
Plastics — Biobased content —

Part 3:

**Determination of biobased synthetic
polymer content**

Plastiques — Teneur biosourcée —

Partie 3: Détermination de la teneur en polymère synthétique biosourcé

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is 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 biobased carbon content*
- *Part 3: Determination of biobased synthetic polymer content*

The following parts are under preparation:

- *Part 4: Determination of the biobased mass content*
- *Part 5: Declaration of biobased carbon content, biobased synthetic polymer content and biobased mass content*

Introduction

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

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

Biobased plastics refer 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 3:

Determination of biobased synthetic polymer content

WARNING — The use of this part of ISO 16620 can involve hazardous materials, operations, and equipment. This part of ISO 16620 does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this part of ISO 16620 to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This part of ISO 16620 specifies the method of determining the amounts of biobased part in the biobased synthetic polymer in plastics products. This calculation method for biobased synthetic polymer content is based on the mass of biobased synthetic polymer in the plastics products.

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.

Knowing the biobased content of plastic products is useful when evaluating their environmental impact.

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

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

3 Terms, definitions, and symbols

3.1 Terms and definitions

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

3.2 Symbols

For the purposes of this document, the symbols given in ISO 16620-1 and the following apply.

W_n mass composition of n constituent of the product;

$m_{\text{BSP},n}$ biobased synthetic polymer content of n constituent of the product;

$x_{\text{B},n}$ biobased carbon content of n constituent of the product.

4 Principle

The indication of biomass used in plastic products is a practical way to assess efforts to develop wholly or partly biobased synthetic polymers. It also helps consumers to understand and compare relative contributions to environmental protection.

This part of ISO 16620 provides a method for the measurement of the biobased synthetic polymer content, derived from biomass resources.

The biobased synthetic polymer content of a plastic item can be calculated from the composition of the plastic, stated as a list of constituents with their percentage by mass, and from the biobased synthetic polymer content of said constituents (see, for examples, [Annex A](#), [Table A.1](#), and [Table A.2](#)).

Only synthetic polymers are eligible to be considered in this calculation, when they are wholly or partly biobased. Natural polymers and any biobased additive are not included in the biobased synthetic polymer content.

5 Procedure

The compositions of biobased synthetic polymers provided by a manufacturer can be used to determine the biobased synthetic polymer content of plastic products.

6 Calculation and expression of results

6.1 Biobased carbon content

The biobased carbon content of each biobased synthetic polymer constituent of a product shall be calculated from the C¹⁴ analysis as described in ISO 16620-2.

6.2 Biobased synthetic polymer content

The biobased synthetic polymer content of a constituent A, $m_{BSP,A}$ is 100 %, where this constituent is a wholly biobased synthetic polymer. If the constituent is a partly biobased synthetic polymer, $m_{BSP,A}$ is the mass fraction of the biobased unit which is wholly biobased in this constituent (see [Annex A](#)). The $m_{BSP,n}$ is 0 %, where the constituent is an additive, native natural polymer, or fossil-based polymer.

Compositions and biobased synthetic polymer contents are shown in [Table 1](#).

Table 1 — Composition, biobased synthetic polymer content in a product

Constituent	Dry mass fraction %	Biobased synthetic polymer content %	Biobased carbon content %
Biobased synthetic polymer	W_A	$m_{BSP,A}$	$x_{B,A}$
Fossil-based synthetic polymer	W_B	0	0
Natural polymer	W_C	0	100
Biobased additive	W_D	0	$x_{B,D}$
Fossil-based additive	W_E	0	0
Inorganic additive	W_F	0	0
Product (total)	100	m_{BSP}	x_B^{TOC}

The biobased synthetic polymer content in a product shall be calculated using Formula (1) (see [Annex A](#)).

The biobased synthetic polymer content is expressed as a percentage of mass.

$$m_{\text{BSP}} = \frac{W_{\text{A}} \times m_{\text{BSP,A}}}{100} \quad (1)$$

where

W_{A} is the % by mass of constituent A, “biobased synthetic polymer”, used in the product;

$m_{\text{BSP,A}}$ is the biobased synthetic polymer content of constituent A.

7 Test Report

The test report shall provide all pertinent information, and specifically the following:

- a) a reference to this International Standard, i.e. ISO 16620-3:2015;
- b) a report on the experimentally determined biobased carbon content for each of the biobased synthetic polymer;
- c) a report on the formula/composition (elemental analysis) of each constituent in the biobased synthetic polymer;
- d) a calculation of the biobased synthetic polymer content, expressed as a percentage of total mass of the product.

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Annex A (informative)

Example of calculations of biobased synthetic polymer content

Biobased synthetic polymers include biobased carbon atoms instead of fossil carbon atoms. Sometimes, it is convenient for customers to define the biobased content in products as a percentage of mass. Examples of the calculation of biobased synthetic polymer content for a composite and a copolymer are shown in [Table A.1](#) and [Table A.2](#). The composite consists of polylactic acid (PLA) as a biobased synthetic polymer, polypropylene as a fossil-based synthetic polymer, starch as a biobased additive, dibutyl phthalate, and calcium carbonate.

Table A.1 — Example of calculation of the biobased synthetic polymer content of a product

Constituent	Chemical formula	Dry mass fraction	Biobased synthetic polymer content
		%	m_{BSP} %
PLA ^a	C ₃ H ₄ O ₂	30	100
PP ^b	C ₃ H ₆	30	0
Starch	C ₆ H ₁₀ O ₅	20	0
DBP ^c	C ₁₆ H ₂₂ O ₄	5	0
Calcium carbonate	CaCO ₃	15	0
Product (Total)		100	30
^a Poly(lactic acid). ^b Polypropylene. ^c Dibutyl phthalate.			

The biobased synthetic polymer content is defined as the mass percent of the biobased synthetic polymer in a product. In [Table A.1](#), the biobased synthetic polymer is only PLA; therefore, the mass percent of PLA, 30%, is the biobased synthetic polymer content.

An example of a partly biobased synthetic polymer of poly(ethylene terephthalate) in which the ethylene glycol unit of the polymer is biobased and the terephthalate unit is fossil-based is shown in [Table A.2](#).

Table A.2 — Example of calculation of the biobased synthetic polymer content of a copolymer

Monomer unit	Chemical formula	Molecular weight	Dry mass fraction	Biobased synthetic polymer content
		g	%	m_{BSP} %
ethylene glycol	C ₂ H ₄ O ₂	60	31,25	100
Terephthalate	C ₈ H ₄ O ₂	132	68,75	0
Copolymer (Total)		192	100	31,25
Poly(ethylene terephthalate): $\{ \{ \text{O}-\text{CH}_2-\text{CH}_2-\text{O} \} \{ \text{CO}-\text{C}_6\text{H}_4-\text{CO} \} \}_n$				

An example of the biobased synthetic polymer of product including PLA, bio-PET as shown in [Table A.2](#), PP, starch, DBP, and calcium carbonate is shown in [Table A.3](#).

Table A.3 — Example of calculation of the biobased synthetic polymer content of a product

Constituent	Chemical formula	Dry mass fraction %	Biobased synthetic polymer content m_{BSP} %
PLA ^a	C ₃ H ₄ O ₂	30	100
Bio-PET	-d	20	31,25 ^e
PP ^b	C ₃ H ₆	10	0
Starch	C ₆ H ₁₀ O ₅	20	0
DBP ^c	C ₁₆ H ₂₂ O ₄	5	0
Calcium carbonate	CaCO ₃	15	0
Product (Total)		100	36,25 ^f
a	Poly(lactic acid).		
b	Polypropylene.		
c	Dibutyl phtalate.		
d	Bio-PET [Poly(ethylene terephthalate)]: $\{[O-CH_2-CH_2-O]-(CO-C_6H_4-CO)\}_n$.		
e	This value was calculated based on Table A.2 .		
f	The biobased synthetic polymer content = $30 + (20 \times 31,25) / 100$ (%).		

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