



SLOVENSKI STANDARD

SIST ISO 11723:2005

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Trda goriva -- Določitev arsena in selena -- Eschka's mešanica in
metoda pridobitve hidrida

Solid mineral fuels -- Determination of arsenic and selenium -- Eschka's mixture and
hydride generation method

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Combustibles minéraux solides -- Dosage de l'arsenic et du sélénium -- Mélange
d'Eschka et méthode par production d'hydrure

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INTERNATIONAL
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**Solid mineral fuels — Determination of
arsenic and selenium — Eschka's mixture
and hydride generation method**

*Combustibles minéraux solides — Dosage de l'arsenic et du sélénium —
Mélange d'Eschka et méthode par production d'hydruure*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 11723 was prepared by Technical Committee ISO/TC 27, *Solid mineral fuels*, Subcommittee SC 5, *Methods of analysis*.

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Solid mineral fuels — Determination of arsenic and selenium — Eschka's mixture and hydride generation method

1 Scope

This International Standard specifies a method using Eschka's mixture during ashing, extraction of the ash residue with acid, and hydride generation atomic absorption spectrometry or hydride generation atomic fluorescence spectrometry, for the determination of arsenic and selenium in solid mineral fuels.

NOTE The method is also applicable to the determination of the analytes by hydride generation inductively coupled plasma atomic emission spectrometry.

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 687:2004, *Solid mineral fuels — Coke — Determination of moisture in the general analysis test sample*

ISO 1170:1977, *Coal and coke — Calculation of analyses to different bases*

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

ISO 5068:1983, *Brown coals and lignites — Determination of moisture content — Indirect gravimetric method*

ISO 5069-2:1983, *Brown coals and lignites — Principles of sampling — Part 2: Sample preparation for determination of moisture content and for general analysis*

ISO 11722:1999, *Solid mineral fuels — Hard coal — Determination of moisture in the general analysis test sample by drying in nitrogen*

ISO 13909-4:2001, *Hard coal and coke — Mechanical sampling — Part 4: Coal — Preparation of test samples*

ISO 13909-6:2001, *Hard coal and coke — Mechanical sampling — Part 6: Coke — Preparation of test samples*

3 Principle

A known mass of the sample is ignited in intimate contact with Eschka's mixture in an oxidizing atmosphere at 800 °C to remove the organic matter. The residue is then extracted with hydrochloric acid and the analytes determined by hydride generation atomic absorption spectrometry or hydride generation atomic fluorescence spectrometry.

4 Reagents

WARNING — Care must be exercised when handling reagents, many of which are toxic and corrosive.

During the analysis, unless otherwise stated, use only reagents of recognized analytical reagent grade and water conforming to Grade 1 of ISO 3696.

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4.1 Eschka's mixture, composed of two parts by mass of light magnesium oxide and one part by mass of anhydrous sodium carbonate.

4.2 Hydrochloric acid (ρ_{20} 1,19 g/ml).

4.3 Nitric acid (ρ_{20} 1,42 g/ml).

4.4 Potassium iodide solution, 500 g/l. Dissolve 50 g of analytical reagent (AR) grade KI in distilled water and adjust the volume to 100 ml (for determination of As).

4.5 Sodium borohydride solution. Weigh 1,50 g of sodium borohydride (NaBH_4) and 0,4 g of sodium hydroxide (NaOH) into a plastic bottle of 125 ml capacity and add 100 ml of distilled water. Prepare freshly on the day of use. Alternatively, commercially available pressed pellets of sodium borohydride may be used.

4.6 Arsenic stock solution (100 mg/l). Dissolve 0,132 0 g \pm 0,000 5 g of arsenic trioxide (As_2O_3 of 99,9 % purity, dried at 110 °C for 1 h) in 25 ml of 20 % KOH solution. Add approximately 50 ml of water and 20 ml of hydrochloric acid (4.2). Adjust the volume with water to 1 litre in a volumetric flask. Alternatively, dissolve 0,416 5 g \pm 0,000 5 g of sodium arsenate ($\text{Na}_2\text{HAsO}_4 \cdot 7\text{H}_2\text{O}$) in approximately 100 ml of water. Add 10 ml of hydrochloric acid (4.2) and adjust the volume with water to 1 litre in a volumetric flask.

NOTE A commercially available certified stock solution may be used as an alternative.

4.7 Dilute arsenic stock solution (1 mg/l). Transfer 5 ml of arsenic stock solution to a 500 ml volumetric flask. Add approximately 100 ml of water and 5 ml of hydrochloric acid (4.2). Adjust to volume with water.

4.8 Arsenic working standard (50 $\mu\text{g/l}$). Transfer 5 ml of dilute arsenic stock solution (4.7) to a 100 ml volumetric flask. Add approximately 20 ml of water and 1 ml of hydrochloric acid (4.2). Adjust to volume with water. Prepare freshly on the day of measurement.

4.9 Selenium stock solution (100 mg/l). Dissolve 0,100 0 \pm 0,000 5 g of elemental selenium (of 99,9 % purity) in a minimum of nitric acid in a beaker. Evaporate to dryness. Add 2 ml of water and evaporate to dryness; repeat this procedure twice. Add 10 ml of water to the residue and 10 ml of hydrochloric acid (4.2). Dissolve the residue by heating. Allow the solution to cool and adjust the volume with water to 1 litre in a volumetric flask. Alternatively, dissolve 0,467 4 g \pm 0,000 5 g of sodium selenate ($\text{Na}_2\text{SeO}_4 \cdot 10\text{H}_2\text{O}$) in approximately 100 ml of water. Add 10 ml of hydrochloric acid (4.2) and adjust the volume with water to 1 litre in a volumetric flask.

NOTE A commercially available certified stock solution may be used as an alternative.

4.10 Dilute selenium stock solution (1 mg/l). Transfer 5 ml of selenium stock solution (4.9) to a 500 ml volumetric flask. Add approximately 100 ml of water and 5 ml of hydrochloric acid (4.2). Adjust to volume with water.

4.11 Selenium working standard (50 $\mu\text{g/l}$). Transfer 5 ml of dilute selenium stock solution (4.10) to a 100 ml volumetric flask. Add approximately 20 ml of water and 1 ml of hydrochloric acid (4.2). Adjust to volume with water. Prepare freshly on the day of measurement.

5 Apparatus

5.1 Balance, capable of weighing to the nearest 0,1 mg.

5.2 Crucible, a shallow silica crucible of capacity approximately 25 ml.

5.3 Silica plate, 6 mm thick, having an easy sliding fit in the muffle furnace.

5.4 Muffle furnace, capable of obtaining 800 °C over 2 h from ambient temperature.

5.5 Plastic bottle, wide necked, of capacity 60 ml (autoclavable) with screw-threaded lid.

5.6 Atomic absorption spectrometer or atomic fluorescence spectrometer, equipped with a hydride generation apparatus.

To minimize potential contamination, clean all laboratory ware with dilute HCl (1 + 10).

6 Preparation of the test sample

The test sample is the general analysis sample, prepared in accordance with ISO 5069-2, ISO 13909-4 or ISO 13909-6, as appropriate. Expose the sample in a thin layer for the minimum time required for the moisture content to reach approximate equilibrium with the laboratory atmosphere.

Before commencing the determination, mix the equilibrated sample thoroughly.

If the results are to be calculated to other than on an 'as analysed' basis i.e. air dried (see Clause 9), concurrently determine the moisture content using a further portion of the test sample by the method described in ISO 5068, ISO 11722 or ISO 687, as appropriate.

7 Procedure

7.1 Blank determination

A blank determination shall be carried out at the same time and under the same conditions as the actual determination, but omitting the sample.

7.2 Preparation of test solution

The procedure, carried out in duplicate, shall be as follows.

Weigh, to the nearest 0,000 1 g, a test portion of approximately 0,5 g and mix intimately with 0,8 g of Eschka's mixture (4.1) in the crucible (5.2). Level the contents of the crucible and cover with 0,2 g of Eschka's mixture.

Place the charged crucible on the cold silica plate (5.3). Insert both into the cold muffle furnace (5.4) and heat at a uniform rate to 800 °C for 2 h. Maintain at this temperature for a further 2 h.

Remove the silica plate and crucible from the furnace and allow to cool.

Transfer the contents of the crucible to the tared plastic bottle (5.5). Wash the residue into the bottle with 5 ml to 10 ml of water (alternatively into a 100 ml beaker).

Add 10 ml of hydrochloric acid (4.2) to the crucible and gently warm on a hotplate. Transfer to the bottle (or beaker). Wash the crucible with a further 5 ml of water and transfer the washings to the bottle (alternatively to a beaker). Shake gently to allow the evolution of any carbon dioxide produced.

WARNING — Hydrochloric acid must be added carefully as the reaction with Eschka's mixture is exothermic and releases carbon dioxide.

Allow the bottle to cool and adjust the mass of solution to 50,0 g with water (alternatively, transfer the solution from the beaker to a 50 ml volumetric flask and make up to volume).

7.3 Preparation of calibration standards

Add 1 g of Eschka's mixture (4.1) to four tared plastic bottles (5.5) (alternatively to beakers). Add approximately 10 ml of water and 20 ml of hydrochloric acid (4.2) to dissolve the Eschka's mixture.

Allow the solutions to cool. Adjust one solution to 50,0 g (alternatively, transfer solution to 50 ml volumetric flasks and adjust one to volume with water). This is the calibration blank. To the other bottles (or flasks), add