

Practicle Work n°2:

Volumetric titration of diiodine in antiseptic solution – Betadine-

1. OBJECTIVES

- Determine the concentration of diiodine (I₂) in an antiseptic solution.
- Apply a redox titration (iodometric titration).
- Use colorimetric detection with indicator (starch).
- Perform a pharmaceutical quality control check.

2. THEORETICAL PRINCIPLE

Betadine contains diiodine (I₂) complexed with povidone (povidone iodine).

The label on a bottle of Betadine reads:

Betadine 10%
Polyvidone -iodine:10g per 100mL

The assay is based on a redox reaction between diiodine and sodium thiosulfate.

Reaction chemical :



The oxidizing/reducing couples involved are:



The reaction equations are:

- Diiodine is reduced to iodide (I⁻) . $\text{I}_2 + 2 \text{e}^- = 2 \text{I}^- \text{-----} > \text{Oxidation}$

-Thiosulfate is oxidized to tetrathionate . $2 \text{S}_2\text{O}_3^{2-} = \text{S}_4\text{O}_6^{2-} + 2 \text{e}^- \text{-----} > \text{Reduction}$

Equivalence detection

The indicator used is **starch** :

- I₂ + starch → dark blue complex
- At the equivalence point: disappearance of blue

3. MATERIALS AND REAGENTS

- Equipment

- Graduated burette (25 or 50 mL)
- Support + clamp, - Erlenmeyer
- Volumetric pipette , - Volumetric flask,
- Magnetic stirrer (if available)
- Beaker

- Reagents

- 10% commercial Betadine solution
- Sodium thiosulfate solution
($\text{Na}_2\text{S}_2\text{O}_3$) $\approx 0.005 \text{ mol}\cdot\text{L}^{-1}$
- Starch solution (freshly prepared)
- Distilled water

4. EXPERIMENTAL PROTOCOL**Step 1: Sample Preparation**

1. Take 10 mL of Betadine with a volumetric pipette.
2. Introduce into a 100 mL volumetric flask.
3. Top up with distilled water to the calibration mark.
4. Homogenize.

Step 2: Preparing the burette

Rinse the burette with the thiosulfate solution and then fill it.

Note the initial volume.

Step 3: Preparing the test sample

Take 10 mL of the diluted solution.

Pour into an Erlenmeyer flask .

Step 4: Titration

Gradually add the thiosulfate while stirring.

The solution changes from brown to pale yellow.

Step 5: Indicator

Add a few drops of starch → blue solution.

Continue titling until the blue disappears completely.

Note the final volume.

5. RESULTS

Calculations

At equivalent : $n_{I_2} = (1/2) (C_{thio} \times V_{thio}) = 1/2 n_{thio}$

$$C_{1(I_2)} = C_{thio} \times V_{thio} / 2 V_{sample}$$

Express the final concentration in mol·L⁻¹ or g·L⁻¹.

6. QUESTIONS

1. Draw a diagram of the experimental setup.
2. In a table, list the colors observed in the reaction mixture and justify their changes: at the beginning of the titration, just before the addition of the starch solution, after the addition of the starch solution, and at the equivalence point?
3. Determine the volume at the equivalence point.
4. Deduce the molar concentration C_1 of I_2 in the diluted solution, then C_0 of I_2 in the commercial solution S_0 of betadine ?
5. Calculate the quantity n_0 of I_2 present in 100 mL of solution S_0 ?
6. What is the quantity n_P of povidone- iodine in 100 mL of solution S_0 ?
7. Determine the mass m_P of povidone iodine in the bottle of betadine ?
8. Why is thiosulfate a reducing agent?
9. Why shouldn't starch be added at the beginning?
10. What is the role of dilution?
11. Give the half-equation for the reduction of diiodine .
12. Calculate the mass of I_2 present in 1 L of solution.
13. Conclusion.

