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Soil quality – Leaching procedures for subsequent chemical and ecotoxicological testing of soil and soil-like materials – Part 3: Up-flow percolation test (ISO 21268-3:2019)

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EUROPEAN STANDARD

EN ISO 21268-3

NORME EUROPÉENNE

EUROPÄISCHE NORM

October 2019

ICS 13.080.05

Supersedes CEN ISO/TS 21268-3:2009

English Version

**Soil quality - Leaching procedures for subsequent
chemical and ecotoxicological testing of soil and
soil-like materials - Part 3: Up-flow percolation test
(ISO 21268-3:2019)**

Qualité du sol - Modes opératoires de
lixiviation en vue d'essais chimiques et
écotoxicologiques ultérieurs des sols et
matériaux du sol - Partie 3: Essai de percolation
à écoulement ascendant (ISO 21268-3:2019)

Bodenbeschaffenheit - Elutionsverfahren
für die anschließende chemische und
ökotoxikologische Untersuchung von Boden und
von Bodenmaterialien - Teil 3: Perkolationsstest
im Aufwärtsstrom (ISO 21268-3:2019)

This European Standard was approved by CEN on 1 September 2019.

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COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (EN ISO 21268-3:2019) has been prepared by Technical Committee ISO/TC 190 "Soil quality" in collaboration with Technical Committee CEN/TC 444 "Test methods for environmental characterization of solid matrices" the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2020, and conflicting national standards shall be withdrawn at the latest by April 2020.

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Endorsement notice

The text of ISO 21268-3:2019 has been approved by CEN as EN ISO 21268-3:2019 without any modification.

Introduction

In various countries, tests have been developed to characterize and assess the substances which can be released from materials. The release of soluble substances upon contact with water is regarded as a main mechanism of release, which results in a potential risk to the environment during the use or disposal of materials. The intent of these tests is to identify the leaching properties of materials. The complexity of the leaching process makes simplifications necessary^[1].

Not all of the relevant aspects of leaching behaviour can be addressed in one standard (see description of influencing factors in [Annex A](#)).

Tests to characterise the behaviour of materials can generally be divided into three categories addressed in ISO 18772^[2] and EN 12920^[3]. The relationships between these tests are summarized below.

- a) “Basic characterization” tests are used to obtain information on the short- and long-term leaching behaviour and characteristic properties of materials. Liquid/solid (L/S) ratios, leachant composition, factors controlling leachability, such as pH, redox potential, complexing capacity, role of dissolved organic carbon (DOC), ageing of material and physical parameters, are addressed in these tests.
- b) “Compliance” tests are used to determine whether the material complies with a specific behaviour or with specific reference values. The tests focus on key variables and leaching behaviour previously identified by basic characterisation tests.
- c) “On-site verification” tests are used as a rapid check to confirm that the material is the same as that which has been subjected to the compliance test(s). On-site verification tests are not necessarily leaching tests.

The test procedure described in this method belongs to category a): basic characterization tests.

This document was originally elaborated on the basis of CEN/TS 14405:2004^[4]. Especially, modifications considering requirements on subsequent ecotoxicological testing and analysis of organic substances have been included. Validation results have been adopted from DIN 19528^[5] and from Japanese validation studies^[15,16].

Soil quality — Leaching procedures for subsequent chemical and ecotoxicological testing of soil and soil-like materials —

Part 3: Up-flow percolation test

1 Scope

This document specifies a test, which is aimed at determining the leaching behaviour of inorganic and organic substances from a soil and soil-like materials. The method is a once-through up-flow percolation test under standardized conditions of flow rate. The material is leached under dynamic hydraulic conditions. The document has been developed to measure the release of inorganic and organic substances from soil and soil-like material as well as to produce eluates for subsequent ecotoxicological testing. For ecotoxicological testing, see ISO 15799[6] and ISO 17616[7]. The test results enable the distinction between different release patterns, for instance wash-out and release under the influence of interaction with the matrix, when approaching local equilibrium between material and leachant.

This test method produces eluates, which can subsequently be characterized by physical, chemical and ecotoxicological methods in accordance with existing standard methods. The results of eluate analysis are presented as a function of the liquid/solid (L/S) ratio. The test is not suitable for substances that are volatile under ambient conditions.

NOTE 1 Volatile organic substances include the low-molecular-weight substances in mixtures such as mineral oil.

NOTE 2 It is not always possible to optimize test conditions simultaneously for inorganic and organic substances and optimum test conditions can also vary between different groups of organic substances. Test requirements for organic substances are generally more stringent than those for inorganic substances. The test conditions suitable for measuring the release of organic substances will generally also be applicable to inorganic substances.

NOTE 3 Within the category of organic substances, a significant difference in behaviour exists between the more polar, relatively water-soluble compounds and apolar, hydrophobic organic substances (HOCs). In the latter case, mechanisms of release (e.g. particle-bound or dissolved organic carbon-bound) can be more crucial as well as sorption losses of soluble HOCs on different materials with which they come in contact (e.g. bottles, filters). The test and the results should be used for leaching of organic substances only with thorough consideration of the specific properties of the substances in question and the associated potential problems.

NOTE 4 For ecotoxicological testing, eluates representing the release of both inorganic and organic substances are needed. In this document, ecotoxicological testing is also meant to include genotoxicological testing.

NOTE 5 The test is generally not suitable for soils with hydraulic conductivities below 10^{-8} m/s (see also [Annex B](#)). It can be difficult to maintain the designated flow rate already in the range of saturated hydraulic conductivity between 10^{-7} m/s and 10^{-8} m/s.

The application of this test method alone is not sufficient for the determination of the leaching behaviour of a material under specified conditions different to those from the test procedure, since this generally requires the application of several test methods, behavioural modelling and model validation. This document does not address issues related to health and safety. It only determines the leaching properties as outlined in [Clause 4](#).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 5667-3:2018, *Water quality — Sampling — Part 3: Preservation and handling of water samples*

ISO 5725-1:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

ISO 5725-2:1994, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

ISO 7027-1, *Water quality — Determination of turbidity — Part 1: Quantitative methods*

ISO 10523, *Water quality — Determination of pH*

ISO 11465, *Soil quality — Determination of dry matter and water content on a mass basis — Gravimetric method*

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 leaching test

test during which a material is put into contact with a *leachant* (3.2) under strictly defined conditions and some substances of the material are extracted

3.2 leachant

liquid used in a *leaching test* (3.1)

Note 1 to entry: For the purposes of this document, the leachant is specified in 5.1.

3.3 eluate

solution recovered from a *leaching test* (3.1)

Note 1 to entry: Eluate is also referred to as leachate.

3.4 liquid to solid ratio L/S

ratio between the total volume of liquid (L in litres), which in this extraction is in contact with the soil sample, and the dry mass of the sample (S in kg of dry matter).

Note 1 to entry: L/S is expressed in l/kg.

3.5 dry matter content

w_{dm}

ratio expressed in percent between the mass of the dry residue, determined in accordance with ISO 11465 and the corresponding raw mass.

3.6 laboratory sample

sample or subsample(s) sent to or received by the laboratory

3.7 test sample

sample, prepared from the *laboratory sample* (3.6), from which *test portions* (3.8) are removed for testing or analysis

3.8 test portion

quantity of material of appropriate size for measurement of the concentration or other properties of interest, taken from the *test sample* (3.7)

Note 1 to entry: The test portion can be taken from the laboratory sample directly if no pre-treatment of sample is required, but usually it is taken from the test sample.

Note 2 to entry: A unit or increment of proper homogeneity, size and fineness, needing no further preparation, can be a test portion.

3.9 soil-like material

excavated soil, dredged materials, manufactured soils, treated soils and fill materials

4 Principle

This document describes a method to determine the release of substances from soil and soil-like material, packed in a column with leachant percolating through it. A continuous vertical up-flow is used, which allows a column test under water-saturated conditions. The test conditions, including the flow rate of the leachant, are chosen such that the substances that are rapidly washed out and the substances that are released under the influence of interaction with the matrix can be deduced from the results. It is intended and assumed that conditions approach local equilibrium between the material and the leachant throughout the test.

The test portion, which originally or after suitable pre-treatment has a particle size less than or equal to 2 mm, is brought into contact with water containing a low concentration (0,001 mol/l) of calcium chloride or demineralised water (5.1) under defined conditions. The leachant is percolated in up-flow direction through the column at a specified flow rate up to a fixed L/S ratio. The eluate is collected in several separate fractions. The standard method is based on the assumption that equilibrium or near-equilibrium is achieved between the liquid and solid phases during the test period. The properties of the eluate are measured using methods developed for water analysis adapted to meet criteria for analysis of eluates, and the eluate may be subjected to subsequent ecotoxicological testing.

After the test, the leaching conditions, in terms of pH, electrical conductivity, and optionally, turbidity, dissolved organic carbon (DOC) or redox potential imposed by the material shall be recorded.

NOTE 1 These parameters often control the leaching behaviour of soil materials and are therefore important for evaluation of the test results. DOC, in particular, is crucial in soil and soil-like materials for many inorganic and organic substances.

NOTE 2 The leachant is 0,001 mol/l CaCl_2 to minimize the mobilisation of DOC caused by an ionic strength of the leachant which is too low.

The properties of the eluate are measured using methods developed for water analysis adapted to meet criteria for analysis of eluates and/or the eluate may be subjected to subsequent ecotoxicological testing.