ILNAS

Institut luxembourgeois de la normalisation
de l'accréditation, de la sécurité et qualité
des produits et services

ILNAS-EN 17505:2023

Soil and waste characterization - Temperature dependent differentiation of total carbon (TOC400, ROC, TIC900)

Caractérisation des sols et des déchets - Différentiation en fonction de la température du carbone total (COT400, COR, CIT900)

Boden- und Abfallbeschaffenheit - Temperaturabhängige Unterscheidung von Gesamtkohlenstoff (TOC400, ROC, TIC900)

10/2023

National Foreword

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EUROPEAN STANDARD
NORME EUROPÉENNE
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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 17505:2023) has been prepared by Technical Committee CEN/TC 444 "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of an identical text or by endorsement, at the latest by April 2024, and conflicting national standards shall be withdrawn at the latest by April 2024.

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Introduction

Carbon occurs in soils and materials similar to soil in a variety of compounds and forms. When determining carbon in soils or soil-like materials, an overall determination of the different mass fractions is most feasible. The summarized declaration of carbon is yet done by differentiating organic and inorganic carbon (EN 15936, ISO 10694). In the proportion classified as “organic carbon”, a fraction of very stable highly aromatic and highly condensed carbon compounds can be present, sometimes in significant mass fractions. Since this black (pyrogenic) carbon is only very slowly decomposed and released, its environmental relevance has to be differently evaluated than the proportions of organic carbon which are faster chemical-biologically decomposed. The environmental relevance is estimated if e.g. the suitability of soils and soil-like materials for disposal in landfill is assessed. For a differentiated assessment, a separate declaration of the different mass fractions of organic, black (pyrogenic) and inorganic carbon is necessary. Using the specified temperature-gradient method and utilizing the combustion characteristic(s), the carbon fractions established according to this standard in soil and soil-like materials can be differentiated.

In respect of the hazard potential, the content of solely organically bonded carbon in solids determined with the described method can be important for disposal and/or recycling.

The method has been validated with the materials listed in Table 1, see also Annex A.

Table 1 — Materials used for validation

Material type	Materials used for validation
soils from natural material	**mineral soils** **soil with anthropogenic admixtures (urban soils)**
tailing material (tailings)	**tailing material from coal mining**
sediment	**sediment**
waste	**waste incineration ash** **foundry sand** **construction waste**

1 Scope

This document specifies a method for the differentiated determination of the organic carbon content (TOC_{400}) which is released at temperatures up to 400 °C, the residual oxidizable carbon (ROC) (including e.g. lignite (brown coal), hard coal, charcoal, black carbon, soot) and the inorganic carbon (TIC_{900}) which is released at temperatures up to 900 °C.

The basis is the dry combustion or decomposition of carbon to CO_2 in the presence of oxygen or non-oxygen conditions using temperatures ranging from 150 °C to 900 °C in dry solid samples of sediment, soil, soil with anthropogenic admixtures and solid waste (see Table 1) with carbon contents of more than 1 g per kg (0,1 % C) (per carbon type in the test portion).

NOTE $TIC_{900'}$ includes the TIC measured after acid addition e.g. by ISO 10694 or EN 15936. TOC_{400} is a fraction of TOC measured according to e.g. ISO 10694 or EN 15936.

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.

EN 16179, *Sludge, treated biowaste and soil - Guidance for sample pretreatment*

EN 15002, *Characterization of waste - Preparation of test portions from the laboratory sample*

ISO 11464, *Soil quality — Pretreatment of samples for physico-chemical analysis*

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 https://www.electropedia.org/

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

3.1
total organic carbon which is released up to 400 °C
TOC_{400}
quantity of carbon which is determined in the range between 150 °C – (400 ± 20) °C to the 1st signal minimum after the minimum holding time at (400 ± 20) °C, in the case of dry combustion in the presence of oxygen

Note 1 to entry: TOC_{400} is a fraction of TOC measured e.g. by ISO 10694 or EN 15936.

3.2
residual oxidizable carbon measured at 600°C
ROC_{600}
quantity of carbon which is determined between the signal minima at (400 ± 20) °C and at (600 ± 20) °C after the minimum holding time at (600 ± 20) °C, in the case of dry combustion in the presence of oxygen following method A (procedure see 8.4)

Note 1 to entry: ROC_{600} may differ from ROC_{900} for some materials

3.3
residual oxidizable carbon measured at 900°C
ROC_{900}
quantity of carbon which is determined during dry combustion in the presence of oxygen after the completed carbon release for the TOC_{400} and TIC_{900B} measurement at (900 ± 20) °C to the first signal minimum after the minimum holding time at (900 ± 20) °C following method B (procedure see 8.5)

Note 1 to entry: ROC_{900} may differ from ROC_{600} for some materials

3.4
total inorganic carbon which is released up to 900 °C in the presence of oxygen
TIC_{900A}
quantity of carbon which is determined between the signal minima at (600 ± 20) °C and at (900 ± 20) °C after the minimum holding time at (900 ± 20) °C, in the case of dry combustion in the presence of oxygen following method A (procedure see 8.4)

Note 1 to entry: TIC_{900A} may differ from TIC_{900B} for some materials

3.5
total inorganic carbon which is released up to 900 °C during non-oxidizing conditions
TIC_{900B}
quantity of carbon which is determined during non-oxidizing conditions between the signal minima at (400 ± 20) °C and at (900 ± 20) °C after expiry of the minimum holding time at (900 ± 20) °C before the ROC_{900B} measurement following method B (procedure see 8.5)

Note 1 to entry: TIC_{900B} may differ from TIC_{900A} for some materials

3.6
total carbon
TC
quantity of carbon present in the sample representing the sum of organic (TOC_{400}), inorganic (TIC_{900A} or TIC_{900B}) and residual oxidizable carbon (ROC_{600} or ROC_{900})

4 Principle

The determination of organic carbon (TOC_{400}), residual oxidizable carbon (ROC_{600} or ROC_{900}) and inorganic carbon (TIC_{900A} or TIC_{900B}) in solids is affected by means of thermal oxidation or decomposition of the different fractions of carbon at different temperatures to CO_2, if necessary, supported by changing between oxidizing and non-oxidizing carrier gases.

The application of the gradient method with a suitable temperature program allows the determination of organic carbon (TOC_{400}), residual oxidizable carbon (ROC) and inorganic carbon (TIC_{900}) and the calculation of total carbon (TC) by sum up these contents.

The final analysis of CO_2 can be performed with different methods, e.g. by means of infrared detection or CO_2 sensitive sensors.

5 Interferences

5.1 Interference due to carbides

Several carbides can interfere with this method.