Preparation & Standardization of ≈ 0.1 N Potassium Permanganate ($KMnO_4$) solution

Redox Reaction

- **Preparation of ≈ 0.1N $KMnO_4$ solution:**

- Dissolve 3.3 gm of solid $KMnO_4$ in a 500 ml beaker containing water, stir thoroughly.
- Heat the solution on a hotplate for 15min. at 70-80 ◦c.
- Cool the solution to room temp. and allow to stand for 2 days in a dark place.
- Filter the solution through the glass wool or asbestos into a 1L volumetric flask, complete the volume to the mark with D.W..

- **Standardlization of $KMnO_4$ solution:**
  - *Filter the prepared soln. through glass wool if it was left for a period of time (a week or more).*
  - *Rinse and Fill the burette with filtered $KMnO_4$ soln.*
  - *Weigh accurately about 200mg sod. oxalate ($Na_2C_2O_4$), previously dried at 110 $^{\circ}$c to constant weight.*
  - *Dissolve it with 100ml of D.W. in a conical flask. Add 7ml. of conc. H_2SO_4.*
  - *Heat the soln. to about 70°c.(adjust temp. using a thermometer).*
  - *Titrate against $KMnO_4$ soln. until a permanent pale pink color appears (persist for 15 sec.).*
  - *Record the volume of $KMnO_4$ consumed.*

- **OXIDATION- REDUCTION REACTIONS:**

❖Methods of analysis involve a change in valence of the reacting substances, thus there is always a transfer of electrons.

❖Electrons lost by reducing agent are gained by oxidizing agent. The oxidizing agent will be reduced; gain of electrons and then decreasing in oxidation number, but the reducing agent will be oxidized; losing of electrons and then increasing in oxidation number.

- Chemical principle:
- Standardization of $KmnO_4$ against sod. oxalate follows oxidation-reduction reaction.

❑ Permanganate ion (MnO_4^-) acts as an oxidizing agent in acidic media, being reduced to Mn^{++}:

$$Mn^{+7}O_4^- + 8H^+ + 5e^- \longrightarrow Mn^{+2} + 4H_2O$$

❑ Oxalate ion ($C_2O_4^=$)acts as reducing agent, being oxidized to CO2 :

$$C_2O_4^= \longrightarrow 2CO_2 + 2e^-$$

- $KMnO_4$ is widely used in volumetric analysis as a standard and oxidizing agent because:

1. It is strong oxidizing agent.
2. The intense color of $KMnO_4$ solution is sufficient to signal the end point in most titrations thus it is used as self indicator.

- On the other hand,

1) $KMnO_4$ is a strong oxidizing agent, then it will oxidize any organic matter present in D.W., so heating for 15min. is to accelerate the oxidation of these organic matter.

2) $KMnO_4$ soln. is allowed to stand for 2days to ensure the completion of the decomposition reaction.

3) It is filtered through asbestos to remove all traces of manganese dioxide (MnO_2) .

4) $KMnO_4$ is unstable in the presence of direct sunlight, organic matter ex. Filter paper.

5) H_2SO_4 is added since $KMnO_4$ is better oxidizing agent in acidic media, H_2SO_4 is added to keep $[H^+]$ion conc. constant through out the titration.

6) Heat to about 70 $^\circ$c because the oxidation of sod. oxalate is rapid enough if the temp. above 60 $^\circ$c .

- Sod. oxalate, not oxalic acid, is used because:

1. The salt can be obtained in very pure condition.
2. Free from water of crystallization.
3. It can be dried to 130 ◦c without decomposition.
4. Stable to air.

The chemical equation for the std. of pot. Permanganate:

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


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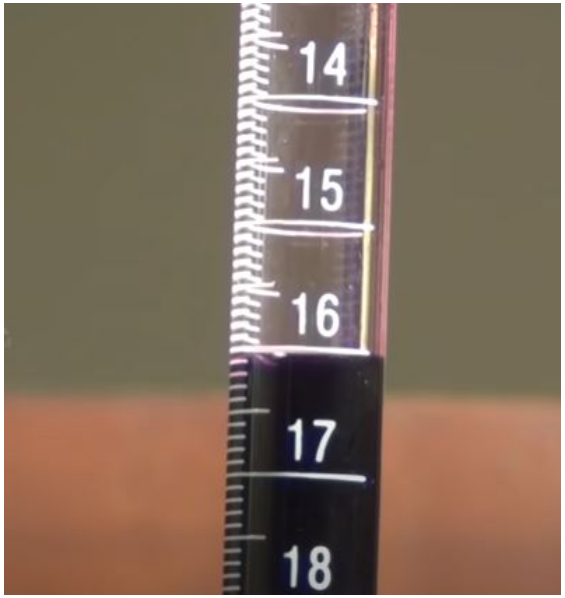
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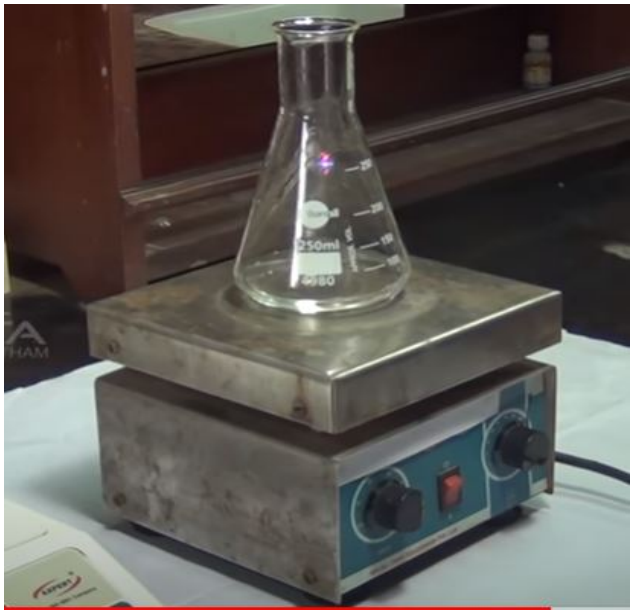
250ml
4980


200
150
100
4980

Calculations

$\underline{KMnO_4}$ $\underline{Na_2C_2O_4}$

$$N \times V = \frac{Wt.}{eq.wt.} \times 1000$$

67gm/mole

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