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Plastics - Biobased content - Part 1: General principles

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1 Scope

This Standard specifies general principles and calculation methods for the determination of biobased content in plastic products. This calculation is based on the mass of carbon or the mass of each component in the plastic product.

This Standard applies to plastic products, plastic materials, polymer resins, monomers or additives made from biobased and/or fossil-based components.

Determining the biobased content of plastic products can help assess their environmental impact.

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.

ISO 472, Plastics - Vocabulary

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

ISO 16620-3, Plastics - Biobased content - Part 3: Determination of biobased synthetic polymer content

ISO 16620-4, Plastics - Biobased content - Part 4: Determination of biobased mass content

3.1 Terms and definitions

The terms and definitions defined in ISO 472 and the following ones apply to this document.

3.1.1 biobased carbon content

the carbon content of the product derived from biomass

NOTE: The content of biobased carbon is expressed by the mass percentage of the specimen, such as the percentage of total carbon content, or the percentage of total organic carbon content.

3.1.2 biomass

materials of biological origin, excluding mineral and/or fossil materials

3.1.3 synthetic polymer

polymers obtained by chemical and/or bioindustrial processes

3.1.4 biobased synthetic polymer

polymers obtained by chemical and/or bioindustrial processes, the raw materials of which are wholly or partly derived from biomass

NOTE: Natural polymers (see 3.1.7) are not biobased synthetic polymers.

3.1.5 biobased synthetic polymer content; mBSP

the content of biobased synthetic polymers in the product

NOTE: The content of biobased synthetic polymer in the product is expressed as the percentage or fraction of the mass of biobased synthetic polymer and the total mass of the product.

3.1.6 carbon content

carbon content in a component, material or product, expressed as a mass percent

3.1.7 natural polymer

a polymer obtained from biomass, where the polymer retains the original chemical structure and components in the biomass Example: Starch, cellulose, lignin or lignocellulose.

3.1.8 product

a resin, material, article or article resulting from a manufacturing process

NOTE: Products can be materials, semi-finished products or final products, such as polyethylene resins obtained from petroleum or biomass, biobased PE films, PET resins, PET bottles, monomers and plasticizers.

3.1.9 total carbon; TC

the total amount of carbon present in the specimen in the form of organic carbon, inorganic carbon and elemental carbon

3.1.10 total organic carbon; TOC

the amount of carbon converted to carbon dioxide by combustion, excluding the amount of carbon released by acid treatment

3.1.11 biobased mass content; mB

the total amount of biobased synthetic polymers, natural polymers, and biobased additives in the product

NOTE: The total content of biobased substances in the product is expressed in terms of the mass percentage or fraction of biobased synthetic polymers, natural polymers and biobased additives relative to the total mass of the product.

3.2 Symbols

: The percentage of biobased carbon content relative to the total carbon content.

: The percentage of biobased carbon content relative to the total organic carbon content.

M_x - The carbon mass of component x.

W_x - The mass of component x.

4 Principle

As shown in Figure 1a), plastic products usually contain the following six categories of components:

- a) Biobased synthetic polymers (component A) and fossil-based synthetic polymers (component B);
- b) Natural polymer (component C);
- c) Biobased additives (organic and/or inorganic) (component D), fossil-based organic additives (component E) and inorganic additives (component F).

In ISO 16620, additives also include fillers.

The biobased content of plastic products can be divided into the following categories:

1) Biobased carbon content [see Figure 1 b1), Figure 1 b2), see 5.1 for the calculation method]. The biobased carbon content in Part 2 of ISO 16620 can be expressed as the mass percentage of biobased carbon relative to total organic carbon , or the mass percentage of biobased carbon relative to total carbon ratio . In plastic products, inorganic compounds such as calcium carbonate are added for D - Biobased additive (organic and inorganic);

E - Fossil-based additive;

F - Non-biobased inorganic additive;

M1 - Biobased carbon;

M2 - Fossil-based carbon;

M3 - Inorganic carbon;

W1 - Biobased synthetic polymer;

W2 - Biobased part of biobased synthetic polymer;

W3 - Biobased component;

W4 - Biobased part of biobased component.

Figure 1 -- Biobased content of plastic products (continued)

5.1.1.1 When biobased components in the product are completely biobased

The biobased carbon content, that is, the amount of carbon from biomass sources [see Figure 1 b1)], expressed as a percentage relative to total organic carbon, is calculated via formula (1).

Where, MA, MB, MC, MD, ME - Carbon mass of components A, B, C, D and E.

The carbon mass in the inorganic additive MF is not considered in formula (1).

ISO 16620-2 gives a method for determining the biobased carbon content of products whose biobased components are derived entirely from biomass.

5.1.1.2 When biobased components in the product are partially biobased

If biobased synthetic polymers and/or biobased additives are partially biobased [see Figure 1 b2)], the biobased carbon content (as a percentage of total organic carbon) is calculated via formula (2).

Where, MA1, MD1 - Biobased carbon mass in components A and D;

MA, MB, MC, MD, ME - Carbon mass of components A, B, C, D and E.