

Aim: Preparation and Standardization of Potassium Permanganate

References:

1. Vogel, A.I. (1989). "Vogel's Textbook of Quantitative Chemical Analysis." 5th Edition, Longman Scientific & Technical.
2. Harris, D.C. (2010). "Quantitative Chemical Analysis." 8th Edition, W.H. Freeman.

Objective:

To prepare a standard solution of potassium permanganate (KMnO_4) and standardize it using a primary standard solution of oxalic acid.

Theory:

Potassium permanganate is a strong oxidizing agent commonly used in redox titrations. It is not a primary standard because it may decompose upon storage and its concentration can change over time. Therefore, it must be standardized before use. Oxalic acid is often used as a primary standard for this purpose due to its stability and purity.

Materials Required:

1. Potassium permanganate (KMnO_4)
2. Oxalic acid dihydrate ($\text{C}_2\text{H}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) – primary standard
3. Concentrated sulfuric acid (H_2SO_4)
4. Distilled water
5. Beakers, burette, pipette, conical flask, measuring cylinder, funnel

Preparation of Potassium Permanganate Solution:

1. Weighing the Potassium Permanganate:

- Accurately weigh about 3.16 g of potassium permanganate (KMnO_4).

2. Dissolution:

- Dissolve the weighed potassium permanganate in about 500 mL of distilled water in a beaker.

3. Transfer and Dilution:

- Transfer the solution to a 1000 mL volumetric flask and make up the volume to 1000 mL with distilled water.

4. Storage:

- Store the prepared potassium permanganate solution in a dark glass bottle to protect it from light, and allow it to stand for at least 24 hours before use. Filter the solution to remove any manganese dioxide precipitate formed due to decomposition.

Standardization of Potassium Permanganate Solution:

1. Preparation of Oxalic Acid Solution:

- Accurately weigh 0.63 g of oxalic acid dihydrate ($C_2H_2O_4 \cdot 2H_2O$) and dissolve it in distilled water in a 250 mL volumetric flask. Make up the volume to 250 mL to get a 0.05 N solution.

2. Reaction Setup:

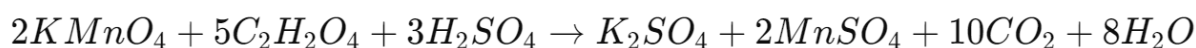
- Pipette 25.0 mL of the oxalic acid solution into a 250 mL conical flask.
- Add about 25 mL of distilled water and 5 mL of concentrated H_2SO_4 to acidify the solution.

3. Titration:

- Heat the solution to about 60-70°C.
- Titrate with the potassium permanganate solution until a faint pink color persists for 30 seconds, indicating the endpoint.

4. Calculation:

- The reaction between potassium permanganate ($KMnO_4$) and oxalic acid ($C_2H_2O_4$) in an acidic medium can be represented as:



- Calculate the normality (N) of the potassium permanganate solution using the formula:

$$N_1V_1 = N_2V_2$$

Where:

- N_1 = Normality of the potassium permanganate solution
- V_1 = Volume of the potassium permanganate solution used
- N_2 = Normality of the oxalic acid solution (0.05 N)
- V_2 = Volume of the oxalic acid solution used (25 mL)

Example Calculation:

- Suppose the volume of potassium permanganate used (V_1) is 20.0 mL:

$$N_1 = \frac{N_2 \times V_2}{V_1} = \frac{0.05 \times 25}{20.0} = 0.0625N$$

Precautions:

1. Ensure the solution is heated to 60-70°C for accurate results.
2. Use a freshly prepared and filtered potassium permanganate solution.
3. Perform the titration quickly to prevent decomposition of oxalic acid.

Result: The normality of the prepared potassium permanganate solution was found to be 0.0625 N.