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Second edition

Soil and waste — Guidance on the selection and application of screening methods

Qualité du sol — Lignes directrices pour la sélection et l'application des méthodes de diagnostic rapide

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Foreword

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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).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC *190*, *Soil quality*.

This second edition cancels and replaces the first edition (ISO 12404:2011), which has been technically revised.

The main changes compared to the previous edition are as follows:

— The contents of ISO 12404:2011 and EN 16123:2013 were merged;

— The scope was widened to include waste;

— The document was developed parallel with CEN according to the Vienna Agreement;

— The text was editorially revised.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document provides guidance on the use of screening methods for soil, soil-like materials and waste characterization. Most of the following clauses are applicable to all matrices mentioned. However, a few subclauses are specific to either waste or soil, including soil-like material, only.

One field of application of screening methods is “on-site verification” as recommended in the European Landfill Directive (1999/31/EC) and the Landfill Decision (2003/33/EC).

Screening methods, which can be chemical, physical or biochemical in nature, can often be applied in a quick and simple manner. Performance of quick and simple tests can be used in the field (i.e. on-site) and, in some cases, are also applicable for laboratory use. They can indicate the presence or absence of an analyte, or provide a qualitative estimate of a parameter such as a concentration or value, or generate a semi-quantitative result.

Screening methods are applicable to processes such as entrance control at waste disposal sites in conjunction with standardized methods, because they allow fast verification of the documented waste characteristics. They can also be used in similar way when soil or soil-like materials are to be reused in accordance with the guidance in ISO 15176.

Regarding soil, they can also be used to produce a spatial distribution of concentrations or values within a site, which can be supported by subsequent reference (laboratory-based) analysis. When used in this way, the purpose is generally to obtain information on target parameters or groups of parameters and the location of unusual concentrations, possibly prior to undertaking a more detailed study or investigation. In waste investigation, the location of samples is limited to an area where waste is dumped but confirmation of the spatial distribution is still one of the investigation purposes, especially when investigating soil-like material.

The use of screening methods usually increases the efficiency of a site investigation. Generally, many more samples can be analysed or checked and screened for target parameters and results generated faster than using conventional laboratory-based reference methods. Additionally, screening methods, particularly if carried out on-site, can offer an immediate decision-making opportunity which enables staff to direct their efforts more effectively to those areas where a more thorough investigation might need to be undertaken. Any required performance criteria prescribed for a parameter or group of parameters need to be known; this should include an estimate of the result uncertainty.

NOTE Although soil screening methods are most commonly used to determine contaminants (pollutants) in soils, for example in investigations of potentially contaminated sites, they can also be used to determine parameters in uncontaminated soils (e.g. agricultural soils). Thus, the word “contaminant” in this document can be construed to apply in any particular context to any relevant soil parameter (e.g. chemical, physical, biological).

Soil and waste — Guidance on the selection and application of screening methods

1 Scope

This document provides guidance on the selection and application of screening methods for assessing soil quality and waste characterization, including distribution of target parameters in soil and soil-like material. The aim of this document is to set up criteria as to when the different kind of screening methods may be applied for the analysis of a certain parameter in soil, including soil-like material, and waste, and which steps are required to prove their suitability.

This document does not recommend any particular screening method but confirms the principles of their selection and application.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
screening
application of any analytical semi-quantitative method for exploratory analysis

3.2
screening method
method which is used (often on-site) to quickly explore a given area including target parameter distribution or to test a set of samples and obtain data on sample characteristics

Note 1 to entry: It is not necessarily directly comparable with reference methods.

3.3
reference method
method which is performed in accordance with national or international standards

3.4
on-site verification
inspection to ensure that the waste accepted at a landfill is the same as described in the accompanying documents and that it is in accordance with the basic characterization and/or compliance testing

Note 1 to entry: Procedures can be found in the European Landfill Directive (1999/31/EC) and the Landfill Decision (2003/33/EC).

4 Principles

This document specifies a framework for selection and application of screening methods.

It defines the whole process, from the selection of the screening method, the applicability and fit-for-purpose testing, the fulfilling of the acceptance criteria, the quality control of the applied method, to the documentation of measurement results.

The suitability of any particular screening method depends on the parameter or group of parameters requiring determination and on the technical nature of the method.

5 Typical areas for application of screening methods

5.1 General

Screening methods constitute a useful addition to standard procedures in the following areas.

5.2 Support of sampling/sample preparation processes

Screening methods may be used for:

— selection of the most suitable analytical method (concentration range, interferences, specificity, robustness);

— pre-selection of samples for analysis in the laboratory;

— provision of information about accompanying compounds relevant for sample preparation.

5.3 On-site verification

Characteristics of sampled waste are verified, e.g. during transport or at the entrance of waste treatment plants and landfills.

5.4 Monitoring of processes

Screening methods can be used:

— to monitor and control processes (e.g. success of treatment or remediation);

— to perform quality control on a treatment plant.

5.5 Identification of homogeneity/heterogeneity of bulk material

Screening methods may be applied to measure “target compounds” in large amounts of waste as well as soil and soil-like material to check the degree of homogeneity.

5.6 Survey of contaminated sites (hot-spot identification)

Screening methods are useful to identify contaminated areas in contamination-suspected sites. Examples for the application to contaminated sites are given in Annex A (flowchart) and Annex B (hot spot detection).

5.7 Identification of sources of contamination

Screening methods can be useful to identify the source of a contaminant (hot spot detection) and its distribution or contamination variability in a material stream or stock-pile.

5.8 Monitoring of large areas

Screening methods may be used for determination of the distribution of key parameters, e.g. nutrients in agricultural land.

5.9 Safety issues

Screening methods can be used to detect potentially toxic compounds (e.g. gases, radioactivity, explosives) which could be hazardous to the personnel taking and processing samples.

6 Selection of a screening method

6.1 General objectives

Before the screening of a site can be carried out, a thorough planning phase is necessary.

First, all information available about the site should be evaluated, often by conducting a preliminary investigation such as desk study and site reconnaissance following ,for example, ISO 18400-202. This may include historical records or data available from previous investigations. Essential prerequisites for the suitable preparation of a screening investigation is information about the hydrogeological situation, the kind of contaminants and/or parameters of interest and the concentrations or values likely to be expected, as well as any information about the locality, including the former use of the site.

NOTE 1 Further additional steps can be considered:

— development of a conceptual site model (see e.g. ISO 21365);

— development of a suitable sampling strategy (see e.g. ISO 18400-104, and ISO 18400-203 or 18400-205, as appropriate);

— preparation of a sampling plan (see e.g. ISO 18400-101).

NOTE 2 Further information relevant to development of sampling strategies can be found in e.g. ISO 11504, ISO 15175, ISO 15176, ISO 15799, ISO 15800 and ISO 19258.

Furthermore, the infrastructure of the site and the accessibility may need to be taken into consideration.

When the target field is waste, a similar approach is advised. Information about sampling strategies and planning can be found in e.g. CEN/TR 15310, Part 1-5.

NOTE 3 For full titles of the documents listed above, see Bibliography.

With this background information, data quality objectives should be defined that determine the applicability of the screening method. Only with these preliminary steps the selection of screening methods is possible.

Some examples of detailed questions are listed below. This list is not exhaustive and not all might be relevant for a specific site:

— parameters and analytes of interest;

— matrices of interest and condition and variability of matrix;

— data quality objectives (see 6.2 for the details);

— parameter values known, expected or already found on-site;

— statistical probability;

— ease of sampling;

— site facilities;

— site area;

— number of results per time unit;

— health and safety considerations.

An example for the selection and application process of screening methods to soil contamination is given in the informative Annex A.

An example for typical results on finding hot spots by screening methods is given in the informative Annex B.

6.2 Data quality objectives (DQOs)

NOTE The data quality objectives (DQOs) process refers to a systematic planning procedure for environmental data collection so that the data can be defensibly interpreted, and statistically analysed where appropriate, to address specified objectives. It includes appropriate sampling design and sampling plans, as well as the analytical strategy and setting analytical data objectives[21]. The concept applies not just to numerical data, but also to the sufficiency of all relevant information in terms of quantity, quality and type.

In land contamination investigations, there are typically DQOs that require laboratory analytical data to be meaningfully comparable to a variety of risk-based or other quality criteria.

DQOs should be set for all investigations. They should be defined for the specific purpose of the site investigation phase or activity, e.g. risk-based assessment (human health and controlled waters), remediation, validation or waste classification.

When setting DQOs, account should be taken of the type, quantity and quality of the data required to inform subsequent decisions based on the data and other available information.

DQOs should be set having regard to QA/QC (Quality Assurance/Control) requirements and how comparison with risk-based or other criteria are to be effectively supported by the site data and information as well as the laboratory analytical data collected.

Review points should be identified at key stages throughout the investigation, assessment and remediation design phases to ensure that DQOs remain aligned to the project requirements. The review should include assessment of the continuing validity of the conceptual site model, data consistency, emerging data gaps and levels of uncertainty. A written record of the review should be maintained and incorporated in the assessment and design process and include a statement on whether the DQOs have been met and any shortfalls within the assessment.

6.3 Selection criteria

6.3.1 General

The following criteria should be taken into consideration when selecting the appropriate screening method. The different criteria should be weighted depending on the intended application. The decision-making process and the results should be documented by the user (see flowchart in Annex C and documentation aid in Annex D).

Prerequisites are:

— one known parameter or a set of known parameters;

— aim of determination;

— matrix (soil, soil-like materials, solid or liquid waste).

If a sample is collected from waste, the sample source of waste is obvious. In the case of a sample collected from the ground, if the sample has no link with information on sampling location, screening application has no meaning. Even with soil-like material, samples are to be linked with sampling location in the same way.

6.3.2 Sampling/sample pre-treatment/preparation

Sampling/sample pre-treatment/preparation may include:

— direct measurement [e.g. (handheld) x-ray-fluorescence systems allow direct measurement with limited sampling/sample pre-treatment/preparation];

— pre-treatment/preparation (e.g. extraction, separation);

— particle size and homogeneity.

Most screening methods require the provision of the analyte in an extract/eluate, which therefore requires sample pre-treatment. Pre-treatment needs to be carried out in accordance with the relevant standards.

6.4 Checks for the selection of candidate methods

6.4.1 General

A candidate screening method should meet predefined requirements in terms of:

— parameter definition;

— field of application;

— method characteristics;

— boundary conditions.

6.4.2 Parameter definition

Possible parameter definitions include:

— total content (e.g. chromium, benzene);

— individual species [e.g. Cr^{3+}, Cr^{6+}, Fe^{2+}, Fe^{3+}, volatile organic compounds];

— group parameters [e.g. total organic carbon (TOC), adsorbable organically bound halogens (AOX)].

— in the case of on-site verification, the parameters are typically defined by declaration or based on the experience of the staff.

6.4.3 Field of application

Fields of application are as follows:

— specified decision value (e.g. limit value, target value);

— concentration range;

— matrix;

— method limitations/interferences.

6.4.4 Method characteristics

Method characteristics are as follows:

— sensitivity, selectivity, accuracy value (e.g. limit value, target value);

— working range;

— limit of detection;

— matrix interferences;

— method limitations/interferences.

6.4.5 Boundary conditions

Boundary conditions are as follows:

— rapidity (in relation to aim of determination);

— mobility;

— costs;

— quality target of analysis;

— frequency of use (continuous, once only);

— competence of staff;

— legal requirements;

— availability and/or ease of acquisition of the necessary equipment;

— infrastructural conditions.

The criteria should be weighted differently depending on the intended application.

6.5 Fit-for-purpose test

In a second step, after passing the selection steps in 6.2, the selected method needs to pass a fit-for-purpose test as described in Clause 8.

In case of frequently repeated tasks, the most suitable screening method should be identified and applied, the necessary equipment kept ready and the procedure documented in a standard operation procedure. Selection and fit-for-purpose testing should therefore be performed only once.

6.6 Quality targets

The general quality target of analytical questions is its ability to establish the relationship between the analytical result and its confidence interval on the one hand, and the decision values on the other. This relationship with the decision values means that the analytical method to be used is subject to requirements regarding the quality of the analytical results. These requirements are task-related and should be defined before the screening method is applied. The definition of these quality targets forms the basis for the selection of the appropriate method.

A documented procedure for the application of a screening method and for all associated quality-control measurements should be available to the person undertaking the test. Only after tests have been carried out which demonstrate the intended sensitivity and stability, should field measurements be undertaken.

Applying control charts to the results of such tests, over a long period of time, should demonstrate the performance of the screening method and indicate whether it is acceptable or not.

