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Guidance on characterization of excavated soil and other materials intended for re-use

Lignes directrices sur la caractérisation de la terre excavée et d'autres matériaux du sol destinés à la réutilisation

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Contents

Page

Foreword ... **iv**

Introduction ... **v**

1 Scope ... **1**

2 Normative reference ... **2**

3 Terms and definitions ... **2**
3.1 Types of soil and other soil materials ... 2
3.2 Soil characteristics ... 4
3.3 Land and sites ... 5
3.4 Utilization, reclamation and treatment ... 5
3.5 Assessment ... 6

4 Characterization of soil materials and sites ... **7**
4.1 General ... 7
4.2 Investigation strategies ... 9
4.3 Sampling strategies ... 10
4.3.1 General considerations ... 10
4.3.2 Sampling in situ soil materials ... 13
4.3.3 Sampling sediments ... 13
4.3.4 Sampling stockpiles of untreated or treated soil materials ... 14
4.3.5 Sampling materials arising from a process-based remediation method ... 14
4.3.6 Sampling manufactured soils ... 14
4.3.7 Sampling soil materials after placement at the target site ... 14
4.3.8 Sampling the water environment ... 14
4.4 Characterization of soil materials ... 14
4.4.1 General ... 14
4.4.2 Description of source and target sites ... 15
4.4.3 Chemical characterization including basic characteristics ... 17
4.4.4 Physical characteristics ... 22
4.4.5 Biological characteristics ... 22

5 Data quality, handling and evaluation ... **23**

6 Using this document ... **24**

Annex A (informative) **Relevant parameters required for the chemical, physical and biological characterization of materials for re-use** ... **25**

Annex B (normative) **Good practice in the re-use of soil materials** ... **35**

Annex C (informative) **Guidance on determination of the scope of investigation needed before excavation of soil materials** ... **39**

Annex D (informative) **Examples of classification and evaluation of soils and other soil materials** ... **41**

Annex E (informative) **Examples of elements and compounds belonging to different contaminant groups** ... **47**

Bibliography ... **50**

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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 of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 7, *Impact assessment*.

This second edition cancels and replaces the first edition (ISO 15176:2002), which has been technically revised. The main changes compared to the previous edition are as follows:

— introduction of references to the ISO 18400 series of standards;

— updated references to international standards.

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.

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Introduction

This document is one of a series providing guidance on the assessment of soils and soil materials in relation to certain functions and uses. It should be read in conjunction with other International Standards, some of which give more specific guidance in relation to some of the uses listed in the Scope or particular aspects of assessments. For example, ISO 15800[1)] gives guidance on assessments relating to human exposure to potentially harmful substances and ISO 15175 gives guidance on characterization of contaminated soil related to groundwater protection.

Soils are the dynamic product of chemical, physical and biological processes. They are the result of interactions between the inherent nature of the parent material, the prevailing environmental conditions and human activities. They are a valuable natural and finite resource which should be conserved wherever possible. When construction, mining or other activities require soils to be excavated and moved from their natural situation, they should as far as possible be re-used in a manner consistent with their natural properties and the intended use of the target location. Soils intended for re-use are usually required to have certain chemical, leaching, geotechnical, physical, biological and radiochemical attributes consistent with this future use. Particular attention should be paid in situations where there is reason to believe that the soil might be contaminated.

Soils that are to be excavated, stripped, or otherwise removed from their original location, should be investigated to determine how they can be re-used so as to minimize the quantities to be disposed of as waste and to determine environmental impacts that might arise during re-use. Treatment of soils and soil materials to remove or destroy contaminants or to reduce their availability to the environment can alter soil properties. These properties should therefore be determined before re-use. For manufactured soils, the characteristics of both the components and of the manufactured product might need to be determined.

The purpose of characterizing soil (or other media) as suggested in this document is usually to enable judgements to be made about its suitability for a defined use (e.g. arable farming, domestic gardens). These judgements can be made by reference to published international or national guidance that sets out physical, chemical or other generic criteria, or against criteria set on a site-specific basis. When substances are present that might be harmful to human health or the environment, the judgement can also be made on the basis of a site-specific qualitative, semi-quantitative or fully quantitative risk assessment. In many jurisdictions, formal guidance on such assessments has been published. In some cases this guidance fits within a legislative framework. Guidance has also been provided by professional organizations and some standardization bodies.

When deciding whether to re-use soil material, other possibly competing or overriding objectives such as protection of soil, nature, water and air; physical planning requirements and national legislative requirements should be considered.

Assessment of soil material for re-use could require the measurement of the chemical, physical, biological, geotechnical and radiochemical characteristics of soil material and of the source and target sites. The assessor should identify those parameters that are appropriate to the task in hand.

This document identifies the functions and properties of soil materials at the source (point of origin) and also the properties of the target (target) site which could be relevant to the potential uses listed in the Scope and indicates for which parameters or procedures there are International Standards available. Radiochemical and geotechnical aspects are not covered. For guidance on the geotechnical aspects of the use of soil materials as construction material, see also other relevant International Standards (e.g. those produced by ISO/TC 182, *Geotechnics in the field of civil engineering*) or national standards.

The way the soil is handled after excavation can affect soil properties. Some suggestions regarding good practice in soil handling and related practice and monitoring after placement are provided in Annex B.

1) Under preparation. Stage at the time of publication: ISO/FDIS 15800.

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Guidance on characterization of excavated soil and other materials intended for re-use

1 Scope

This document provides guidance on the range of tests that could be necessary to characterize soil and other soil materials intended to be re-used, with or without preliminary treatment (e.g. screening to remove over large material). It is intended to be of use in determining the suitability of soil materials for re-use (see 3.4.1), and the assessment of the environmental impacts that might arise from re-use. It takes into account the different requirements of topsoil, sub-soil and other soil materials such as sediments or treated soils. International Standard methods are listed that might be of use for characterization.

Soil materials include natural soils and other materials (e.g. fill, made ground) excavated, stripped, or otherwise removed from their original in-ground or above-ground location (e.g. stockpile), dredged materials, manufactured soils, and soil treated to remove or destroy contaminants. For manufactured soils, which are often made using excavated materials together with other materials such as "green waste", the characteristics of the components and of the manufactured product might need to be determined.

NOTE The terms "excavated soil" and "excavated soil materials" are used for brevity throughout the document to embrace the range of materials covered.

An overriding principle governing the guidance provided in this document is that when there is to be no change in intended land use at the target site, imported soil materials cannot lead to a permanent reduction in performance of relevant soil functions.

The guidance provided is intended to cover a range of possible end uses, including:

— play areas for small children, including nursery schools, kindergartens, etc.;

— schools;

— gardens and other residential areas;

— allotments;

— horticulture;

— agriculture;

— forestry;

— recreational areas, e.g. parks, sport fields;

— restoration of damaged ecosystems;

— mining and industrial sites;

— construction sites;

— road and rail constructions.

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It is not applicable to the placement of soil materials in an aqueous environment or to restore underground workings. It does not address geotechnical requirements when soil materials are to be used as construction material.

NOTE The sensitive end uses listed above such as play areas for small children, schools, gardens, agriculture and recreational areas require particular care, particularly when excavated soils are derived from contaminated sites.

2 Normative reference

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:

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

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

3.1 Types of soil and other soil materials

3.1.1
soil
upper layer of the Earth's crust transformed by weathering and physical/chemical and biological processes composed of mineral particles, organic matter, water, gases and living organisms organized in generic soil horizons

Note 1 to entry: In a broader civil engineering sense, soil includes topsoil and sub-soil; deposits such as clays, silts, sands, gravels, cobbles, boulders and organic matter and deposits such as peat; materials of human origin such as wastes; ground gas and moisture; and living organisms.

[SOURCE: ISO 11074:2015, 2.1.11, modified —"gases" replaces "air".]

3.1.2
topsoil
upper part of a natural soil that is generally dark coloured and has a higher content of organic matter and nutrients when compared to the (mineral) horizons below, excluding the humus layer

Note 1 to entry: For arable land, topsoil refers to the ploughed soil depth, while for grassland; it is the soil layer with high root content.

[SOURCE: ISO 11074:2015, 2.1.21]

3.1.3
subsoil
natural soil material below the topsoil and overlying the parent material parent rock beneath

Note 1 to entry: All or much of the original rock structure has usually been obliterated by pedogenic processes.

[SOURCE: ISO 11074:2015, 2.1.20, modified — "parent rock beneath" added.]

3.1.4
soil material
material composed of excavated soil, dredged materials, manufactured soils, treated soils and fill materials

[SOURCE: ISO 11074:2015, 7.4.16]

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3.1.5
excavated soil
soil material extracted from the ground

EXAMPLE Topsoil, subsoil, altered parent rock, typically arising during construction works.

[SOURCE: ISO 11074:2015, 2.2.6]

3.1.6
manufactured soil
manufactured product intended to perform specified soil functions produced by blending combinations of natural, waste, or manufactured materials with the addition of nutrients or other additives, when necessary

[SOURCE: ISO 11074:2015, 2.2.9, modified — "manufactured materials" replaces "soil materials".]

3.1.7
treated soil
soil that has been subjected to a process-based treatment method

[SOURCE: ISO 11074:2015, 2.2.16, modified — "process-based treatment method" replaces "ex situ or in situ process".]

3.1.8
dredged material
solid material excavated or otherwise removed from waters, e.g. during maintenance, construction, reconstruction and harbour or channel extension operation

Note 1 to entry: Dredged material might consist of sediment and soil taken from below the water surface.

[SOURCE: ISO 11074:2015, 2.2.4, modified — "material excavated" changed to "solid material excavated or otherwise removed from waters" and "extension measures from waters" modified in "harbor or channel extension operation". In note 1 to entry: "subhydric soils" deleted and "soil and their parent material beneath the surface water body" changed to "soil taken from below the water surface".]

3.1.9
anthropogenic ground
deposits which have accumulated through human activity

[SOURCE: ISO 11074:2015/DAmd 1:2019[2)]]

3.1.10
fill
anthropogenic ground in which the material has been selected, placed and compacted in accordance with an engineering specification

[SOURCE: ISO 11074:2015/DAmd 1:2019]

3.1.11
made ground
anthropogenic ground comprising material placed without engineering control and/or manufactured by man in some way, such as through crushing or washing, or arising from an industrial process

[SOURCE: ISO 11074:2015/DAmd 1:2019]

2) Under preparation. Stage at the time of publication: ISO 11074:2015/DAmd 1:2019.

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3.2 Soil characteristics

3.2.1
soil functions
roles performed by soil that support ecosystems, the biosphere, the water environment and human activities

EXAMPLE Control of substances and energy cycles as compartment of ecosystems, basis for life of plants, animals and humans, basis for stability of buildings and roads, basis for the yield of agriculture, horticulture, and forestry, carrier of genetic reservoir, document of natural history, archaeological and palaeological document.

[SOURCE: ISO 11074:2015, 3.3.31, modified — "roles performed by soil that support ecosystems, the biosphere, the water environment and human activities" replaces "description of the significance of soils to man and the environment".]

3.2.2
background concentration
concentration of a substance characteristic of a soil type in an area or region arising from both natural sources and anthropogenic diffuse sources such as atmospheric deposition

[SOURCE: ISO 11074:2015, 3.5.1, modified — "anthropogenic diffuse sources" replaces "non-natural diffuse sources".]

3.2.3
background value
statistical characteristics of the total (natural pedo-geochemical and anthropogenic) content of substances in soil

Note 1 to entry: It is commonly expressed in terms of an average, median, or a range of values.

[SOURCE: ISO 11074:2015, 3.5.2, modified — Note 1 to entry added.]

3.2.4
natural background concentration
concentration of a substance that is derived solely from natural sources (i.e. of geogenic origin), commonly expressed in terms of average, a range of values, or a natural-background value

[SOURCE: ISO 11074:2015, 3.5.7]

3.2.5
natural background value
statistical characteristics of the natural pedo-geochemical content of a substance in soils

[SOURCE: ISO 11074:2015, 3.5.8]

3.2.6
contaminant
substance or agent present in soil as a result of human activity

Note 1 to entry: There is no assumption in this definition that harms results from the presence of the contaminant.

[SOURCE: ISO 11074:2015, 3.4.6]

3.2.7
potentially harmful substance
substance which by its chemical form, concentration or presence, can be dangerous to humans or the environment

Note 1 to entry: It can be present naturally or as a result of human activity.

[SOURCE: ISO 11074:2015, 3.4.19]

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3.2.8
residual contamination
amount or concentration of contaminants remaining in a specific medium, following remediation

[SOURCE: ISO 11074:2015, 3.4.21]

3.2.9
trace element
element present in low concentration in soil material in respect to the most commonly observed natural background level

[SOURCE: ISO 11074:2015, 3.5.12]

3.2.10
essential trace element
element essential at low concentrations for plant or animal (including human) metabolism

Note 1 to entry: An element can be essential at low concentrations but become harmful at higher concentrations.

[SOURCE: ISO 11074:2015, 3.5.5]

3.2.11
soil characterization
determination of relevant physical, chemical, and biological properties of the soil

[SOURCE: ISO 11074:2015, 2.1.12]

3.3 Land and sites

3.3.1
damaged land
degraded land
land which, due to natural processes or human activity, is no longer able to properly sustain an economic function and/or its original natural ecological function

[SOURCE: ISO 11074:2015, 2.2.2]

3.3.2
target site
site at which soil is to be re-used

[SOURCE: ISO 11074:2015, 2.3.14]

3.4 Utilization, reclamation and treatment

3.4.1
re-use of soil material
useful and harmless utilization of soil materials

Note 1 to entry: Re-use can mean transfer of soil materials to another location for use in agriculture, horticulture, forestry, gardens, recreational areas and construction sites.

[SOURCE: ISO 11074:2015, 2.2.12]

3.4.2
construction works
applications where soil materials are not required to have a direct productive use although they can support other layers intended to have a productive use

Note 1 to entry: For example, including earthworks (e.g. embankments), landscape engineering, road construction, construction of waste disposal sites, and backfilling of excavated sites or surface mines.

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[SOURCE: ISO 11074:2015, 2.2.1, modified — "surface" added before "mines" in Note 1 to entry]

3.4.3
reclamation
rehabilitation
return of damaged, degraded or derelict land to beneficial use

Note 1 to entry: The term remediation is commonly restricted to the process of dealing with contaminated/polluted sites.

[SOURCE: ISO 11074:2015, 2.2.11]

3.4.4
soil rehabilitation
action taken to improve the capability of damaged or degraded soil to perform specified functions (e.g. addition of organic matter and nutrients to promote plant growth)

[SOURCE: ISO 11074:2015, 6.1.22]

3.4.5
remediation strategy
combination of remedial techniques and associated work programmes that will meet specified contamination-related remediation objectives and other objectives (e.g. engineering related), and overcome possible restraints

[SOURCE: ISO 11074:2015, 6.1.20, modified — "techniques" replaces "methods, "programmes" added, "(e.g. residual contaminant concentrations)" removed, "possible restraints" replaces "residual concentration"]

3.4.6
process-based treatment method
application of physical, chemical or biological processes either to remove or destroy contaminants, or to reduce their availability to the environment

Note 1 to entry: Different treatment methods, e.g. biotreatment, are defined in ISO 11074.

3.4.7
stockpile
temporary deposit of soil material

[SOURCE: ISO 11074:2015, 2.2.14 modified — Note 1 and Note 2 to entry deleted]

3.4.8
investigation for compliance or performance
investigation, or programme of on-going inspection, testing or monitoring, to confirm that a remediation strategy has been properly implemented and/or when a containment approach has been adopted, that this continues to perform to the specified level

EXAMPLE Testing to confirm that all contaminated material has been removed.

3.5 Assessment

3.5.1
hazard
property of a substance or material, or situation that in particular circumstances could lead to harm or pollution

[SOURCE: ISO 11074:2015, 5.2.15]

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3.5.2
hazard
re-use of soil & soil materials
property of a substance or material, or any action that which might have an adverse effect on soil functions

Note 1 to entry: A hazard has the potential to cause harm.

3.5.3
risk
combination of the probability and frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence

[SOURCE: ISO 11074:2015, 5.2.24]

3.5.4
harmlessness
<application of soil materials> condition in which the application of a soil material does not result in damage, as defined by specific criteria, to the present functions of the soil already at the target site

[SOURCE: ISO 11074:2015, 5.2.14]

3.5.5
data quality objectives
statement of the required detection limits, accuracy, reproducibility and repeatability of the required analytical and other data

Note 1 to entry: Generic data quality objectives are sometimes set at national level. Data quality objectives can also embrace the amount of data required for an area of land (or part of a site) or for a stockpile to enable a sound comparison with generic guidelines or standards or for a site-specific or material-specific estimation of risk.

[SOURCE: ISO 11074:2015, 5.1.2]

4 Characterization of soil materials and sites

4.1 General

The purpose of characterizing soil materials and sites intended for re-use of soil material is to enable judgements to be made about their suitability for a defined use (e.g. arable farming, domestic gardens, construction works). Before such judgements can be made, the right type, quantity and quality of information and data shall be available (see Clause 5). It is necessary to determine relevant site information and chemical, physical and biological soil and soil material characteristics as appropriate. This requires the development of a soil management plan which should include:

— an investigation strategy (see 4.2) and, if necessary;

— sampling strategies (see 4.3) and, if necessary;

— analytical and testing strategies (see 4.4);

— and always an assessment framework (see Clause 5);

for each site, soil and soil material that is to be assessed.

Sometimes investigations are required for the sole purpose of deciding whether soil and other soil material such as fill materials are suitable for re-use for a target site (see Figure 1) but this might be only one of a number of objectives of a more comprehensive investigation of a suspect potentially contaminated site. In this latter case, the initial task becomes to ensure that the overall sampling, analytical and testing strategies for the investigation properly address the needs of this specific objective. In practice, investigations are commonly phased for both technical and cost reasons and it could therefore be preferable to carry out at least part of the characterization, particularly for

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