl.no.	Vol. of oxalic Acid (ml)	Strength of oxalic Acid (N)	Burette reading of $KMnO_4$ (ml)			Mean vol. of $KMnO_4$ (ml)
			Initial (ml)	Final (ml)	Vol. required (ml)	
1.						
2.						

4.Table. Titration of Mohr's salt solution with $KMnO_4$:

Sl.no.	Vol. of Mohr's salt solution(ml)	Strength of $KMnO_4$ (N)	Burette reading of $KMnO_4$ (ml)			Mean vol. of $KMnO_4$ (ml)
			Initial (ml)	Final (ml)	Vol. required (ml)	
1.						
2.						

CALCULATION:

(A) Strength of $KMnO_4$ solution:

We know $V_1S_1 = V_2S_2$

or, $S_2 = V_1S_1/V_2$

= …….. (N)

Here, V_1=volume of oxalic acid

S_1=strength of oxalic acid

V_2=volume of $KMnO_4$

S_2=strength of $KMnO_4$

(B) Strength of Fe^{2+} in Mohr's salt solution:

Volume of $KMnO_4$ solution required for Mohr's salt solution = **a** cc = ……cc.

Strength of $KMnO_4$ solution = **y** (N) = …… (N).

a ml of **y**(N) $KMnO_4$ solution ≡ 55.85 X **a** X **y**/1000gm of Fe^{2+}

≡ z gm of Fe^{2+} = ……gm.

1000ml of Mohr's salt contain = z X 1000/5 gm of Fe^{2+}

= …… gm. = w gm of Fe^{2+}

Amount of Fe^{2+} = w gm /lit = …… gm./ lit

DISCUSSION:

Estimation of Fe^{+2} was done in the supplied Mohr's salt solution by redox titration using $KMnO_4$ as oxidizing agent. All the apparatus were well cleaned with distilled water prior to the experiment. If the apparatus are not cleaned properly, then sole determination of Fe^{+2} in the Mohr's salt solution is not possible as water may contain trace amount of Fe^{+2} ions. The standardization of $KMnO_4$ was done by heating oxalic acid solution at 60-70^{0}C, redox titration will take place to a certain extent and strength of $KMnO_4$ will be of lower value. The mineral acid H_2SO_4 should be used in the reaction mixture as redox titration takes place under acidified condition. Mineral acid like HCl or HNO_3 should not be used as HCl reacts with $KMnO_4$ and HNO_3 itself is an oxidizing agent. The use of (H_2SO_4:H_3PO_4) in the Mohr's salt solution is to maintain the proper pH and H_3PO_4 reacts with Fe^{+3} to form $FePO_4$ and complete oxidation of Fe^{+2} proceeds and the equilibrium shifts to the right (Fe^{+2} to Fe^{+3}). As redox reaction is temperature dependent, estimation of Fe^{+2} is done at a fixed temperature i.e. room temperature.

Conclusion:

The amount of Fe^{2+} estimated in the supplied Mohr's salt solution is …….. gms. /lit at ……^{0}C.