Date 27/10/20

Expt. No. 5 Page No. 11

EXPERIMENT: To determine the amount of Fe^{2+} and Fe^{3+} ions by permanganometry.

THEORY: Mn^{7+} oxidizes Fe^{2+} in acidic medium to Fe^{3+} and itself gets reduced to divalent manganese Mn^{2+}. $KMnO_4$ acts as a self indicator. If Fe^{3+} is present in the solution, it can be reduced by boiling the solution with zinc pieces in acidic medium and can be titrated with standard $KMnO_4$. The end point in this case corresponds to presence of both Fe^{2+} and Fe^{3+} ions in the solution.

PROCEDURE:

(i) Standardization of $KMnO_4$

1. Transfer 10ml of the standard 0.1N ferrous ammonium sulphate (FAS) solution to a clean conical flask using a pipette.
2. Add 5ml of 4N sulphuric acid.
3. Titrate the solution against $KMnO_4$ solution taken in a burette. The color of the solution changes from colorless to pink.
4. Note the volume of solution used and repeat the titration at least 5 times and take the mean of the closely related readings (V_1).

(ii) Determination of Fe^{2+}

1. Pipette out 10ml of the given solution in the titration/conical flask.
2. Add 5ml of 4N sulphuric acid.
3. Titrate the solution against $KMnO_4$ solution taken in a burette. The color of the solution changes from colorless to pink.
4. Note the volume of the solution used and repeat the titration at least 5 times and take the mean of the closely related readings (V_2).

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EXPERIMENT: To determine the amount of Fe^{2+} and Fe^{3+} ions by permanganometry.

APPARATUS: Pipette, burette, beakers, conical flask, funnel, burette stand and clamp.

CHEMICALS: Mohr's salt solution (Ferrous Ammonium Sulphate; $FeSO_4(NH_4)_2SO_4.6H_2O$), permanganate ($KMnO_4$) and sulphuric acid (H_2SO_4).

CHEMICAL EQUATIONS:

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

INDICATOR: $KMnO_4$ (acts as a self indicator)

OBSERVATIONS:

(i) Standardization of $KMnO_4$

Volume of 0.1N FAS solution taken for each titration = 10ml

Sr. No.	Burette Reading (in ml)		Volume of $KMnO_4$ used (in ml)
	Initial	Final	
1.	0.0	10.5	10.5
2.	0.0	10.5	10.5
3.	0.0	10.5	10.5

Mean Volume (V_1) = 10.5 ml

(ii) Determination of Fe^{2+}

Volume of given sample taken for each titration = 10ml

Sr. No.	Burette Reading (in ml)		Volume of $KMnO_4$ used (in ml)
	Initial	Final	
1.	0.0	10.5	10.5
2.	0.0	10.5	10.5
3.	0.0	10.5	10.5

Mean Volume (V_2) = 10.5 ml

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(iii) Determination of Fe^{2+} and Fe^{3+} (Total Iron Content)

1. Pipette out 10ml of aqueous solution P into the conical flask. (green sol^n has already been boiled with 2-3 gms of zinc pieces and 5ml of dil. H_2SO_4 to reduce Fe^{3+} to Fe^{2+}).
2. Add 5ml of 4N H_2SO_4.
3. Titrate it with standard $KMnO_4$ solution till the solution turns from colorless to pink.
4. Note the volume of the solution used and repeat the titration at least 5 times and take the mean of the closely related readings (V_3).

RESULT: The amount of Fe^{2+} = 5.544 gm/l
and the amount of Fe^{3+} = 2.128 gm/l

PRECAUTIONS: 1. Lower meniscus to be read for colorless solutions.
2. Upper meniscus to be read for colored solutions.
3. Continue the titration until a permanent pink color appears in the conical flask.
4. Do not blow in the pipette.

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(iii) Determination of Fe^{2+} and Fe^{3+} (Total Iron Content)

Volume of the given sample taken for each titration = 10 ml

Sr. No.	Burette Reading (in ml)		Volume of $KMnO_4$ used (in ml)
	Initial	Final	
1.	0.0	14.5	14.5
2.	0.0	14.5	14.5
3.	0.0	14.5	14.5

Mean Volume (V_2) = 14.5 ml

CALCULATIONS:

(i) Normality of $KMnO_4$

($KMnO_4$) (FAS)

$N_1V_1 = N_2V_2$

$N_1 = \frac{0.1 \times 10}{10.5} = 0.095N$

(ii) Determination of Fe^{2+}

(Sol^n of Fe^{2+}) ($KMnO_4$)

$N_1 \times 10 = 0.095 \times 10.5$

$N_1 = 0.099N$

Strength of $Fe^{2+} = 0.099 \times 56 = 5.544 gm/l$

(iii) Determination of Fe^{3+} in a mixture of Fe^{2+} and Fe^{3+}

$N_1 = \frac{0.095 \times 14.5}{10} = 0.137N$

Strength of total Fe = $0.137 \times 56 = 7.672 gm/l$

Strength of Fe^{3+} ions = $\frac{(14.5 - 10.5) \times 0.095 \times 56}{10} = 2.128 gm/l$

RESULT : The amount of $Fe^{2+} = 5.544 gm/l$; and the amount of $Fe^{3+} = 2.128 gm/l$

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