OK biobased : from ASTM D6866 to EN 16640

Information Document 531 (EN) – 19.12

1. Introduction

The first OK biobased® certificates were issued in December 2009.
At the time, the only standard dealing with the biobased origin of a product was the American ASTM D6866 standard, published in 2006. Several standards now exist, both at European and international level. It is therefore time to update our certification system.

2. Two main approaches and some subtilities

When dealing with the bio-based origin of products, two approaches are used:

- the bio-based (biomass) content,
- the bio-based carbon content

Each approach has its own particularities with, depending on the context, its advantages and disadvantages.
OK biobased® has been developed in the "biobased carbon content" approach, focusing on the origin of carbon, while another certification scheme is based on the "biobased/ biomass content", taking into account, in addition to carbon, nitrogen, oxygen and hydrogen.

The differences are explained in another note published by TÜV AUSTRIA (see note 536 "*Bio-based content vs bio-based carbon content*").
The "biobased carbon content" approach, which therefore focuses on the origin of carbon, itself has two variants, depending on whether only organic carbon (TOC) or all carbon (organic and inorganic) (TC) is taken into account; i. e. whether or not carbonates are taken into account.

The American committee that developed the ASTM D6866 standard, based on the principle that the primary focus is on reducing CO2 emissions from fossil (organic) sources, chose to express the bio-based carbon content as a percentage of the organic carbon present in the targeted product.

A few years later, Europeans chose to express bio-based carbon as the percentage of total carbon present in a product for different reasons.

It must be recognized that most of the products we have certified are not affected by this difference due to the absence (or marginal presence) of carbonates.

3. Definitions and symbols

This results in several definitions and symbols:

m_B : bio-based content or biomass content, expressed as a percentage of the **total mass** of sample

X_B : bio-based carbon content by **mass**, expressed as a percentage of the mass of the sample (dry)

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

4. And several standards

Each approach has its own test standard, American, European or international:

ASTM D6866 – Standard test method for determining the **biobased (*carbon*) content** of solid, liquid and gaseous samples using radiocarbon analysis

EN 16640 - Bio-based products - Bio-based carbon content - Determination of **the bio-based carbon content** using the radiocarbon method

EN 16785-1 - Bio-based products - Bio-based content - Part 1: Determination of the **bio-based content** using the radiocarbon analysis and elemental analysis

ISO 16620-2 - Plastics - Biobased content – Part 2: Determination of the **biobased carbon content**

ISO 16620-4 - Plastics - Biobased content – Part 4: Determination of the **biobased mass content**

The test methods are similar, but the way the results are expressed differs from one standard to another.

5. OK biobased® and its stars

To facilitate consumer understanding, we have opted for star identification, from 1 to 4, depending on the percentage of bio-based carbon (X_B^{TOC}) measured.

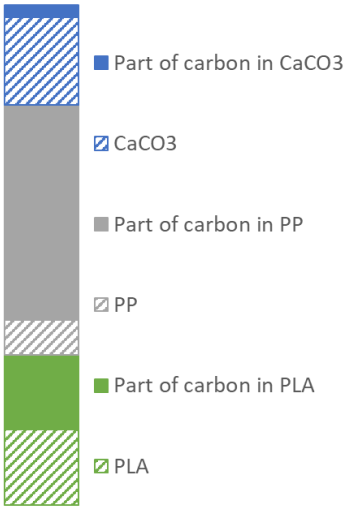
Depending on the certified products (resins, components or intermediate components or finished products), the precise value of the bio-based carbon content is determined or simply the class (i.e. the number of stars), without specifying the X_B^{TOC}.

The emergence of certain legislations imposing bio-based content, within the meaning of EN 16640 and not ASTM, leads us to slightly revise our approach, 10 years after the first certificates.

We will therefore gradually move from ASTM D6866 / organic carbon to the European standard EN 16640 / total carbon.
This transition will obviously have some consequences on the measured values and therefore on the stars.

6. Effect on a partially bio-based product

Let's take the example of a product "A" of 10 gr and composed of 3 components:



- 30% PLA, fully bio-based (green)
- 50% PP of fossil origin (grey)
- 20% inorganic filler, e. g. $CaCO_3$ (blue)

As indicated in the table below and as a reminder, PLA is composed of 50% organic carbon, PP is 86% and carbon - inorganic - represents 12% of $CaCO_3$.

Carbon therefore represents 60.4% of the weight of product A.

	weight	X^{TOC}	X^{TIC}	X^{TC}	Carbon by weight
PLA	3 gr	50 %	0 %	50 %	1,50 gr
PP	5 gr	86 %	0 %	86 %	4,30 gr
$CaCO_3$	2 gr	0 %	12 %	12 %	0,24 gr
Product A	10 gr	58 %	2,4 %	60,4 %	6,04 gr

The bio-based content, m_B, of product "A" is therefore worth 3 gr / 10 gr = **30%**. See also note 536.

The biobased carbon content, X^{TOC}_B, measured according to the American approach, is therefore worth:
1.50 / (1.50 + 4.30) = **25.9%.**

The biobased carbon content, X_B^{TC}, measured according to the European approach, is:
1.50 / (1.50 + 4.30 + 0.24) = **24.8%**.

In most cases, the $X_B^{TC} = X_B^{TOC}$. Only in a few cases, when the product has a significant amount of inorganic carbon, the X_B^{TC} will be lower[1].

7. Effects on certificates and classes

Different cases can occur:

(a) New certificates
Issued in accordance with EN 16640:

- Determination of the biobased carbon content X_B^{TC} according to EN 16640
- As an option, reference to the ASTM D6866 can also be indicated on the certificate.
- Stars are determined on the basis of the X_B^{TC}

(b) Prolongations of expired certificates
Issued in accordance with the new EN 16640 approach:

- The previous X_B^{TOC} values are converted to X_B^{TC}
- As an option, reference to the ASTM D6866 can also be indicated on the certificate.
- Stars are determined on the basis of the X_B^{TC}

(c) Extension of existing certificates
following a technical or administrative change

Two situations are possible:

- The certificate holder wishes to keep the old approach (ASTM D6866) until the certificate expires:
  - The previous X_B^{TOC} values are kept
  - Stars are determined on the basis of X_B^{TOC}
- The holder decides to move directly to the new EN 16640 approach:
  - The previous X_B^{TOC} values are converted to X_B^{TC}
  - As an option, the old X_B^{TOC} values can also be indicated on the certificate.
  - Stars are determined on the basis of the X_B^{TC}

There will therefore be, during a transitional period, two different ways of determining the number of stars.
The differences, almost systematically decreasing, will however affect a limited number of certificates[2].

[1] Except in the case of renewable inorganic carbon

[2] Only in case of significant presence of $CaCO_3$ for example.