

**Aim:** Limit Test for Arsenic

**References:**

1. Indian Pharmacopoeia (IP) 2022, Appendix 2.3.7, Limit Test for Arsenic.
2. British Pharmacopoeia (BP) 2023, Appendix VIII, Limit Test for Arsenic.
3. United States Pharmacopoeia (USP) 43-NF 38, General Chapter <211> Arsenic.

**Objective:**

To determine the presence and permissible limit of arsenic in a pharmaceutical substance to ensure it meets the safety standards specified by pharmacopeial guidelines.

**Materials and Reagents**

**1. Reagents:**

- Standard arsenic solution (1 ppm As)
- Hydrochloric acid (HCl, 10% v/v)
- Stannous chloride solution (SnCl<sub>2</sub>, 20% w/v in HCl)
- Potassium iodide solution (KI, 10% w/v)
- Zinc granules (ARSENIC-FREE)
- Lead acetate cotton or paper
- Silver diethyldithiocarbamate solution
- Purified water

**2. Apparatus:**

- Arsenic apparatus (Gutzeit apparatus or alternative)
- Nessler cylinders (50 mL)
- Pipettes (1 mL, 2 mL, 5 mL)
- Glass rods
- Measuring cylinders
- Beakers (100 mL)

- Analytical balance

### **Principle:**

The limit test for arsenic is based on the conversion of all arsenic present in the sample into arsine gas ( $\text{AsH}_3$ ) by the action of zinc and acid. The arsine gas reacts with silver diethyldithiocarbamate to produce a red color. The intensity of the color is visually compared against a standard arsenic solution to determine whether the arsenic content in the sample is within acceptable limits.

### **Procedure:**

#### **1. Preparation of Standard Arsenic Solution:**

- **Standard Arsenic Solution (1 ppm As):** Dissolve 0.132 g of arsenic trioxide ( $\text{As}_2\text{O}_3$ ) in 5 mL of 10% NaOH solution and neutralize with dilute sulfuric acid ( $\text{H}_2\text{SO}_4$ ). Add 10 mL of 1% w/v potassium iodide solution and dilute to 1000 mL with purified water to obtain a 100 ppm arsenic stock solution. From this, take 10 mL and dilute to 100 mL with purified water to make a 10 ppm arsenic solution. Finally, dilute 10 mL of this solution to 100 mL to obtain a 1 ppm standard arsenic solution.

#### **2. Preparation of the Test Solution:**

- Weigh and dissolve the specified quantity of the test substance in 25 mL of water.
- Add 5 mL of hydrochloric acid (10% v/v) and 1 mL of stannous chloride solution.
- Transfer the solution to a Gutzeit apparatus and add 1 g of zinc granules.
- Immediately close the apparatus, and let the reaction proceed to generate arsine gas.

#### **3. Preparation of the Standard Solution:**

- Transfer 1 mL of the standard arsenic solution (1 ppm As) to a Gutzeit apparatus.
- Add 25 mL of purified water, 5 mL of hydrochloric acid (10% v/v), and 1 mL of stannous chloride solution.
- Add 1 g of zinc granules to generate arsine gas.

#### **4. Collection of Arsine Gas:**

- Allow the arsine gas generated in both the test and standard solution to pass through a filter paper impregnated with silver diethyldithiocarbamate.

- Ensure that the gas is absorbed completely onto the paper, causing it to develop a red color if arsenic is present.

#### **5. Comparison:**

- Compare the intensity of the red color developed on the filter paper in the test solution with that of the standard solution against a white background.

#### **Observation:**

- The color intensity of the test solution should not be darker than that of the standard solution, indicating that the arsenic content is within the permissible limit.

**Result:** The sample passes the limit test if the red color of the test solution is not more intense than that of the standard arsenic solution, confirming that the arsenic content is within the acceptable limit.