Analysis: ‘Pb-210 in water’

This method describes the determination of Pb-210 in water solutions by the use of auto-deposition of the Pb-210 decay product Bi-210 on nickel. Due to its electrochemical characteristic Po-210 is collected as well. For solid samples special chemical treatment is necessary.

Basics

The method of Pb-210 determination uses the deposition of its progeny Bi-210 on nickel surfaces according to the electrochemical series of metals. It includes a chemical acid pulping, a following decay products buildup period, their deposition and the measurement of β–radiation from Bi-210. Additionally present is the α–radiation from Po-210.

Method

The method includes the following steps:

- Sample preparation
- Sample concentration by evaporation
- Dissolving of the residuum
- Deposition of Bi-210/Po-210 on nickel
- Activity measurement

Method description

Sample preparation

> To avoid adsorption the sample should have pH = 1 by adding 10 ml of 14 mol/l nitric acid per liter sample. To cancel the buildup of Pb-210 from water containing Rn-222 the sample is to be de-emanated with nitrogen or 'radon-free/poor' air by bubbling the tenfold volume of gas through the sample. In laboratory the samples are filtrated and stored for 30 days to obtain equilibrium between Pb-210 and Bi-210.

Sample treatment

1. 1 liter sample is transferred to a beaker and evaporated completely to dryness. Suitable is a hot-air cabinet at 170 °C.
2. The residuum is heated on a sand bath to dryness after adding 2 ml perchloric acid to remove interfering nitrates.
3. By adding of 8 ml hydrochloric acid of 12 mol/l the residuum is dissolved and transferred with distilled water to a 400 ml beaker. The solution volume should be 200 ml to have a 0,5 mol/l hydrochloric solution.
4. Ferric atoms are masked with 100 mg ascorbic acid.

5. A nitric acid treated and purified nickel planchet is placed in a planchet holder with only one side contacting the sample-solution. The sample-beaker with the planchet holder is set to a water bath.
6. By permanent 18 hours stirring and a temperature of about 85 °C the Bi-210 and Po-210 isotopes are deposited on the planchet.
7. After deposition termination the planchet is removed from the holder, rinsed with distilled water and dried on air.

Sample measurement

The end-point of the deposition is set to be the start-point of Bi-210 decay. To eliminate the interferences from other potentially deposited Bi-nuclides like Bi-214 and Bi-212 the planchet is measured after a delay time of 5 hours in a $\beta-$ counter.

Remarks

If additionally Po-210 is of interest a counter with $\alpha/\beta-$ separation is needed. Better results only for Po-210 are available with its deposition on silver planchets followed by $\alpha-$spectroscopy where Po-208 or Po-209 might serve as tracer isotopes.