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Wood and wood-based products — Calculation of the biogenic carbon content of wood and conversion to carbon dioxide

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The UK participation in its preparation was entrusted to Technical Committee B/543, Round and sawn timber.

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

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Holz und Holzprodukte - Berechnung des biogenen Kohlenstoffgehalts im Holz und Umrechnung in Kohlenstoffdioxid

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Foreword

This document (EN 16449:2014) has been prepared by Technical Committee CEN/TC 175 “Round and sawm timber”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2014, and conflicting national standards shall be withdrawn at the latest by September 2014.

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Introduction

By the process of photosynthesis, growing trees absorb (sequester) atmospheric carbon dioxide which is then, together with the release of some of the oxygen back into the atmosphere, incorporated, within the cambium, into the cells of the tree as both wood and bark.

The absorbed carbon dioxide is effectively fixed in the wood as biogenic carbon. When using wood, that biogenic carbon is transferred to the product system. Wood products therefore constitute a pool (reservoir) of biogenic carbon for the duration of their service lifetime as those products. At end-of-life, that carbon leaves the product system; in the case of use for energy generation the biogenic carbon is oxidized to carbon dioxide and released back into the atmosphere.

This European Standard provides a calculation method to quantify the amount of atmospheric carbon dioxide based on that biogenic carbon content.

The information can also be used to estimate the potential benefits associated with carbon storage in wood and wood-based products; for example, by building designers in the early stages of the building design process. It also provides the basis for that information as required by product category rules and the development of EPDs.

EN 16485, *Round and sawn timber - Environmental Product Declarations - Product category rules for wood and wood-based products for use in construction*, addresses the aspects of wood and wood-based products as required for life-cycle assessment.

This European Standard can also be used in the context of the work of other CEN committees, e.g. CEN/TC 112, CEN/TC 124, CEN/TC 350 and CEN/TC 411.

1 Scope

This European Standard provides a calculation method to quantify the amount of atmospheric carbon dioxide based on the biogenic carbon content of wood.

2 Normative references

Not applicable.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
moisture content
mass of moisture in wood expressed as a percentage of its oven-dry mass

[SOURCE: EN 844-4:1997]

4 Wood – the basic material

Wood, depending on the tree species, comprises, in varying amounts, cellulose (40 % to 55 %), hemi-cellulose (12 % to 15 %), lignin (15 % to 30 %) and extractives (2 % to 15 %). From that it is determined that wood is, by weight, 50 % carbon. For the purpose of this European Standard, the value of the carbon fraction of woody biomass is taken as 0,5. The other main elemental constituents are oxygen (44 %) and hydrogen (6 %). Some species also contain small amounts of mineral deposits which are of no significance in this instance.

Trees and wood also contain moisture in various forms and in various amounts. Wood will generally be dried down to moisture contents commensurate with end use. The moisture content of some wood-based products will be commensurate with the manufacturing process.

The amount of moisture in wood has a bearing on both size and density; as moisture is removed wood shrinks and density decreases. As the amount of absorbed carbon dioxide is being determined based on the given volume and density of wood and wood-based products being used, the moisture content of the wood at that time will also be required.

NOTE EN 350-2, *Durability of wood and wood-based products - Natural durability of solid wood - Part 2: Guide to natural durability and treatability of selected wood species of importance in Europe*, provides density values at 12 % moisture content for the listed species.

12 % is commonly used as the reference moisture content when determining the properties of wood; in the absence of more specific product details, 12 % moisture content and the density values as provided in EN 350-2 may be used as default values.

5 Calculating carbon dioxide based on biogenic carbon content

The calculation is based on the atomic weights of carbon (12) and carbon dioxide (44).

Based on the product biogenic carbon content and the volume of wood, density and moisture content the following formula shall be used:

$$P_{CO_2} = \frac{44}{12} \times cf \times \frac{\rho_\omega \times V_\omega}{1 + \frac{\omega}{100}} \quad (1)$$

where

P_{CO2} is the biogenic carbon oxidized as carbon dioxide emission from the product system into the atmosphere (e.g. energy use at the end-of-life) (kg);

cf is the carbon fraction of woody biomass (oven dry mass), 0,5 as the default value;

ω is the moisture content of the product (e.g. 12 (%));

ρ_{ω} is the density of woody biomass of the product at that moisture content (kg/m^3);

V_{ω} is the volume of the solid wood product at that moisture content (m^3).

For wood-based products, wood volume content V_{ω} = VP x percentage of wood.

VP is the gross volume of the wood-based product.

A calculation example is provided in Annex A.

Annex A
(informative)

Formula (1), Calculation example

Consider 25 m^3 of European whitewood incorporated into a building as glulam or cross-laminated timber – from EN 350-2 the density value of European whitewood at 12 % moisture content is 460 kg/m^3. Using Formula (1), atmospheric carbon dioxide based on biogenic carbon content of, say, 95 % of the total volume by way of allowance for the glue content, amounts to 17 883 kg.

$$P_{CO_2} = \frac{44}{12} \times 0,5 \times \frac{460 \times 25 \times 0,95}{1 + \frac{12}{100}} = 17\,883 \text{ kg } CO_2 \quad \text{(A.1)}$$

In any situation, if the precise moisture content of the wood and wood products is uncertain, a higher moisture content for a given volume of wood will provide a more conservative estimation of carbon dioxide.

For any project, estimation of the total amount of carbon dioxide is determined by quantifying the volume of wood of each species used in each wood and wood-based product in each application and applying the above calculation in each case, (i.e. $P1co_2$ + $P2co_2$, etc.).

Bibliography

[1] EN 350-2:1994, *Durability of wood and wood-based products - Natural durability of solid wood - Part 2: Guide to natural durability and treatability of selected wood species of importance in Europe*

[2] EN 844-4:1997, *Round and sawn timber - Terminology - Part 4: Terms relating to moisture content*

[3] EN 16485, *Round and sawn timber - Environmental Product Declarations - Product category rules for wood and wood-based products for use in construction*

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