INTERNATIONAL STANDARD

ISO 21438-2

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Workplace atmospheres — Determination of inorganic acids by ion chromatography —

Part 2:
Volatile acids, except hydrofluoric acid (hydrochloric acid, hydrobromic acid and nitric acid)

Air des lieux de travail — Détermination des acides inorganiques par chromatographie ionique —

Partie 2: Acides volatils, sauf acide fluorhydrique (acide chlorhydrique, acide bromhydrique et acide nitrique)

Reference number
ISO 21438-2:2009(E)

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Contents

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 21438-2 was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 2, *Workplace atmospheres*.

ISO 21438 consists of the following parts, under the general title *Workplace atmospheres — Determination of inorganic acids by ion chromatography*:

- *Part 1: Non volatile acids (sulfuric acid and phosphoric acid)*
- *Part 2: Volatile acids, except hydrofluoric acid (hydrochloric acid, hydrobromic acid and nitric acid)*
- *Part 3: Hydrofluoric acid and particulate fluorides*

Introduction

The health of workers in many industries is at risk through exposure by inhalation of volatile inorganic acids. 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 part of ISO 21438 has been published in order to make available a method for making valid exposure measurements for volatile inorganic acids in use in industry, such as hydrochloric acid, hydrobromic acid and nitric acid, but excluding hydrofluoric acid. It is intended to be of benefit to: agencies concerned with health and safety at work; industrial hygienists and other public health professionals; analytical laboratories; industrial users of hydrochloric acid, hydrobromic acid and nitric acid and their workers, etc.

It has been assumed in the drafting of this part of ISO 21438 that the execution of its provisions and the interpretation of the results obtained are entrusted to appropriately qualified and experienced people.

INTERNATIONAL STANDARD **ISO 21438-2:2009(E)**

Workplace atmospheres — Determination of inorganic acids by ion chromatography —

Part 2:
Volatile acids, except hydrofluoric acid (hydrochloric acid, hydrobromic acid and nitric acid)

1 Scope

This part of ISO 21438 specifies a method for the determination of the time-weighted average mass concentration of hydrogen chloride (HCl) gas and hydrochloric acid mist, hydrogen bromide (HBr) vapour and hydrobromic acid mist and nitric acid (HNO_3) vapour and mist in workplace air by collection on an alkali-impregnated quartz fibre filter and analysis by ion chromatography.

For mist 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 analytical method is applicable to the determination of masses of 0,01 mg to 2,5 mg of HCl, HBr and HNO_3 per sample.

The range of concentrations of HCl, HBr and HNO_3 in air for which the measuring procedure is applicable is determined by the sampling method selected by the user. For a 240 l air sample, the working range is approximately 0,04 $mg \cdot m^{-3}$ to 10 $mg \cdot m^{-3}$ for HCl, HBr and HNO_3.

The procedure is intended to differentiate between the acids and their corresponding salts. If both are present in the air, particulate salts are trapped on a pre-filter. Co-sampled particulate matter trapped on the pre-filter and/or deposited on the walls of the sampler may be analysed, if desired.

Acids can react with co-sampled particulate matter on the pre-filter, causing interference with the measurement of the acid concentration.

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 648, *Laboratory glassware — Single-volume pipettes*

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

ISO 3585, *Borosilicate glass 3.3 — Properties*

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 8756, *Air quality — Handling of temperature, pressure and humidity data*

EN 13205, *Workplace atmospheres — Assessment of performance of instruments for measurement of airborne particle concentrations*

3 Terms and definitions

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

3.1 General definitions

3.1.1
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 produced intentionally or not and whether placed on the market or not

[EN 1540:1998[1]]

3.1.2
breathing zone
⟨general definition⟩ space around the worker's face from where he or she takes his or her breath

3.1.3
breathing zone
⟨technical definition⟩ hemisphere (generally accepted to be 0,3 m in radius) extending in front of the human face, centred on the mid point of a line joining the ears, the base of the hemisphere being a plane through this line, the top of the head and the larynx

NOTE 1 The definition is not applicable when respiratory protective equipment is used.

NOTE 2 Adapted from EN 1540:1998[1].

3.1.4
exposure (by inhalation)
situation in which a chemical agent is present in air which is inhaled by a person

3.1.5
measuring procedure
procedure for sampling and analysing one or more chemical agents in the air and including storage and transportation of the sample

3.1.6
operating time
period during which a sampling pump can be operated at specified flow rate and back pressure without recharging or replacing the battery

[EN 1232:1997[2]]

3.1.7

time-weighted average concentration

TWA concentration

concentration of a chemical agent in the atmosphere, averaged over a reference period

NOTE More detailed discussion of TWA concentrations is available in Reference [3].

3.1.8

limit value

reference figure for concentration of a chemical agent in air

NOTE An example is the Threshold Limit Value® (TLV) for a given substance in workplace air, as established by the ACGIH[3].

3.1.9

reference period

specified period of time stated for the limit value of a specific chemical agent

NOTE Examples of limit values for different reference periods are short-term and long-term exposure limits, such as those established by the ACGIH[3].

3.1.10

workplace

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

[EN 1540:1998[1]]

3.2 Particle size fraction definitions

3.2.1

inhalable convention

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

[ISO 7708:1995]

3.2.2

inhalable fraction

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

NOTE The inhalable fraction depends on the speed and direction of air movement, on breathing rate and on other factors.

[ISO 7708:1995]

3.2.3

total airborne particles

all particles surrounded by air in a given volume of air

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

[ISO 7708:1995]

3.3 Sampling definitions

3.3.1
personal sampler
device attached to a person that samples air in the breathing zone

[EN 1540:1998[1]]

3.3.2
personal sampling
process of sampling carried out using a personal sampler

[EN 1540:1998[1]]

3.3.3
sampling instrument
sampler
⟨for the purposes of this part of ISO 21438⟩ device for collecting airborne particles

NOTE Instruments used to collect airborne particles are frequently referred to by a number of other terms, e.g. sampling heads, filter holders, filter cassettes.

3.3.4
static sampling
area sampling
process of air sampling carried out in a particular location

3.4 Analytical definitions

3.4.1
blank solution
solution prepared by taking a reagent blank, laboratory blank or field blank through the same procedure as used for sample dissolution

3.4.2
calibration blank solution
calibration solution prepared without the addition of any working standard solution

NOTE The concentration of chloride, nitrate and bromide in the calibration blank solution is taken to be zero.

3.4.3
calibration solution
solution, prepared by dilution of a working standard solution, containing chloride, nitrate and bromide at concentrations that are suitable for use in calibration of an analytical instrument

3.4.4
extraction solution
solvent or solution used to solubilize the analyte(s) of interest

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 as used for sampling, that does not leave the laboratory

3.4.7

linear dynamic range

range of concentrations over which the calibration curve for chloride, nitrate and bromide is linear

NOTE 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 as used for preparation of laboratory blank, field blank and sample solutions

3.4.9

sample dissolution

process of obtaining a solution containing chloride, nitrate and bromide from a sample, which might or might not involve complete dissolution of the sample

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

3.4.11

sample solution

solution prepared from a sample by the process of sample dissolution

NOTE 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.

3.4.12

stock standard solution

solution, used for preparation of the calibration solutions, containing chloride, nitrate and/or bromide at a certified concentration that is traceable to national standards

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, e.g. dilution

NOTE The blank test solution is the blank solution and the sample test solution is the sample solution if these solutions are not subjected to any further operations before analysis.

3.4.14

working standard solution

solution, prepared by dilution of the stock standard solution(s), that contains chloride, nitrate and bromide at concentrations that are better suited to preparation of calibration solutions than the concentration of chloride, nitrate and bromide in the stock standard solutions

3.5 Statistical terms

3.5.1

analytical recovery

ratio of the mass of analyte measured when a sample is analysed to the known mass of analyte in that sample, expressed as a percentage

3.5.2

bias

consistent deviation of the results of a measurement process from the true value of the air quality characteristic itself