

DD CEN/TS 16137:2011



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Plastics — Determination of bio-based carbon content

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National foreword

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Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the international organization responsible for its conversion to an international standard. A review of this publication will be initiated not later than 3 years after its publication by the international organization so that a decision can be taken on its status. Notification of the start of the review period will be made in an announcement in the appropriate issue of *Update Standards*.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into an international Standard, to extend the life of the Technical Specification or to withdraw it. Comments should be sent to the Secretary of the responsible BSI Technical Committee at British Standards House, 389 Chiswick High Road, London W4 4AL.

The UK participation in its preparation was entrusted to Technical Committee PRI/-/1, UK co-ordination for international work on plastics.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Amendments issued since publication

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TECHNICAL SPECIFICATION
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CEN/TS 16137

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English Version

Plastics - Determination of bio-based carbon content

Plastiques - Détermination de la teneur en carbone
biosourcé

Kunststoffe - Bestimmung des biobasierten
Kohlenstoffgehalts

This Technical Specification (CEN/TS) was approved by CEN on 20 December 2010 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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Foreword

This document (CEN/TS 16137:2011) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

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Introduction

This Technical Specification specifies the calculation method for the determination of bio-based carbon content in monomers, polymers, plastics materials and products using the ^{14}C method.

This calculation method using the ^{14}C method is based on the well established analytical test methods used for the determination of the age of objects containing carbon.

This Technical Specification provides the reference test methods for laboratories, producers, suppliers and purchasers of bio-based polymer materials and products. It can be also useful for authorities and inspection organizations.

NOTE 1 This Technical Specification is based on EN 15440 [4] prepared by CEN/TC 343, Solid recovered fuels.

NOTE 2 The analytical test methods specified in this Technical Specification are compatible with those described in ASTM D6866 - 10 [9].

1 Scope

This Technical Specification specifies a calculation method for the determination of the bio-based carbon content in monomers, polymers and plastic materials and products, based on the ^{14}C content measurement.

It also specifies three test methods to be used for the determination of the ^{14}C content from which the bio-based carbon content is calculated:

- Method A: Proportional scintillation-counter method (PSM);
- Method B: Beta-ionisation (BI);
- Method C: Accelerator mass spectrometry (AMS).

The bio-based carbon content is expressed by a fraction of sample mass, as a fraction of the total carbon content or as a fraction of the total organic carbon content.

This calculation method is applicable to any polymers containing organic carbon, including biocomposites.

NOTE This Technical Specification does not provide the methodology for the calculation of the biomass content of a sample.

2 Normative references

The following referenced documents are indispensable for the application 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.

CEN/TR 15932:2010, *Plastics — Recommendation for terminology and characterisation of biopolymers and bioplastics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CEN/TR 15932:2010 and the following apply.

3.1

bio-based carbon content

amount of carbon in a sample that is of recent origin, as evidenced by its ^{14}C isotope content

3.2

biomass content

mass fraction of bio-based material in a sample

3.3

organic material

material containing carbon-based compound in which the element carbon is attached to other carbon atoms, hydrogen, oxygen, or other elements in a chain, ring, or three-dimensional structure

3.4

organic carbon

carbon from organic material

3.5

isotope abundance

fraction of atoms of a particular isotope of an element

3.6

percentage modern carbon

pmC

percent modern carbon relative to the N.I.S.T.¹⁾ oxalic acid radiocarbon standard reference material SRM 4990B

NOTE In 1950, the internationally accepted radiocarbon dating reference value is 95 % of this activity of this NBS oxalic acid SRM 4990b. In 2010, the value of 100 % bio-based carbon is set at 105 pmC.

3.7

laboratory sample

sub-quantity of a sample suitable for laboratory tests

3.8

sample

quantity of material, representative of a larger quantity for which the property is to be determined

3.9

sample preparation

actions taken to obtain representative analyses samples or test portions from the original sample

3.10

β particle

electron emitted during radioactive decay

3.11

total carbon

TC

quantity of carbon present in a sample in the form of organic, inorganic and elemental carbon

[EN 13137:2001]

3.12

total organic carbon

TOC

quantity carbon that is converted into carbon dioxide by combustion and which is not liberated as carbon dioxide by acid treatment

[EN 13137:2001]

4 Symbols and abbreviations

4.1 Symbols

C	symbol for element carbon
^{14}C	carbon isotope with an atomic mass of 14
x^{TC}	total carbon content, expressed as a percentage of the mass of the sample
x^{TOC}	total organic carbon content, expressed as a percentage of the mass of the sample
x_{B}	bio-based carbon content by mass, expressed as a percentage of the mass of the sample

1) National Institute of Standards and Technology - Gaithersburg, Maryland, USA.

x_B^{TC} bio-based carbon content by total carbon content, expressed as a percentage of the total carbon content

x_B^{TOC} bio-based carbon content by total organic carbon content, expressed as a percentage of the total organic carbon content

pmC(s) measured value, expressed in pmC, according to AMS method, of the sample

REF reference value, expressed in pmC, of 100 % bio-based carbon depending on the origin of organic carbon

m mass of a sample expressed in grams

4.2 Abbreviations

AMS accelerator mass spectroscopy

BI beta-ionisation

Bq Bequerel (desintegrations per second)

cpm counts per minute

CV coefficient of variation

dpm disintegrations per minute

GM Geiger-Müller

LLD lower limit of detection

LSC liquid scintillation-counter or liquid scintillation-counting

MOP 3-methoxy 1-propyl amine

PE polyethylene

PLA poly(lactic acid)

pmC percentage of modern carbon

PSM proportional scintillation-counter method

TC total carbon

TOC total organic carbon

5 Principle

The ^{14}C present in chemicals is originating from recent atmospheric CO_2 . Due to its radioactive decay, it is almost absent from fossil products older than 20 000 years to 30 000 years. The ^{14}C content may thus be considered as a tracer of chemicals recently synthesized from atmospheric CO_2 and particularly of recently produced bio-products.

The determination of the biomass content is based on the measurement of ^{14}C in bio-based polymers which allows the calculation of the bio-based carbon fraction.