

Determination of Bismuth in Cosmetics

Bismuth compounds are often used in cosmetics as a replacement for lead given its toxicity. Bismuth can be measured by hydride generation atomic fluorescence spectrometry. The sample preparation consists of oxidizing Bi to Bi^{3+} , which reacts with NaBH_4 to yield BiH_3 . The BiH_3 is moved to the atomizer by the carrier gas and broken down there. The ground state of Bi can be excited by the light from the Bi-HC lamp and the fluorescence signal is measured consequently by photomultiplier tube.

1. Major equipment and reagents

- LUMINA 3300 atomic fluorescence spectrometer with Se lamp

NaBH_4 solution:

- Dissolve 10 g NaBH_4 in 500 mL (1 g/L NaOH) solution

Bismuth standard solution:

- Commercial available selenium standard solution (1000 ppm), diluted to 1 ppm

Thiourea solution:

- Measure 0.7 g thiourea, dissolve in 100 mL distilled water

$\text{Mg}(\text{NO}_3)_2$ solution:

- Measure 500 g $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, add distilled to the total volume at 1000 mL
- MgO
- Concentrated HNO_3 (65~68%)
- Concentrated HCl (36~38%)
- Concentrated HClO₄
- Concentrated H_2SO_4
- High pure argon (>99.99%)
- High pure distilled water

2. Method

Measure 1 g sample into a 150 mL Erlenmeyer flask, add 10 mL HNO_3 and 5 mL H_2O . Place on hot plate and heat until no yellowish smoke comes out, cool down, add 3 mL HClO_4 , 5 mL H_2SO_4 , and heat on plate again. If the color of the mixture is brown, add more HNO_3 and repeat heating step until the solution becomes clear. Cool down and add 20 mL of distilled water, heat until white smoke comes out and add water again. Repeat this procedure three times and remove the remaining to the volumetric flask and add water to a final volume of 50 mL.

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3. Instrument parameters

Carrier gas	500 mL/min
Shield gas	700 mL/min
HCL current	100 mA
PMT voltage	400 V
Integration time	6 s
Pump speed	50 r/min
Reducing reagent solution	2% NaBH ₄ in 0.1% NaOH

4. Results

This method gives:

Detection limit: 0.7ppb,
Recovery rate: 90~118%
Relative standard deviation: 2~7%