CHAPTER-08

Experiment: 08

PREPARATION OF STANDARD SOLUTION AND STANDARDIZATION OF POTASSIUM PERMANGANATE

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Aim:

Preparation of standard solution and standardization of 0.1 N solution of potassium permanganate.

Requirements:

A. Glassware & Instruments:

1. Clean and calibrated burette
2. Pipette
3. Weighing balance
4. Burette stand
5. Thermometer
6. Spatula
7. Measuring cylinder
8. Wire gauze
9. Conical flask
10. Bunsen burner
11. Tripod stand

B. Chemicals & Reagents:

1. Analyte- 0.1N Potassium permanganate
2. Titrant- Oxalic Acid
3. Dilute Sulphuric Acid
4. Distilled water

Theory:

Oxalic acid is oxidized by Potassium permanganate, in acidic medium to Carbon dioxide and water.

$2KMnO_4 + 5Na_2C_2O_4 + 8H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + Na_2SO_4 + 8H_2O$

The reaction is complete between 60 and 90 degrees Celsius.

$KMnO_4$ is a potent oxidizer in acidic environments. Under suitable storage conditions, it can hold its concentration for an extended period. In addition to being a self-indicator, its small excess provides the solution a distinctive pink colour.

HCl cannot be substituted for H_2SO_4 due to its rapid oxidation to chlorine in the presence of permanganate.

Nitric acid is stronger than $KMnO_4$.

Principle:

A redox reaction is used to standardise potassium permanganate in relation to sodium oxalate, which serves as the primary standard. During this reaction, potassium permanganate plays the role of the oxidising agent, and sodium oxalate takes on the role of the reducing agent. The titration is conducted using an acidic media.

Procedure:

Preparation of 0.1N $KMnO_4$ Solution:

- We know that the equivalent weight of $KMnO_4$ is 31.6 g/eq.
- For preparation of 1N solution, we will require 31.6g of $KMnO_4$.
- So, for 0.1N solution, 3.2g of analytical grade of $KMnO_4$ will be taken on a watch glass.
- Transfer it into a big 250 ml flask.
- Add warm distilled water to the flask and shake well in order to dissolve $KMnO_4$.
- Now decant the upper clear solution on the top and transfer it to 1000 ml clean flask.
- Repeat this process several times but be careful not to add water up to the mark.
- Finally, when the powdered $KMnO_4$ is completely dissolved, make up the solution up to mark 1L.
- The prepared solution will be approximately 0.1N. It will be standardized with oxalic acid or preferably sodium oxalate.
- Prevent this solution from direct sunlight because photodecomposition occurs.

Standardization of $KMnO_4$ solution:

- Dry sodium oxalate for 2 hours at 105-110°C.
- Place it in a desiccator and let it cool.
- Transfer 6.7g (the equivalent weight of sodium oxalate is 67g) of the pure sodium oxalate to a 1000ml volumetric flask holding 500ml of water.
- Complete the volume with purified water
- Pour 10 ml of this solution into a conical flask and add 5 ml of diluted H2SO4 along the side of the flask. Heat the contents to 70 degrees Celsius.
- Titrate against potassium permanganate solution from the burette until a faint pink colour persists for 30 seconds upon shaking the flask.
- Repeat the procedure until you have 3 concordant readings.

Reaction:

$2KMnO_4 + 5Na_2C_2O_4 + 8H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + Na_2SO_4 + 8H_2O$

(Pot. Permanganate) (Oxalic acid) (Sulfuric acid) (Pot sulphate) (Mn sulphate) (Carbon dioxide) (Sod sulphate) (Water)

Oxidation reaction: $[MnO^-_4 + 8H^+ 5e^- \rightarrow Mn^{2+} + 4H_2O] \times 2$

Reduction reaction: $[(COO^-)_2 - 2e^- \rightarrow 2CO_2] \times 5$

Calculation:

Observation table

S. No.	Volume of Sodium oxalate solution taken (ml)	Burette reading of $KMnO_4$		Volume of $KMnO_4$ consumed (ml)
		IR	FR	
1.				
2.				
3.				

mEq. of Oxalic acid = mEq. of Potassium permanganate at the end point

N1 V1 = N2 V2

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Where N1= Normality of $Na_2C_2O_4$

V1= Volume of $Na_2C_2O_4$

N2= Normality of $KMnO_4$

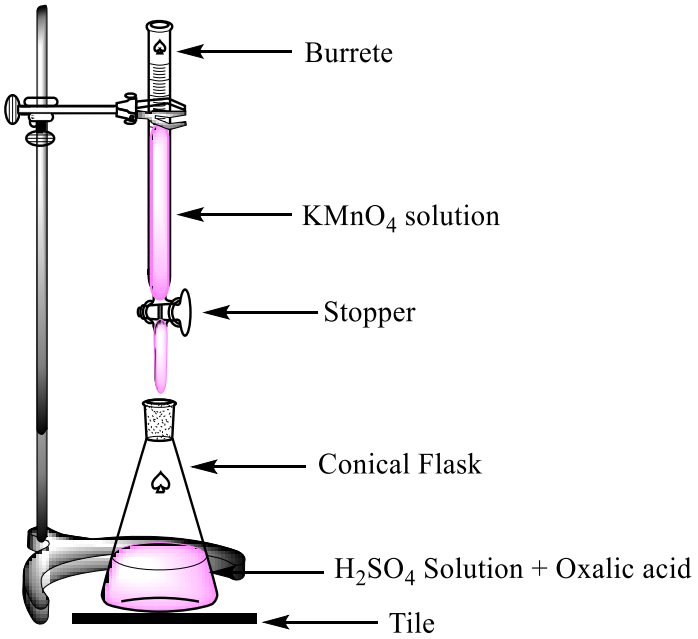
V2= Volume of $KMnO_4$

N1 V1 = N2 V2

(0.1N) (10ml) = (unknown (N2)) X Volume of $KMnO_4$ consumed (from burette)

N2 (Normality of $KMnO_4$) = (0.1*10) / Volume of $KMnO_4$ consumed (from burette)

Diagram:



Application:

1. Potassium permanganate's oxidising characteristic makes it an effective disinfectant. It is effective against dermatitis, canker sores, ulcers, eczema, and fungal infections.
2. In water treatment plants, chlorine is used to eliminate pollutants and remove foul odours. It oxidises iron, H_2S, and manganese into solid particles that are subsequently filtered out. It can also be used to purify swimming pool water.

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3. When combined with 80 percent H_2S, it functions as a rocket and torpedo propellant.
4. It can be utilised as an antidote for phosphorus poisoning.
5. In the paper manufacturing sector, the kappa number (amount of standard permanganate solution consumed by wood pulp) is used to determine the amount of bleaching chemical required.
6. It functions as a disinfectant.
7. Extremely good for treating athlete's foot infections.
8. It is utilised in water treatment facilities
9. It is frequently used to treat fish parasite infestations. Etc.

Result:

Based on the results of the experiment described above, it is clear that potassium permanganate can be standardised using oxalic acid in an efficient manner. Calculations revealed that the prepared Potassium permanganate solution has a concentration of.....N.

Viva questions:

- What is the chemical formula of potassium permanganate?
- What do you understand by the term standardization?
- What is secondary standard substance?
- What do you understand by the term self-indicator?
- Why sulfuric acid is used during titration?
- Why external indicator is not required in this titration?
- What is the molecular weight of oxalic acid?
- Why heating is required during titration?

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