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Water quality — Determination of trace elements using atomic absorption spectrometry with graphite furnace

Qualité de l'eau — Dosage des éléments traces par spectrométrie d'absorption atomique en four graphite



Reference number ISO 15586:2003(E)

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Foreword

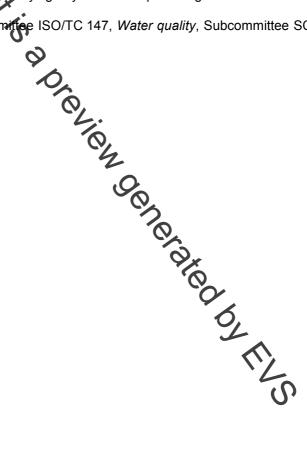
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Water quality — Determination of trace elements using atomic absorption spectrometry with graphite furnace

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1 Scope

This International Standard includes principles and procedures for the determination of trace levels of: Ag, Al, As, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, and Zn in surface water, ground water, drinking water, wastewater and sediments, using atomic absorption spectrometry with electrothermal atomization in a graphite furnace. The method is applicable to the determination of low concentrations of elements.

The detection limit of the method for each element depends on the sample matrix as well as of the instrument, the type of atomizer and the use of chemical modifiers. For water samples with a simple matrix (i.e. low concentration of dissolved solids and particles), the method detection limits will be close to instrument detection limits. The minimum acceptable detection limit values for a 20-µl sample volume are given in Table 1.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3696:1987, Water for analytical laboratory use — Specification and test methods

ISO 5667-1, Water quality — Sampling — Part 1: Guidance on Redesign of sampling programmes

ISO 5667-2, Water quality — Sampling — Part 2: Guidance on sampling techniques

ISO 5667-3, Water quality — Sampling — Part 3: Guidance on the preservation and handling of water samples

ISO 5667-4, Water quality — Sampling — Part 4: Guidance on sampling from lakes, natural and man-made

ISO 5667-5, Water quality — Sampling — Part 5: Guidance on sampling of drinking water and water used for food and beverage processing

ISO 5667-6, Water quality — Sampling — Part 6: Guidance on sampling of rivers and streams

ISO 5667-10, Water quality — Sampling — Part 10: Guidance on sampling of waste waters

ISO 5667-11, Water quality — Sampling — Part 11: Guidance on sampling of groundwaters

ISO 5667-15, Water quality — Sampling — Part 15: Guidance on preservation and handling of sludge and sediment samples

ISO 15587-1, Water quality — Digestion for the determination of elements in water — Part 1: Aqua regia digestion

ISO 15587-2, Water quality — Digestion for the determination of elements in water — Part 2: Nitric acid digestion

Element	Characteristic mass m_0^a	Detection limit ^b	Optimum working range ^c
	pg	μg/l	µg/I
Ag	1,5	0,2	1 to 10
Al	10	1	6 to 60
As	9 15	1	10 to 100
Cd	0,	0,1	0,4 to 4
Со	10	1	6 to 60
Cr	3	0,5	2 to 20
Cu	5 ^d	0,5	3 to 30
Fe	5	1	3 to 30
Mn	2,5	0,5	1,5 to 15
Мо	10		6 to 60
Ni	13		7 to 70
Pb	15		10 to 100
Sb	20	0	10 to 100
Se	25	20	15 to 150
ТІ	10 ^d	1 2	6 to 60
V	35	2 0	20 to 200
Zn	0,8	0,5	0,5 to 5

Table 1 — Approximate characteristic masses, instrument detection limits and optimum working ranges for water samples using a 20 µl sample volume

The characteristic mass (m_0) of an element is the mass in picograms, corresponding to a signal of 0,004 4 s, using the integrated absorbance (peak area) for evaluation.

b The detection limits are calculated as three times (3 ×) the standard deviation of repeated neasurements of a blank solution.

The optimum working range is defined as the concentration range that corresponds to regrated absorbance readings between с 0,05 s and 0,5 s. d

If Zeeman effect background correction is used, the m_0 -value will be higher.

3 Principle

Water samples are preserved by acid treatment, filtered and preserved by addition of acid, or digested. Sediment samples are digested. A small sub-sample of sample solution is injected into a graphite furnace of an atomic absorption spectrometer. The furnace is electrically heated. By increasing the temperature stepwise, the sample is dried, pyrolized and atomized. Atomic absorption spectrometry is based on the ability of free atoms to absorb light. A light source emits light specific for a certain element (or elements). When the light beam passes through the atom cloud in the heated graphite furnace, the light is selectively absorbed by atoms of the chosen element(s). The decrease in light intensity is measured with a detector at a specific wavelength. The concentration of an element in a sample is determined by comparing the absorbance of the sample with the absorbance of calibration solutions. If necessary, interferences may be overcome by adding a matrix modifier to the samples before analysis, or by performing the calibration with the standard addition technique.

The results are given as the mass of analyte (micrograms, µg, or milligrams, mg) per litre of water, or per kilogram of dried material in sediments.