
**Workplace air — Determination
of lithium hydroxide, sodium
hydroxide, potassium hydroxide
and calcium dihydroxide — Method
by measurement of corresponding
cations by suppressed ion
chromatography**

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*Air des lieux de travail — Détermination de la teneur en hydroxyde de
lithium, hydroxyde de sodium, hydroxyde de potassium et dihydroxyde
de calcium — Méthode par mesurage des cations correspondants par
chromatographie ionique*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 146, *Air quality*, Subcommittee SC 2, *Workplace atmospheres*.

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Introduction

The health of workers in many industries is at risk through exposure by inhalation of lithium hydroxide, sodium hydroxide, potassium hydroxide, and calcium dihydroxide. Industrial hygienists and other public health professionals need to determine the effectiveness of measures taken to control workers' exposure, and this is generally achieved by making workplace air measurements. This International Standard has been published in order to make available a method for making valid exposure measurements for lithium hydroxide, sodium hydroxide, potassium hydroxide, and calcium dihydroxide in use in industry. It will be of benefit to: agencies concerned with health and safety at work; industrial hygienists and other public health professionals; analytical laboratories; industrial users of lithium hydroxide, sodium hydroxide, potassium hydroxide, and calcium dihydroxide and their workers; etc.

It has been assumed in the drafting of this International Standard that the execution of its provisions and the interpretation of the results obtained are entrusted to appropriately qualified and experienced people.

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Workplace air — Determination of lithium hydroxide, sodium hydroxide, potassium hydroxide and calcium dihydroxide — Method by measurement of corresponding cations by suppressed ion chromatography

1 Scope

This International Standard specifies a method for the determination of the time-weighted average mass concentration of lithium hydroxide (LiOH), sodium hydroxide (NaOH), potassium hydroxide (KOH), and calcium dihydroxide [Ca(OH)₂] in workplace air by collection of the particulate hydroxides on a filter and analysis of the corresponding cations using ion chromatography.

For aerosol sampling, the method is applicable to the personal sampling of the inhalable fraction of airborne particles, as defined in ISO 7708, and to static (area) sampling.

The method is applicable to the determination of masses of 0,005 mg to at least 2,5 mg of lithium per sample and 0,01 mg to at least 5 mg of sodium, potassium, and calcium per sample.

The concentration range of particulate LiOH, NaOH, KOH, and Ca(OH)₂ in air for which the measuring procedure is applicable is determined by the sampling method selected by the user. For a 1 m³ air sample, the working range is approximately 0,002 mg m⁻³ to at least 20 mg m⁻³ for all four hydroxides. For a 30 l air sample, the lower limit of the working range is approximately 0,1 mg m⁻³ for all four hydroxides.

The procedure does not allow differentiation between the hydroxides and their corresponding salts if both are present in the air. If the cations are present alone in the form of hydroxides, the method is specific for these basic compounds. In other circumstances, the results obtained represent the highest concentration of the hydroxides that could be present in the sampled air. (See [12.6](#).)

2 Normative references

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

ISO 1042, *Laboratory glassware — One-mark volumetric flasks*

ISO 7708:1995, *Air quality — Particle size fraction definitions for health-related sampling*

ISO 8655-1, *Piston-operated volumetric apparatus — Part 1: Terminology, general requirements and user recommendations*

ISO 8655-2, *Piston-operated volumetric apparatus — Part 2: Piston pipettes*

ISO 8655-6, *Piston-operated volumetric apparatus — Part 6: Gravimetric methods for the determination of measurement error*

ISO 13137:—¹⁾, *Workplace atmospheres — Pumps for personal sampling of chemical and biological agents — Requirements and test methods*

EN 13205-1, *Workplace atmospheres — Assessment of performance of instruments for measurement of airborne particle concentrations — Part 1: General requirements*

1) To be published.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 General definitions

3.1.1

breathing zone

<general definition> space around the worker's face from which breath is taken

[SOURCE: EN 1540:2011, 2.4.5, modified]

3.1.2

breathing zone

<technical definition> hemisphere (generally accepted to be 0,3 m in radius) extending in front of the human face, centred on the midpoint of a line joining the ears; the base of the hemisphere is a plane through this line, the top of the head, and the larynx

Note 1 to entry: The definition is not applicable when respiratory protective equipment is used.

[SOURCE: EN 1540:2011, 2.4.5, modified]

3.1.3

chemical agent

any chemical element or compound, on its own or admixed, as it occurs in the natural state or as produced, used, or released, including release as waste, by any work activity, whether or not produced intentionally and whether or not placed on the market

[SOURCE: Council Directive 98/24/EC, Art. 2(a)]

3.1.4

exposure (by inhalation)

situation in which a chemical agent is present in the air that is inhaled by a person

[SOURCE: EN 1540:2011, 2.4.1, modified]

3.1.5

occupational exposure limit value

limit value

limit of the time-weighted average of the concentration of a chemical agent in the air within the breathing zone of a worker in relation to a specified reference period

[SOURCE: Council Directive 98/24/EC, Art. 2(d)]

EXAMPLE Threshold limit values® (TLVs) established by the ACGIH,^[15] indicative occupational exposure limit values (IOELVs) promulgated by the European Commission,^[16] and national limit values. Information on national limit values is available from the International Labour Organization (ILO)^[17] and on the GESTIS database.^[18]

3.1.6

measuring procedure

measurement procedure

set of operations, described specifically, used for the sampling and analysis of chemical agents in air

Note 1 to entry: A measuring procedure for the sampling and analysis of chemical agents in air usually includes the following steps: preparation for sampling, sampling, transportation and storage, preparation of samples for analysis, and analysis.

[SOURCE: ISO/IEC Guide 99:2007, modified]

3.1.7**operating time**

period during which the pump can be operated at a specified flow rate and pressure drop without recharging or replacing the battery

[SOURCE: ISO 13137:—, 3.12]

3.1.8**reference period**

specified period of time for which the occupational exposure limit value of a chemical agent applies

Note 1 to entry: The reference period is usually 8 h for long-term measurements and 15 min for short-term measurements.

Note 2 to entry: Examples for different reference periods are short-term and long-term limit values, such as those established by the ACGIH.^[15]

[SOURCE: EN 1540:2011, 2.4.7, modified]

3.1.9**workplace**

designated area or areas in which the work activities are carried out

[SOURCE: EN 1540:2011, 2.5.2]

3.2 Particle size fraction definitions**3.2.1****inhalable convention**

target specification for sampling instruments when the inhalable fraction is of interest

[SOURCE: ISO 7708:1995]

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3.2.2**inhalable fraction**

mass fraction of total airborne particles which is inhaled through the nose and mouth

Note 1 to entry: The inhalable fraction depends on the speed and direction of air movement, on breathing rate, and other factors.

[SOURCE: ISO 7708:1995]

3.2.3**total airborne particles**

all particles surrounded by air in a given volume of air

Note 1 to entry: Because all measuring instruments are size-selective to some extent, it is often impossible to measure the total airborne particles concentration.

[SOURCE: ISO 7708:1995]

3.3 Sampling definitions**3.3.1****air sampler**

device for separating chemical agents from the surrounding air

Note 1 to entry: Air samplers are generally designed for a particular purpose, e.g. for sampling gases and vapours or for sampling airborne particles.

[SOURCE: EN 1540:2011, 3.2.1, modified]

3.3.2

personal sampler

sampler, attached to a person, that collects gases, vapours, or airborne particles in the breathing zone to determine exposure to chemical agents

[SOURCE: EN 1540:2011, 3.2.2]

3.3.3

personal sampling

process of sampling carried out using a personal sampler

[SOURCE: EN 1540:2011, 3.3.3]

3.3.4

**static sampler
area sampler**

sampler, not attached to a person, that collects gases, vapours, or airborne particles at a particular location

[SOURCE: EN 1540:2011, 3.2.3]

3.3.5

**static sampling
area sampling**

process of air sampling carried out in a particular location

[SOURCE: EN 1540:2011, 3.3.4]

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3.4 Analytical definitions

3.4.1

analysis

all operations carried out after sample preparation to determine the amount or concentration of the analyte(s) of interest present in the sample

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[SOURCE: EN 14902:2005, 3.1.1, modified]

3.4.2

blank solution

solution prepared by taking a reagent blank, laboratory blank, or field blank through the same procedure used for sample dissolution

3.4.3

calibration blank solution

calibration solution prepared without the addition of any working standard solution

Note 1 to entry: The concentrations of Li, Na, K and Ca in the calibration blank solution are taken to be zero.

[SOURCE: EN 14902:2005, 3.1.3, modified]

3.4.4

calibration solution

solution prepared by dilution of the working standard solution, containing Li, Na, K, and Ca at concentrations that are suitable for use in calibration of the analytical instrument

[SOURCE: EN 14902:2005, 3.1.3, modified]

3.4.5

field blank

filter that is taken through the same handling procedure as a sample, except that it is not used for sampling, i.e. it is loaded into a sampler, transported to the sampling site, and then returned to the laboratory for analysis

3.4.6**laboratory blank**

unused filter, taken from the same batch used for sampling, that does not leave the laboratory

3.4.7**linear dynamic range**

range of concentrations over which the calibration curve for Li, Na, K, or Ca is linear

Note 1 to entry: The linear dynamic range extends from the detection limit to the onset of calibration curvature.

3.4.8**reagent blank**

all reagents used in sample dissolution, in the same quantities used for preparation of laboratory blank, field blank, and sample solutions

3.4.9**sample dissolution**

process of obtaining a solution containing Li, Na, K, and Ca from a sample, which might or might not involve complete dissolution of the sample

[SOURCE: EN 14902:2005, 3.1.25, modified]

3.4.10**sample preparation**

all operations carried out on a sample, after transportation and storage, to prepare it for analysis, including transformation of the sample into a measurable state where necessary

[SOURCE: EN 14902:2005, 3.1.24, modified]

3.4.11**sample solution**

solution prepared from a sample by the process of sample dissolution

Note 1 to entry: A sample solution might need to be subjected to further operations, e.g. dilution, in order to produce a test solution that is ready for analysis.

[SOURCE: EN 14902:2005, 3.1.22, modified]

3.4.12**stock standard solution**

solution, used for preparation of the calibration solutions, containing Li, Na, K, or Ca at a certified concentration that is traceable to national standards

[SOURCE: EN 14902:2005, 3.1.26, modified]

3.4.13**test solution**

blank solution or sample solution that has been subjected to all operations required to bring it into a state in which it is ready for analysis

Note 1 to entry: "Ready for analysis" includes any required dilution. If a blank solution or sample solution is not subject to any further operations before analysis, it is a test solution.

[SOURCE: EN 14902:2005, 3.1.30, modified]

3.4.14**working standard solution**

solution, prepared by dilution of the stock standard solution, that contains Li, Na, K, and Ca at concentrations that are better suited to preparation of calibration solutions than the concentrations of Li, Na, K, or Ca in the stock standard solutions

[SOURCE: EN 14902:2005, 3.1.32, modified]

3.5 Statistical terms

3.5.1

analytical recovery

ratio of the mass of analyte measured in a sample to the known mass of analyte in that sample

Note 1 to entry: The analytical recovery is usually given as a percentage.

[SOURCE: EN 1540:2011, 5.1.1]

3.5.2

bias

difference between the expectation of a test result or measurement result and a true value

Note 1 to entry: Bias is the total systematic error as contrasted to random error. There may be one or more systematic error components contributing to the bias. A larger systematic difference from the true value is reflected by a larger bias value.

Note 2 to entry: The bias of a measuring instrument is normally estimated by averaging the error of indication over an appropriate number of repeated measurements. The error of indication is the “indication of a measuring instrument minus a true value of the corresponding input quantity”.

Note 3 to entry: In practice, the accepted reference value is substituted for the true value.

Note 4 to entry: In the case of measurement procedures for the sampling and analysis of chemical agents in air, the accepted reference value can be, for example, the certified value of a reference material, the concentration of a standard test atmosphere, or the target value of an interlaboratory comparison.

[SOURCE: ISO 3534-2:2006, 3.3.2]

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3.5.3

coverage factor

k

numerical factor used as a multiplier of the combined standard uncertainty in order to obtain an expanded uncertainty

Note 1 to entry: A coverage factor, *k*, is typically in the range from 2 to 3.

[SOURCE: ISO/IEC Guide 98-3:2008]

3.5.4

combined standard uncertainty

u_c

standard uncertainty of the result of measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or covariances of these other quantities weighted according to how the measurement result varies with changes in these quantities

[SOURCE: ISO/IEC Guide 98-3:2008]

3.5.5

expanded uncertainty

quantity defining an interval about a result of a measurement, expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand

[SOURCE: ISO/IEC Guide 98-3:2008]

3.5.6

precision

closeness of agreement of independent test/measurement results obtained under stipulated conditions

Note 1 to entry: Precision depends only on the distribution of random errors and does not relate to the true value or the specified value.