

ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	Cembrit Holding A/S
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-CEM-20160114-IAD1-EN
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Valid to	01/12/2022

Corrugated sheets Cembrit Holding A/S

www.bau-umwelt.com / <https://epd-online.com>



1. General Information

<p>Cembrit Holding A/S</p> <p>Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany</p> <hr/> <p>Declaration number EPD-CEM-20160114-IAD1-EN</p> <hr/> <p>This Declaration is based on the Product Category Rules: Fibre cement / Fibre concrete, 07.2014 (PCR tested and approved by the SVR)</p> <hr/> <p>Issue date 02/12/2016</p> <hr/> <p>Valid to 01/12/2022</p> <hr/> <p></p> <hr/> <p>Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)</p> <hr/> <p></p> <hr/> <p>Dr. Burkhard Lehmann (Managing Director IBU)</p>	<p>Fibre Cement Corrugated Sheets</p> <hr/> <p>Owner of the Declaration Cembrit Holding A/S Sohngaardsholmsvej 2, PO Box 750 9100 Aalborg Denmark</p> <hr/> <p>Declared product / Declared unit 1 ton fibre cement corrugated sheets</p> <hr/> <p>Scope: The corrugated sheet roof covering is produced by Cembrit at two manufacturing sites in Trzemeszno, Poland and Sumperk, Czech Republic. Results declared in this EPD represent the average of both sites weighted by their respective annual production output (mass). The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.</p> <hr/> <p>Verification</p> <p>The CEN Norm /EN 15804/ serves as the core PCR</p> <p>Independent verification of the declaration according to /ISO 14025/</p> <p><input type="checkbox"/> internally <input checked="" type="checkbox"/> externally</p> <hr/> <p></p> <hr/> <p>Dipl. Natw. ETH Sascha Iqbal (Independent verifier appointed by SVR)</p>
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2. Product

2.1 Product description

The products are corrugated sheets in fibre cement. The sheets are commonly provided with a water-based coating but some products are provided uncoated. The declaration includes all coated and uncoated products. Finishing accessories such as ridges and ventilation outlets are available in fibre cement or plastic.

2.2 Application

Cembrit corrugated sheets are intended for installation as roofing and/or cladding on wooden or metal sub constructions.

2.3 Technical Data

The data listed in the DoP apply.

Constructional data

Name	Value	Unit
Thermal conductivity	0.4	W/(mK)
Gross density	1480 - 1700	kg/m ³
Moisture content at 23 °C, 80% humidity	11	M.-%
Coefficient of thermal expansion	10	10 ⁻⁶ K ⁻¹
Min. breaking load	2000-4250	N/m
Min. breaking moment	30-55	Nm/m
Water vapour permeability	10	mmHg*hr* m ² /g
Moisture expansion	0	mm/m

2.4 Placing on the market / Application rules

For the placing on the market in the EU/EFTA (with the exception of Switzerland) the Regulation (EU) No 305/2011 applies. The product needs a Declaration of Performance (DoP) taking into consideration /EN 494:2012+A1:2015

Fibre-cement profiled sheets and fittings — Product specification and test methods /and the CE-marking.

For the application and use the respective national provisions apply.

- Approval by /DIBt, Zulassung Z-31.1-196/
Approval by /CSTB Institute 091-L2-14/
(Sumperk, CZ)
- /BBA Certificate Number 03/4049/ Product Sheet 1 (Cembonit range) and Product sheet 2 (Cemsix range)
- Approval by /INTRON, Certificate CTG 480/5/(Sumperk, CZ)

2.5 Delivery status

Width x length x thickness (max 1150 x 3050 x 6.5 mm) depending on type. With or without pre-punched holes and cut corners. Specific dimensions can be obtained on local Cembrit websites. Cembrit corrugated sheets are delivered in natural grey and coated versions in various colours with a smooth and even surface.

2.6 Base materials / Ancillary materials

Name	Value	Unit
Portland cement (CEM I+II)	71 - 83.2	%
Inert filler (lime, mica, silica)	10	%
Cellulose	3 - 5	%
Polyvinyl alcohol (PVA)	1.8 - 2	%
Pozzolanic filler (cenospheres from fly ash)	0 - 6	%
Acrylic emulsion	0.8	%
Antiblock	0.1 - 0.2	%
Iron oxide pigment	0 - 0.2	%
Paint primer	<0.1	%
Mould oil	<0.05	%

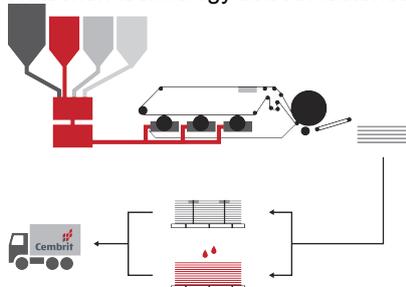
Due to chemically bond water (12.5%), only approx. 840 kg of material is used for 1 ton of product. Coatings (manufactured or bought in) are water-based acrylic and use mainly iron oxide pigments. The products do not contain any SVHCs according to REACH declarations from material suppliers and backwards in the entire production chain.

Material explanation

- Portland Cement: Manufactured according to /DIN EN 197-1/ from limestone, marl and sand. The material is crushed, dried, calcinated to clinker and ground to cement.
- Inert filler: a filler to optimize deformation properties and material bonding.
- Cellulose Fibres (0.5-3mm): To assure collection of powder during filtration. Sourced from FSC sources.
- PVA fibres (4-6mm): Synthetic Polyvinyl-Alcohol fibre used as reinforcement.
- Pozzolanic filler: Cenospheres from fly ash used for improving product performance.

2.7 Manufacture

Cembrit corrugated sheets are manufactured with Hatschek technology at both factories.



A very thin slurry of water, binder and fibres is mixed and introduced into each of the vats of the Hatschek machine. The rotating sieve cylinder in the vats collects a thin layer of solid material that is further dewatered as it is transferred to a felt and further on to an accumulating format roller. At the required thickness, the accumulated layers are automatically

cut into the required product size, corrugated, and transferred into the pre-curing area, and waste is returned to the manufacturing process. After pre-curing, the products are stored under continued control of temperature and humidity. Cembrit corrugated sheets are delivered in natural grey and coated versions in various colours with a smooth and even surface. The backside has an anti-blocking treatment.

2.8 Environment and health during manufacturing

Dust developing during the processing can cause a slight alkaline reaction (pH » 12) but can be avoided with standard dust extractors.

The sites operate an environmental management system certified according to /ISO 14001:2004/:

- Bureau Veritas Certification Czech Republik s.r.o., Certificate No. 11000072
- Bureau Veritas Certification Poland, Certificate No. PL11000074/P.

2.9 Product processing/Installation

Corrugated sheets are used for covering roofs of different shapes and pitches and as exterior wall cladding. The sheets can be delivered with or without pre-punched holes and cut corners. When cutting, sufficient protection against dust must be ensured. E.g. Festool dust extractor CTH26E is able to handle dust with MAC values < 0.1 mg/m³. According to German regulation /TRGS 900/ the limit for general dust is 6 mg/m³. Additional products necessary (screws, join strip, bird blocks etc.) are not the subject of this declaration.

2.10 Packaging

PE film and wooden pallets are used as packaging materials. Polyethylene foils can be recycled locally and reusable pallets can be returned to the building material suppliers.

2.11 Condition of use

Free lime from the cement reacts with carbon dioxide from the surrounding air over long time periods to form calcium carbonate (carbonation). The coating materials are bound as solids due to the hot coating in the use stage. The water used in coatings evaporates.

2.12 Environment and health during use

Hazards to water, air and soil will not arise from fibre cement as tested to the Dutch Soil Decree /BRL 5071/.

2.13 Reference service life

Reference service life is optional for a cradle-to-gate EPD and is not declared.

2.14 Extraordinary effects

Fire

Corrugated sheets are classified as non-combustible/ fire class A according to:

- /PAVUS/ a.s., test report
- /Building Research Institute/
- /EN 13501-1/ classified A1.
- /DIN 4102/, part 1 classified A2-s1, d0
- /MPA Hannover/
- /Building Research Institute/

Fumes classification according to /EN 13501-2001-02/: Smoke production "s1".

Water

No relevant information

Mechanical destruction

No relevant information

2.15 Re-use phase

Undamaged sheets can be directly reused.

The sheets can be re-pulverized and used as additive in the production of fibre cement or can be used e.g. in road construction or anti-noise barriers.

2.16 Disposal

Fibre cement can be deposited without pre-treatment. Waste: 170101 in European Waste Catalogue /EWC/.

2.17 Further information

Please contact info@cembrit.com

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit and conversion factor are listed in the table below.

Name	Value	Unit
Declared unit	1	t
Gross density	1590	kg/m ³
Conversion factor to 1 kg	0.001	-

3.2 System boundary

The following processes were included in the A1-A3 production stage of the Cembrit corrugated sheets:

- A1: Manufacture of preliminary products (Cement, fillers, cellulose, PVA fibre, pigments, coatings and water)
- A2: Transport of raw materials and packaging
- A3: Manufacturing process in the plant including energy, water, disposal and process emissions
- A3: Manufacture of packaging

3.3 Estimates and assumptions

The following dataset approximations were chosen from the /GaBi database/:

- Burning of LPG: thermal energy from propane
- Virgin cellulose: Kraftliner (Brown)
- Mica: kaolin
- Silicate dust: Silica fume (ferro-silicium)
- Back coat, Acrylic paint, Primer and paint pigments: Water-borne paint, industry black

The weight of the any coated or uncoated fibre cement products is assumed identical.

3.4 Cut-off criteria

All significant inputs to mass or energy (>1%) have been considered, i.e. all raw material, pre-products,

and energy consumptions. Cutoffs are estimated to be less than 2% in total. All significant outputs (>1% per impact) are included. Machines, facilities and other capital goods are excluded. Packaging for incoming raw material (0.08% of the product mass) has been excluded.

3.5 Background data

Background data is taken from the /GaBi 6 software/, see www.gabi-software.com/databases/

3.6 Data quality

The input data for raw material production and the consumption of process energy is measured data acquired directly from the sites. Data was checked for plausibility and can be classified as being good. Background data was taken from thinkstep's GaBi database 2015. The GaBi electricity grid mix relates to 2011 data from the International Energy Agency and considered of good data quality. More information at <http://documentation.gabi-software.com/>.

3.7 Period under review

The input data for raw material production and the consumption of process energy on the manufacturing site is annual data from 2014.

3.8 Allocation

Electricity and thermal energy recovery from waste incineration is looped back into module A3 to offset input of primary energy. A closed loop recycling of fibre cement material is not modelled. The factory outputs are near identical in terms of material, mass and value, and no allocation has been applied.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account.

4. LCA: Scenarios and additional technical information

Modules A4-A5 and module B, C and D are not declared. Packaging from A3 to be disposed of at installation is listed as A5 below although excluded from the results.

Name	Value	Unit
Wood pallets	12.4	kg
Cardboard boxes	0.37	kg
Paper inserts	0.53	kg

Polyethylene (PE) foil	0.38	kg
PET straps	0.22	kg
Polypropylene (PP) straps	0.21	kg
Cardboard protection edges	0.79	kg

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement ¹⁾	Refurbishment ¹⁾	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	MND	MND	MND	MND

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 ton of fibre cement corrugated sheets

Parameter	Unit	A1	A2	A3
Global warming potential	[kg CO ₂ -Eq.]	8.04E+2	1.38E+1	1.61E+0
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	1.03E-5	4.40E-9	7.08E-9
Acidification potential of land and water	[kg SO ₂ -Eq.]	2.39E+0	1.04E-1	2.73E-2
Eutrophication potential	[kg (PO ₄) ³⁻ -Eq.]	2.27E-1	1.52E-2	8.44E-3
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	2.29E-1	7.35E-4	1.86E-2
Abiotic depletion potential for non-fossil resources	[kg Sb Eq.]	9.57E-4	1.32E-6	1.40E-5
Abiotic depletion potential for fossil resources	[MJ]	5.95E+3	1.73E+2	2.10E+2

RESULTS OF THE LCA - RESOURCE USE: 1 ton of fibre cement corrugated sheets

Parameter	Unit	A1	A2	A3
Renewable primary energy as energy carrier	[MJ]	1.05E+3	2.73E+1	6.33E+0
Renewable primary energy resources as material utilization	[MJ]	6.87E+2	0.00E+0	1.84E+2
Total use of renewable primary energy resources	[MJ]	1.74E+3	2.73E+1	1.91E+2
Non-renewable primary energy as energy carrier	[MJ]	6.67E+3	2.12E+2	1.93E+2
Non-renewable primary energy as material utilization	[MJ]	3.55E+2	0.00E+0	3.04E+1
Total use of non-renewable primary energy resources	[MJ]	7.02E+3	2.12E+2	2.24E+2
Use of secondary material	[kg]	IND	IND	IND
Use of renewable secondary fuels	[MJ]	1.84E+2	2.09E-3	1.25E-2
Use of non-renewable secondary fuels	[MJ]	1.04E+3	2.18E-2	1.43E-2
Use of net fresh water	[m ³]	2.26E+0	5.34E-2	-4.78E-1

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES:

1 ton of fibre cement corrugated sheets

Parameter	Unit	A1	A2	A3
Hazardous waste disposed	[kg]	1.43E-3	9.61E-5	7.48E-5
Non-hazardous waste disposed	[kg]	3.09E+0	6.48E-2	3.48E+1
Radioactive waste disposed	[kg]	4.02E-1	1.58E-2	5.24E-3
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	0.00E+0	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	0.00E+0

6. LCA: Interpretation

The main impact on GWP is from the cement production, covering 60-70% of the impact. The origin within the cement production is in this order:

Calcination from clinker process >> emission from fossil fuel combustion in clinker production > electricity for clinker process > electricity for cement grinding.

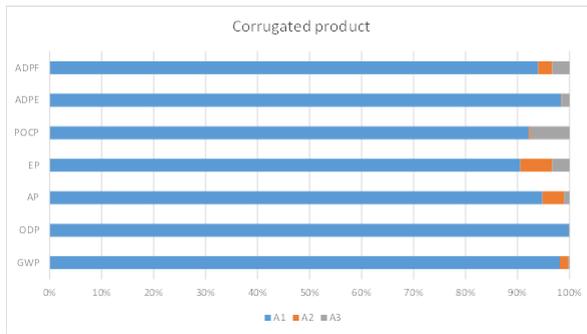
Other significant impacts are from power consumption for the tile production and coating (15-20%), and minor impacts from the heat consumption from various fuels (10-15%).

The GWP value is dominated by CO₂ air emission accounting for 97-98% of the impact followed by methane with 2-3% and various other substances with very low impacts.

Negative impacts are related to CO₂ uptake in growth of wood which is used to product cardboard packaging and cellulosic fibre material. The CO₂ emission which

will take place at disposal of packaging in module A5 is excluded as it represents a low GWP value (<10kg CO₂ eq/t product).

The figure below shows the GWP in details with specific origins within the modules A1-A3 for the two involved production sites.



For the renewable primary energy (PERM and PERE) there is approx. an equal split between the use for material and the use for energy, and virtually all in phase A1.

For the non renewable primary energy (PENRE and PENRM) the vast majority is primary energy consumption in module A1 and only a little part remaining as material (PENRM). The phases A2 and A3 are insignificant.

The POCP impact is mainly from the cement processes, making up approx. 50% of the result. This is followed by the power consumption with approx. 30% of the impact. The substances causing the impacts are air emissions of carbon monoxide, nitrogen oxides, sulphur dioxide, and unspecified VOCs all at 10-25%.

The result for AP is dominated by the power consumption and cement production, with 2/3 of the impact comes from sulphur dioxide and 1/3 from nitrogen oxides.

The EP impact is mainly from the cement production with other significant values from production of fibres and the combined power consumption from tile production and coating. Approx. 75% of the impact is from nitrogen oxides emission to air and minor impacts are from freshwater emissions of COD, nitrate, nitrogen and phosphate.

The resource depletion of elements is virtually only from the cement production and is related to the sulphur content in gypsum and to a minor extent the sodium and chloride in rock salt

The impact on ADP fossil is from the cement production followed by power consumption for tile production and coating. Also important is the production of fibres, and the additional consumptions of energy for tile production and for coating. The split is almost equal on ADP fossil related to crude oil, hard coal, lignite and natural gas; each making up 20-30% of the impact.

The impact on depletion of the ozone layer is very small; hence almost negligible substance emission will seemingly cause a large impact and defining this as major result is questionable. The result is caused by very small emissions of R11 and R114.

7. Requisite evidence

7.1 Leaching

/Intron Report: A850950/R20100098/RZw/Nbe/ issued 25 March 2010 - Testing covered leaching due to inorganic components (15 metals and 4 anions) and composition of organic components. "All components fulfill the requirements from the /BRL 5701/ and the

Soil Quality Decree. The fibre cement boards from Cembrit comply with the environmental requirements from the /BRL 1103/ and /BRL 5071/.

7.2 VOC emission

The product is not intended for indoor use and hence no specific VOC emission tests are performed.

8. References

Institut Bauen und Umwelt

Institut Bauen und Umwelt e.V., Berlin(pub.): Generation of Environmental Product Declarations (EPDs);

General principles

for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013/04
www.bau-umwelt.de

ISO 14025

DIN EN ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures

EN 15804

EN 15804:2012-04+A1 2013: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

PCR – Part A, 2016

Product Category Rules for Building-Related Products and Services, Part A: Calculation Rules for the Life

Cycle Assessment and Requirements on the Project Report version 1.4, 18.03.2016, Institut Bauen und Umwelt e.V., 2016

PCR - Part B, 2014

PCR Guidance-Texts for Building-Related Products and Services, Part B: Requirements on the EPD for Fibre cement / Fibre concrete, version 1.6 04.07.2014, Institut Bauen und Umwelt e.V., 2014

BBA

BBA Certificate Number 03/4049. Product Sheet 1 (Cembonit range) and Product sheet 2 (Cemsix range) The BBA is a UKAS accredited certification body — Number 113. BBA website at www.bbacerts.co.uk

DIBt

Deutsches Institut für Bautechnik. Zulassung Z-31.1-196. Covering Sumperk, CZ

DIN 4102

DIN 4102: Fire behaviour of building materials and building components. English version.

EN 13501-1

EN 13501-1:2007+A1:2009. Fire classification of construction products and building elements. English version.

EN 197-1

EN 197-1. Cement - Part 1: Composition, specifications and conformity criteria for common cements; German version prEN 197-1:2014 Edition 2014-07

EN 494:2012+A1:2015

Fibre-cement profiled sheets and fittings — Product specification and test methods

EWC

The European Waste Catalogue (EWC). <http://ec.europa.eu/environment/waste/framework/list.htm>

GaBi, 2014

GaBi 6.5 dataset documentation for the software-system and databases, LBP, University of Stuttgart and thinkstep, Leinfelden-Echterdingen, 2014 (<http://documentation.gabi-software.com/>)

Gabi 6 software

GaBi 6 databases. <http://www.gabi-software.com/>. Database year 2014.

IEA 2008

International Energy Agency Statistics, 2012. <http://www.iea.org/stats/index.asp>.

Intron 2010

Intron Report: A850950/R20100098/RZw/Nbe/ Approval by /INTRON, Certificate CTG 480/4, for Sumperk, CZ

/ISO 14001:2004/

ISO 14001:2004. Environmental management systems -- Requirements with guidance for use. English version.

/ISO 14040/

ISO 14040:2006. Environmental management -- Life cycle assessment -- Principles and framework. English version.

Izolacja

Approval by Izolacja COBR PIB No 77/06/1/192/WC-2 and 77/06/1/330/WC-1/ (Poland)

The Research and Development Centre for Building Insulation industry, Katowice (COBR PIB, Katowice). Al. W. Korfantego 193, 30-157 Katowice, Poland.

MPA Hannover

Materialprüfanstalt für Werkstoffe und Produktionstechnik

/MPA Hannover, test report 101070/ dated 17 June 2011.

PAVUS

/PAVUS a.s., test report PK1-01-07-009-A-0/ dated 29 January 2007.

/PAVUS a.s., test report PK1-01-07-011-A-0/ dated 27 January 2007.

/PAVUS a.s., test report PK1-01-07-010-A-0/ dated 29 January 2007.

/BRL 5071/

BRL 5071 Components made of fibre cement of the Dutch Soil Decree. Amendment of 14 November 2008.

/BRL 1103/

BRL 1103 Roofs and outer walls with profiled fibre cement boards, version of 06 -10 -2005.

/TRGS 900/

Technische Regel für Gefahrstoffe 900.

Arbeitsplatzgrenzwerte (TRGS 900). Ausgabe: Januar 2006. BArBl. Heft 1/2006 S. 41-55 zuletzt geändert und ergänzt: GMBI 2015 S. 1186-1189 [Nr. 60] vom 06.11.2015

**Publisher**

Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Tel +49 (0)30 3087748- 0
Fax +49 (0)30 3087748- 29
Mail info@bau-umwelt.com
Web www.bau-umwelt.com

**Programme holder**

Institut Bauen und Umwelt e.V.
Panoramastr 1
10178 Berlin
Germany

Tel +49 (0)30 - 3087748- 0
Fax +49 (0)30 – 3087748 - 29
Mail info@bau-umwelt.com
Web www.bau-umwelt.com

**Author of the Life Cycle Assessment**

thinkstep ApS
Raadhuspladsen 16
1550 Copenhagen V
Denmark

Tel +45 7020 3171
Fax +45 7020 3172
Mail info@thinkstep.com
Web www.thinkstep.com

CEMBRIT

Owner of the Declaration

Cembrit Holding A/S
Sohngaardsholmsvej 2
9100 Aalborg
Denmark

Tel +45 99 37 22 22
Fax +45 99 37 23 22
Mail info@cembrit.com
Web www.cembrit.com