Aim: Preparation and Standardization of Sodium Thiosulfate

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 sodium thiosulfate ($Na_2S_2O_3$) and standardize it using a primary standard solution of potassium dichromate ($K_2Cr_2O_7$).

Theory:

Sodium thiosulfate is a common titrant used in iodometric titrations. It reacts with iodine quantitatively, making it suitable for use in redox titrations. The standardization of sodium thiosulfate is necessary because it is not a primary standard; it may decompose over time or due to exposure to light and air. Potassium dichromate is used as the primary standard to standardize sodium thiosulfate solution.

Materials Required:

1. Sodium thiosulfate pentahydrate ($Na_2S_2O_3 \cdot 5H_2O$)
2. Potassium dichromate ($K_2Cr_2O_7$) – primary standard
3. Starch indicator
4. Distilled water
5. Concentrated sulfuric acid (H_2SO_4)
6. Potassium iodide (KI)
7. Beakers, burette, pipette, conical flask, measuring cylinder, funnel

Preparation of Sodium Thiosulfate Solution:

1. Weighing the Sodium Thiosulfate:

- Accurately weigh about 24.8 g of sodium thiosulfate pentahydrate ($Na_2S_2O_3 \cdot 5H_2O$).

2. Dissolution:

- Dissolve the weighed sodium thiosulfate 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 sodium thiosulfate solution in a dark glass bottle to protect it from light and air, which can cause decomposition.

Standardization of Sodium Thiosulfate Solution:

1. Preparation of Potassium Dichromate Solution:

- Accurately weigh 0.1248 g of potassium dichromate ($K_2Cr_2O_7$) and dissolve it in distilled water in a 250 mL volumetric flask. Make up the volume to 250 mL to get a 0.1 N solution.

2. Reaction Setup:

- Pipette 25.0 mL of the potassium dichromate solution into a 250 mL conical flask.

- Add 5 mL of concentrated H_2SO_4 to acidify the solution.

- Add an excess of potassium iodide (about 2 g), which will react with potassium dichromate to liberate iodine (I_2).

3. Titration:

- Titrate the liberated iodine with the sodium thiosulfate solution until the solution becomes pale yellow.

- Add 2-3 drops of freshly prepared starch solution as an indicator. The solution will turn blue-black.

- Continue the titration until the blue-black color disappears, indicating the endpoint.

4. Calculation:

- The reaction between iodine (I_2) and sodium thiosulfate ($Na_2S_2O_3$) can be represented as:

$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

- Calculate the normality (N) of the sodium thiosulfate solution using the formula:

$$N_1V_1 = N_2V_2$$

Where:

- N_1 = Normality of the sodium thiosulfate solution

- V_1 = Volume of the sodium thiosulfate solution used

- N_2 = Normality of the potassium dichromate solution (0.1 N)

- V_2 = Volume of the potassium dichromate solution used (25 mL)

Example Calculation:

- Suppose the volume of sodium thiosulfate used (V_1) is 23.5 mL:

$$N1 = \frac{N2 \times V2}{V1} = \frac{0.1 \times 25}{23.5} = 0.106N$$

Precautions:

1. Always use freshly prepared starch solution.

2. Protect the sodium thiosulfate solution from light.

3. Ensure all glassware is clean and dry before use.

Report: The normality of the prepared sodium thiosulfate solution was found to be 0.106 N.