

# DRAFT INTERNATIONAL STANDARD

## ISO/DIS 16620-4

ISO/TC 61/SC 5

Secretariat: DIN

Voting begins on:  
2015-06-15

Voting terminates on:  
2015-09-15

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## Plastics — Biobased content —

### Part 4: Determination of the biobased mass content

*Plastiques — Teneur biosourcée —*

*Partie 4: Détermination de la teneur en masse biosourcée*

ICS: 83.080.01

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Reference number  
ISO/DIS 16620-4:2015(E)

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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 16620-4 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 5, *Physical-chemical properties*.

ISO 16620 consists of the following parts, under the general title *Plastics — Biobased content*:

- *Part 1: General principles*
- *Part 2: Determination of the biobased carbon content*
- *Part 3: Determination of the biobased synthetic polymer content*
- *Part 4: Determination of the biobased mass content*
- *Part 5: Declarations of the biobased carbon content, biobased synthetic polymer content and biobased mass content*

## Introduction

Increased use of biomass resources for manufacturing plastics products is effective for reducing global warming and the depletion of fossil resources.

Current plastics products are composed of biobased synthetic polymers, fossil-based synthetic polymers, natural polymers and additives that can include biobased materials.

"Biobased plastics" refers to plastics that contain materials wholly or partly of biogenic origin.

In this series of International Standards, the "biobased content" of biobased plastics refers to the amount of the biobased carbon content, the amount of the biobased synthetic polymer content or the amount of the biobased mass content, only.

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# Plastics — Biobased content — Part 4: Determination of the biobased mass content

## 1 Scope

This part of ISO 16620 specifies a method of determining the biobased mass content in plastics products, based on the radiocarbon analysis and elemental analysis.

This part of ISO 16620 is applicable to plastic products and plastic materials, polymer resins, monomers or additives, which are made from biobased or fossil-based constituents.

This method is applicable provided that the plastic product contains carbon element and that a statement giving its composition and origin is available.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/DIS 16620-1, *Plastics — Biobased content — Part 1: General principles*

ISO/DIS 16620-2, *Plastics — Biobased content — Part 2: Determination of the biobased carbon content*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/DIS 16620-1 and ISO/DIS 16620-2 and the following apply.

### 3.1

#### formulation

mixing of different constituents (of a product), without any chemical reaction

## 4 Principle

This method, supported by rules described in Clause 5, consists in:

- a) the determination of the biobased carbon content and elemental composition of the product by using the radiocarbon analysis and elemental analysis respectively, and
- b) a comparison between:
  - 1) the data of the statement comprising the composition and the origin of the product, and
  - 2) the data resulting from the radiocarbon analysis and elemental analysis of the product.

NOTE The "statement" in the sense of this document is not to be confused with the "declaration" of the biobased mass content, resulting of this method, which is out of the scope of this part of ISO 16620.

For the purpose of this Part of ISO 16620, two groups of products are distinguished depending on whether they are obtained by chemical synthesis (Group I) or by formulation (Group II).

NOTE As products obtained by formulation can be made from several constituents, sometimes in a great number, the complete method described for Group 1 may be difficult to implement. This is the reason why a simplified method was developed for those products.

## 5 Rules for allocation of elements

### 5.1 Oxygen, hydrogen and nitrogen elements

It is not possible by isotopic measurements to establish a distinction between elements originating from biomass and elements originating from non-biomass, such as oxygen, hydrogen or nitrogen.

Unless otherwise specified in 5.2, the following convention applies:

If oxygen (O) and/or hydrogen (H) and/or nitrogen (N) element(s) is(are) bound to carbon structure derived from biomass, it(their) fraction(s) is(are) considered to be part(s) of the biobased mass content.

### 5.2 Chemical reactions

For products/constituents of products obtained by chemical synthesis, the following rule shall be applied:

- a) if the reactants are exclusively derived from biomass, the biobased mass content of the product/constituent of the product is 100 %;
- b) if none of the reactants is derived from biomass, the biobased mass content of the product/constituent of the product is 0 %, and
- c) if the reactants are derived from both biomass and non-biomass, the standard chemical rules apply for the allocation of the elements of the product/constituent of the product.

EXAMPLE Esters derived from the condensation of an acid with a primary alcohol keep the O element coming from the alcohol.

### 5.3 Natural constituents

This method is not needed for the determination of the biobased mass content in natural constituents (e.g. natural polymers) wholly derived from biomass.

The biobased carbon content and the biobased mass content of a natural constituent are one equal to 100 %.

NOTE This differentiates the calculation of the biobased mass content according to this part of ISO 16620 from the calculation of the biobased synthetic polymer content according to ISO 16620-3, where the natural polymer content is 0 %.

## 6 Statement

### 6.1 Products obtained by chemical synthesis (Group I)

The statement to be provided with the product under consideration shall include:

- a) information related to the production process and the raw materials/chemicals from which the product is made;
- b) a complete elemental composition of the biobased and non-biobased parts of the product, and
- c) the biobased carbon content and biobased mass content of the product, obtained by calculation, using common rules of the stoichiometry and the rules for allocation of elements as defined in Clause 5.

EXAMPLE Polyethylene terephthalate obtained by polycondensation of terephthalic acid from fossil resources with biobased ethylene glycol.



| Fraction                                  | C<br>% | H<br>% | O<br>% | Total<br>% |
|---|--------|--------|--------|------------|
| Fossil fraction (from terephthalic acid)  | 50,0   | 2,1    | 16,6   | 68,7       |
| Bio-based fraction (from ethylene glycol) | 12,5   | 2,1    | 16,6   | 31,2       |
| Total                                     | 62,5   | 4,2    | 33,3   | 100        |

## 6.2 Products obtained by formulation (Group II)

For products obtained by formulation, this method is applicable provided that each of the constituents of the product have been first analysed according to this method and the statement giving the biobased mass content of each constituent has been validated.

The statement to be provided with the product under consideration shall include:

- information related to the production process and the raw materials/chemicals from which the product is made;
- a complete elemental composition of the biobased and non-biomass parts of each constituent of the product;
- the validated biobased carbon content and biobased mass content of each of the constituents of the product;
- the biobased carbon content and the biobased mass content of the product, obtained by calculation according to Annex A and taking into account the rules for allocation of elements as defined in Clause 5.

## 7 Sampling

The samples shall be representative of the product under consideration and the quantity or mass of the samples shall be accurately established.

If available, product sampling procedures for the determination of the biobased carbon content and elemental composition shall be used and the details shall be documented.

For the determination of the biobased mass content, one sample is submitted to testing.

## 8 Procedure, calculation and validation criteria

### 8.1 Products obtained by chemical synthesis (Group I)

#### 8.1.1 Procedure

Determine the biobased carbon content of the sample according to the method specified in ISO/DIS 16620-2.

Determine the contents of carbon, hydrogen, oxygen and/or nitrogen of the sample according to suitable standard analytical methods. If other element(s) is(are) present, its(their) content(s) may be also determined.

For determining the total carbon content and organic carbon content, test methods as described in ISO 10694 [1], ISO 8245 [2], EN 13137 [3], ISO 17247 [4], ISO 15350 [5], ISO 609 [6], ASTM D5291-02 [7] or ASTM E1019-11 [8] may be used, as applicable.

Report the test results on dry basis.