**EXPERIMENT**

**Aim:**

**To prepare M/20 solution of Mohr's salt solution and titrate it against the given potassium permanganate solution. Also find the molarity and strength of the potassium permanganate solution.**

**Theory:**

**Potassium permanganate is a strong oxidant in the presence of sulphuric acid. Mohr's salt is a double salt forming a single crystalline structure having the formula $FeSO_4(NH_4)_2SO_4.6H_2O$. The chemical name for Mohr's salt is ferrous ammonium sulphate.**

**In this titration Mohr's salt acts as a reducing agent and potassium permanganate acts as an oxidising agent. So, the reaction between Mohr's salt and potassium permanganate is a redox reaction. In this redox reaction, ferrous ion from Mohr's salt gets oxidised and pink coloured of manganese present in potassium permanganate, which is in the +7 oxidation state gets reduced to colourless $Mn^{2+}$ state.**

**The chemical reaction and the molecular chemical equation is given below.**

**Overall reaction –**

$$2KMnO_4 + 10\ FeSO_4 + 8\ H_2SO_4 \rightarrow K_2SO_4 + 2\ MnSO_4 + 5\ Fe_2(SO_4)_3 + 8\ H_2O$$

**The ionic equation involved in the process is given below.**

**Oxidation half reaction – $[Fe^{2+} \rightarrow Fe^{3+} - e^-] \times 5$**

**Reduction half reaction – $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$**

**Overall ionic equation – $MnO_4^- + 8\ H^+ + 5\ Fe^{2+} \rightarrow Mn^{2+} + 5\ Fe^{3+} + 4H_2O$**

**This titration is based upon oxidation-reduction titrations. When ferrous ammonium sulphate solution is titrated against potassium permanganate in the presence of acidic medium by sulphuric acid. Acidic medium is necessary in order to prevent precipitation of manganese oxide.**

**Indicator: Here $KMnO_4$ acts as a self-indicator and this titration is called permanganate titration.**

**Catalyst: $Mn^{2+}$ (auto-catalysis)**

**Materials Required:**

**Mohr's salt (ferrous ammonium sulphate)**
**Potassium permanganate solution**
**Dilute sulphuric acid (4 N)**
**Chemical balance**
**Burette**
**Burette stand**
**Pipette**
**Conical flask**

**Funnel**
**Measuring flask**
**Weighing bottle**
**White tile**

**Apparatus Setup:**
**In burette – $KMnO_4$ solution**
**In Conical flask – 10 ml of Ferrous Ammonium Sulphate (Mohr's salt) + half a test tube given sulphuric acid**

**End Point – Colourless to permanent pale pink colour.**

**Procedure:**
**(a) Preparation of 0.05 M standard solution of ferrous ammonium sulphate:**
**The quantity of Mohr's salt required for the 100 ml of the solution having a normality of 0.05 M can be calculated as follows:**

- **The molar mass of mohr's salt = 392 g/mol**
- **M= wt x 1000 /molar mass x Volume (in ml)**
- **0.05 = wt x1000/ 392 x 100**
- **Wt = ?**
- **Weigh an empty watch glass using a chemical balance.**
- **Weigh accurately ? gm of Mohr's salt in a chemical balance.**
- **With the help of a funnel transfer the Mohr's salt into the measuring flask.**
- **Now wash the funnel with distilled water without removing the funnel from the flask.**
- **Make the solution up to the marked point with distilled water and make sure the Mohr's salt is fully dissolved.**
- **This solution is 0.05 M standard solution of Mohr's salt.**

**(b) Titration of potassium permanganate solution against standard ferrous ammonium sulphate (Mohr's salt) solution:**

- **Wash and rinse the burette and pipette with distilled water and then rinse with the corresponding solution to be filled in them.**
- **Rinse the burette with the potassium permanganate solution and fill the burette with potassium permanganate solution.**
- **Fix the burette in the burette stand and place the white tile below the burette in order to find the endpoint correctly.**
- **Rinse the pipette and conical flask with standard ammonium ferrous sulphate solution.**
- **Pipette out 10 ml of 0.05 M standard Mohr's salt solution into the conical flask.**

- **Add a test tube full of sulphuric acid in order to prevent oxidation of manganese to form manganese dioxide.**
- **Note down the initial reading in the burette before starting the titration.**
- **Now start the titration, titrate against potassium permanganate solution and simultaneously swirl the solution in the flask gently.**
- **Initially, the purple colour of $KMnO_4$ is discharged with ferrous ammonium sulphate. The appearance of a permanent pink colour reveals the endpoint.**
- **Repeat the titration until concordant values are obtained.**
- **Note down the upper meniscus on the burette readings.**
- **Record the reading in the observation table given below in order to calculate the molarity of $KMnO_4$ given.**

## Observations:

| S. No. | Volume of FAS/ Mohr's salt soln | Volume of $KMnO_4$ | | Volume of $KMnO_4$ used |
|---|---|---|---|---|
| | | Initial reading | Final reading | |
| 1 | 10 ml | | | |
| 2 | 10 ml | | | |
| 3 | 10 ml | | | |
| | | | | |

**Titre value:**

**Calculations:**

**From the overall balanced chemical equation, it is clear that 2 moles of potassium permanganate react with 10 moles of Mohr's salt.**

$$\frac{\text{Molarity of } KMnO_4 \times \text{Volume of } KMnO_4}{\text{Molarity of Mohr's salt} \times \text{Volume of Mohr's salt}} = \frac{\text{No. of moles of } KMnO_4}{\text{No. of moles of Mohr's salt}} = \frac{2}{10}$$

$$\text{Therefore, Molarity of } KMnO_4 = \frac{\text{Molarity of Mohr's salt} \times \text{Volume of Mohr's salt} \times 2}{\text{Volume of } KMnO_4 \times 10}$$

**= 0.05 x 10 x 2/ ? x 10**

**= ??**

**Strength of potassium permanganate in g/L = Molarity x molar mass**

**= ?? x 158**

**= ???**

## Results

**Molarity of given $KMnO_4$ solution is _____ M**

**The strength of given potassium permanganate solution is _____ g/L**

**Precautions:**

- **Potassium permanganate is dark in colour, so always read the upper meniscus.**
- **Rinse the pipette and burette before use.**
- **Use dilute sulphuric acid for acidifying the potassium permanganate.**
- **Clean all the apparatus with distilled water before starting the experiment and then rinse with the solution to be taken in them.**
- **Take accurate readings once it reaches the endpoint and doesn't go with average readings.**
- **Do not use rubber cork burette as it is can be attacked by $KMnO_4$**
- **Use the antiparallel card or auto parallax card while taking the burette readings.**
- **The strength of the unknown solution should be taken up to two decimal places only.**