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Zrak na delovnem mestu – Pregled in opis napak pri tehtanju zbranih aerosolov

Workplace atmospheres -- Controlling and characterizing errors in weighing collected aerosols

Atmosphères des lieux de travail -- Contrôle et caractérisation des erreurs de pesée des aérosols collectés

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Workplace atmospheres — Controlling and characterizing errors in weighing collected aerosols

Atmosphères des lieux de travail — Contrôle et caractérisation des erreurs de pesée des aérosols collectés

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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 15767 was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 2, *Workplace atmospheres*.

Introduction

Assessment of airborne aerosol hazards in the occupational setting entails sampling onto a collection medium, followed by analysis of the collected material. The result is generally an estimated concentration of a hazardous material in the air. The accuracy of such estimates depends on several factors, one of which relates to the specific type of analysis employed.

This International Standard deals with a specific type of analysis which finds the most general application in the sampling of aerosols, namely the weighing of sampled material. Gravimetric analysis, though apparently simple, is subject to errors from instability in the mass of the sampling medium and other elements which must be weighed. An example is provided by aerosol samplers designed to collect particles so as to agree with the inhalable aerosol sampling convention. For some sampler types, filter and cassette are weighed together to make estimates. Therefore, if the cassette, for example, absorbs or loses water between the weighings required for a concentration estimation, then errors may arise. This International Standard describes such potential errors and provides solutions for their minimization.

Workplace atmospheres — Controlling and characterizing errors in weighing collected aerosols

1 Scope

This International Standard provides recommendations for controlling the analytical uncertainty associated with aerosol collection medium instability, where collection medium or substrate includes any article used to collect particles (e.g. filter or foam material) as well as those supporting elements which must be analysed by weighing.

This International Standard is applicable to results compiled both from the literature and, if necessary and feasible, through laboratory experiment. Expected errors associated with given aerosol capture methods are quantified where possible. Recommendations as to materials to be used are given. Means of controlling or correcting errors arising from instability are provided. Recommendations for the weighing procedure are given. A procedure for estimating weighing errors is described. Finally, recommendations are given for the reporting of measured masses.

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

EN 482, *Workplace atmospheres — General requirements for performance of procedures for the measurement of chemical agents*

EN 13205:2001, *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
substrate
aerosol sampling filter, foam, etc., together with whatever mounting is weighed as a single item

NOTE As an example of the converse, the 25-mm or 37-mm plastic filter cassette often used for “total dust” sampling in either its closed-face or open-face version is *not* part of the substrate in the definition above, since it is not weighed.

3.2
equilibration time
time constant characterizing an approximately exponentially damped approach of the mass of an aerosol collection medium to a constant value

NOTE 1 The constant can be defined as the mean difference of the mass from equilibrium per mean mass loss or gain rate as measured over a finite time interval.

NOTE 2 There may be important instances in which several time constants are required to describe the approach to equilibrium.

NOTE 3 Equilibration time is expressed in seconds.

3.3
field blank
blank substrate that undergoes the same handling as the sample substrate, generally including conditioning and, often, loading into the samplers or transport containers, as well as transportation between lab and sampling site, but without being exposed to sampling

3.4
lab blank
blank substrate that undergoes the same handling as the sample substrate in the laboratory, including conditioning and loading into the samplers or transport containers if this is done in the laboratory

3.5
blank substrate
collection medium or substrate taken from the same batch as the sampling medium, but unexposed to sampling

3.6
limit of detection
LOD
three times the estimated standard deviation of the mass of the sample, accounting for the double weighing (exposed vs. unexposed) and for the uncertainty associated with any correction blanks used

NOTE The value LOD can be used as a threshhold value to assert the presence of a substance with confidence in the method. Annex B describes how to estimate, on the basis of the method evaluation, the false positive rate in such assertions.

3.7
limit of quantitation
LOQ
ten times the estimated standard deviation of the mass of the sample

NOTE The value LOQ can be used as a threshhold value to assure measurement of a substance accurately. For details, see Annex B.

4 Weight instability — Causes and minimization

4.1 General

Weight instability of sampling substrates can be attributed to several causes [1] to [11]. The following subclauses address the more important of these.

4.2 Moisture sorption

4.2.1 Moisture sorption is the most common cause of weight instability. Water can be directly collected by the filter or foam or other substrate material that is weighed. Water sorption by any part of the sampling system which is weighed must be suspected as well. For example, the sampling cassette itself, if weighed, can be the cause of significant error [1].

4.2.2 The effects of water sorption can be reduced by using non-sorptive materials. However, there may exist specific sampling needs for which a hydrophobic material is not feasible. Table 1 presents a list of common aerosol sampling substrates with different water adsorption features.

Table 1 — Water sorption characteristics of some aerosol sampling media

Substrate or cassette type	Water sorption			
	Very low	Low	High	Very high
Cellulose fibre filter			*	
Glass fibre filter		*		
Quartz fibre filter		*		
Cellulose ester membrane filter			*	
Polytetrafluoroethylene filter	*			
PVC membrane filter		*	*	
Polycarbonate filter	*			
Silver membrane filter	*			
Polyurethane foam				*
Greased Mylar impaction substrate		*	*	
Greased aluminium foil impaction substrate		*		
Carbon-filled resin				*
Aluminium cassette		*	*	
Stainless steel cassette	*			

NOTE 1 References [2] to [4] provide further details. Also, reference [5] reports that filters of evidently the same material, but originating from different manufacturers, can have widely differing variabilities.

NOTE 2 There is generally a trade-off between hydrophobicity and conductivity in many materials [9]. Therefore, one must be aware of the possibility of creating sampling problems when reducing hygroscopicity.

NOTE 3 Pre-treatments of substrates, such as greasing, can also affect water sorption.

4.3 Electrostatic effects

Electrostatic effects are a common source of weighing problems. These effects can usually be minimized by discharging the substrate through the use of a plasma ion source or a radioactive source. Using conductive materials may reduce such problems. See also reference [7].

4.4 Effects of volatile compounds (other than water)

4.4.1 Volatile compounds can be present in unused collection media [3], or can be adsorbed onto media during sampling.

4.4.2 Desorption of volatiles from unused media can be controlled, for example, by heating or oxygen plasma treatment prior to conditioning and weighing. Alternatively, losses may be compensated by the use of blanks (see Clause 5).

4.4.3 When volatile materials collected during sampling form part of the intended sample, standardized written procedures are required to ensure that any losses are minimized or at least controlled, for example by conditioning under tightly specified conditions.