
Kakovost tal - Parametri geokemijskega modeliranja izpiranja in speciacija sestavin v tleh in talnih materialih - 4. del: Ekstrakcija huminskih snovi iz trdnih vzorcev (ISO 12782-4:2012)

Soil quality - Parameters for geochemical modelling of leaching and speciation of constituents in soils and materials - Part 4: Extraction of humic substances from solid samples (ISO 12782-4:2012)

Bodenbeschaffenheit - Parameter zur geochemischen Modellierung der Elution und Speziation von Bestandteilen in Böden und Materialien - Teil 4: Extraktion von Huminstoffen aus Feststoffproben (ISO 12782-4:2012)

Qualité du sol - Paramètres pour la modélisation géochimique de la lixiviation et de la spéciation des constituants des sols et des matériaux - Partie 4: Extraction des substances humiques des échantillons solides (ISO 12782-4:2012)

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Soil quality - Parameters for geochemical modelling of leaching and speciation of constituents in soils and materials - Part 4: Extraction of humic substances from solid samples (ISO 12782-4:2012)

Qualité du sol - Paramètres pour la modélisation géochimique de la lixiviation et de la spéciation des constituants des sols et des matériaux - Partie 4: Extraction des substances humiques des échantillons solides (ISO 12782-4:2012)

Bodenbeschaffenheit - Parameter zur geochemischen Modellierung der Elution und Speziation von Bestandteilen in Böden und Materialien - Teil 4: Extraktion von Humusstoffen aus Feststoffproben (ISO 12782-4:2012)

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Foreword

This document (EN ISO 12782-4:2012) has been prepared by Technical Committee ISO/TC 190 "Soil quality" in collaboration with Technical Committee CEN/TC 345 "Characterization of soils" 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of an identical text or by endorsement, at the latest by December 2012, and conflicting national standards shall be withdrawn at the latest by December 2012.

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**Soil quality — Parameters for geochemical
modelling of leaching and speciation of
constituents in soils and materials —**

**Part 4:
Extraction of humic substances from
solid samples**

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*Qualité du sol — Paramètres pour la modélisation géochimique de la
lixiviation et de la spéciation des constituants des sols et des matériaux —*

Partie 4: Extraction des substances humiques des échantillons solides
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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.

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ISO 12782-4 was prepared by Technical Committee ISO/TC 190, *Soil quality*, Subcommittee SC 7, *Soil and site assessment*.

ISO 12782 consists of the following parts, under the general title *Soil quality — Parameters for geochemical modelling of leaching and speciation of constituents in soils and materials*:

- Part 1: *Extraction of amorphous iron oxides and hydroxides with ascorbic acid*
- Part 2: *Extraction of crystalline iron oxides and hydroxides with dithionite*
- Part 3: *Extraction of aluminium oxides and hydroxides with ammonium oxalate/oxalic acid*
- Part 4: *Extraction of humic substances from solid samples*
- Part 5: *Extraction of humic substances from aqueous samples*

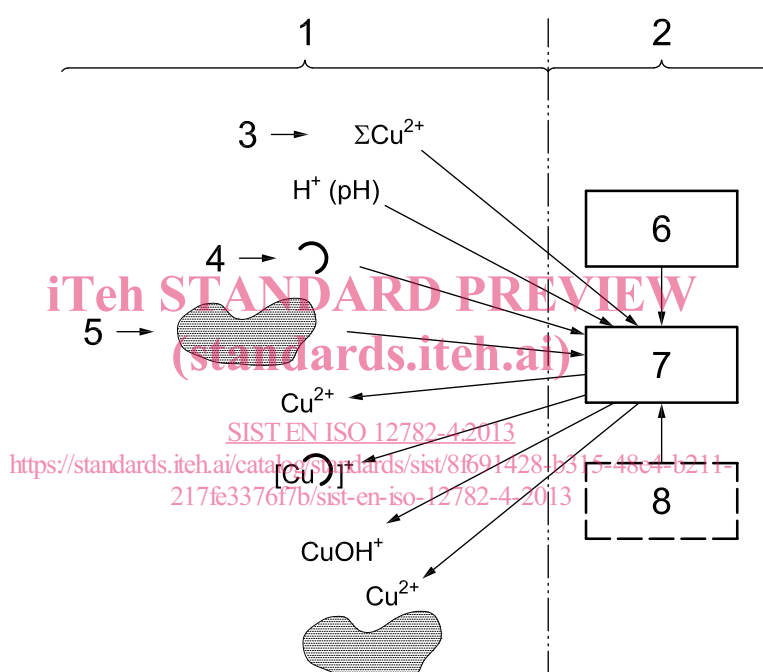
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Introduction

In addition to leaching procedures for subsequent chemical and ecotoxicological testing of soil and other materials including waste, predictive models are becoming indispensable tools in the environmental risk assessment of these materials. Models are particularly required when the results of laboratory leaching tests are to be translated to specific scenarios in the field, with regard to assessing the risks of both contaminant migration and bioavailability.

In the past few years, geochemical models have been shown to be valuable tools to be combined with the data obtained from characterization leaching standards, such as pH-dependence and percolation tests. These models have the advantage of being based on fundamental thermodynamic parameters that have a general validity. In order to enable extrapolation of laboratory leaching data to the mobility and/or bioavailability of a constituent in a specific field scenario, these models require additional input parameters for specific soil properties (see Figure 1).



Key

- 1 experiment
- 2 geochemical speciation modelling
- 3 available metal concentration
- 4 dissolved humic substances
- 5 reactive (solid) surfaces
- 6 database with stability constants
- 7 computer program
- 8 assumptions

Figure 1 — Relationships between experimental data, as obtained from laboratory leaching/extraction tests, and geochemical modelling of the speciation of a heavy metal in the environment (modified after M. Gfeller & R. Schulin, ETH, Zürich)

Characterization leaching standards provide information on the concentrations of the contaminant of interest as a function of, in particular, pH and liquid/solid (L/S) ratio. In addition, a more complete analysis of the leachates also provides information on the major ion composition and dissolved organic carbon (DOC), parameters that are particularly important for the chemical speciation of constituents through processes such as precipitation, complexation and competition for adsorption on reactive mineral and organic surfaces in the soil. As illustrated

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in Figure 1 for the example of copper, geochemical modelling enables calculation of the metal distribution among these different chemical species in the system of interest. This provides necessary information for risk-assessment purposes, as these different chemical forms play distinct roles in the mobility and bioavailability of the metal in the soil. In addition to information obtained from the leaching standards (in their current state of development/definition), two additional types of information are required.

- a) The “available” (sometimes also referred to as “active” or “exchangeable”) concentration of the constituent in the solid phase, as opposed to the total concentration determined by acid destruction of the solid matrix. This “available” concentration can be obtained by leaching at low pH, a condition that can be obtained by extending the pH range in the pH-dependent leaching test (ISO/TS 21268-4) down to $\text{pH} \approx 0,5$ to $\text{pH} \approx 1$.
- b) The concentration of reactive organic and mineral surfaces in the soil, which constitute the major binding (adsorption) sites for most constituents in the soil matrix.

The major reactive surfaces that control the binding of constituents by sorption processes to the soil matrix are particulate organic matter and iron and aluminium (hydr)oxides. It is generally accepted that the reactivity of these mineral and organic surfaces can strongly vary as a function of their specific surface area/crystallinity [iron and aluminium (hydr)oxides] and composition (organic matter). When the results are intended to be used for the above-described purposes of geochemical modelling in conjunction with leaching tests, it is important that the methods be selective for reactive surfaces for which generic thermodynamic adsorption parameters are also available for the most important major and trace elements.

These reactive surfaces have been identified in soils, as well as in a variety of other materials for which the leaching of constituents is of relevance. It has been shown that the binding properties of these surfaces play a generic role in the speciation and leaching of constituents among these different materials. As an example, a similar geochemical modelling approach, using model input from the partial or complete ISO 12782 series, has been successfully applied to different soils^[3], amended soils^{[4][5]}, municipal incinerator bottom ash^[6], steel slag^{[7][8]}, bauxite residues^[9], and recycled concrete aggregate^[10]. Hence, the scope of the ISO 12782 series extends from soils to materials including soil amendments and waste materials.

This part of ISO 12782 aims to determine important reactive organic surfaces in soil and materials, for which generic thermodynamic adsorption parameters exist, i.e. humic and fulvic acids. The procedure is based on Reference [11], while generic thermodynamic adsorption parameters for humic and fulvic acids are available in References [12] and [13].

Thermodynamic parameters for adsorption models other than those used in References [12] and [13] are also available in the literature and may also be used to model the binding of constituents to humic and fulvic acids.

The method^[14] is based on a conventional isolation and purification method^[11] that is also used by the International Humic Substances Society (IHSS).