ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Knauf USG Systems GmbH & Co. KG**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-USG-20130023-IAA1-EN
Issue date	11.10.2013
Valid to	11.10.2018

AQUAPANEL® Cement Board Indoor / Outdoor

Knauf USG Systems GmbH & Co. KG

Institut Bauen und Umwelt e.V.

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

1. General Information

Knauf USG Systems GmbH & Co. KG

Programme holder
IBU - Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Declaration number
EPD-USG-20130023-IAA1-EN

This Declaration is based on the Product Category Rules:
Fibre cement / Fibre concrete, 07-2012
(PCR tested and approved by the independent expert committee)

Issue date
11.10.2013

Valid to
11.10.2018

Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)

Dr. Burkhart Lehmann
(Managing Director IBU)

AQUAPANEL® Cement Board Indoor / Outdoor

Owner of the Declaration
Knauf USG Systems GmbH & Co. KG
Kipperstraße 19
44147 Dortmund

Declared product / Declared unit
1 m² AQUAPANEL® Cement Board Indoor und AQUAPANEL® Cement Board Outdoor

Scope:
This environmental product declaration refers to AQUAPANEL® Cement Board Indoor / Outdoor produced in Iserlohn, Germany. 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.

Verification

The CEN Norm EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025
☐ internally ☒ externally

Prof. Dr. Birgit Grahl
(Independent tester appointed by SVA)

2. Product

2.1 Product description
Cement-bound, mineral building panel with planar lattice structures of longitudinally and transversely arranged glass fibre mats, for indoor or outdoor use. The composition of the panels differs for their different uses.

2.2 Application
"AQUAPANEL® Cement Board Indoor / Outdoor" building panels are used as non-load-bearing wall elements indoors or outdoors.

2.3 Technical Data

Building data
AQUAPANEL® Cement Board Outdoor

Name	Value	Unit
Thermal conductivity /DIN 4108/	3	W/(mK)
Water vapour diffusion resistance /DIN EN ISO 12572/	66	-
Swelling (air-dry to water-saturated)	10	mm/m
Gross density	1152	kg/m^3
Modulus of elasticity	4000 - 7000	N/mm^2
Flexural strength	-	N/mm^2
Coefficient of linear expansion	7	mm/mK
Material class /DIN 4102/ /DIN 4102/	Non-combustible A1	
Bending strength /DIN EN ISO 10456/	9.60	MPa
Freeze-thaw cycle resistance /DIN EN 12467/	Given	
Length variation upon change in air humidity from 65 % to 85 % (swelling) /DIN EN 318/	0.23	mm/mm
Length variation upon change in air humidity from 65 % to 30 % (contraction) /DIN EN 318/	0.21	mm/mm
pH	12	

2.4 Placing on the market / Application rules
/DIN EN 12467: 2006-12/, Fibre-cement flat sheets – Product specification and test methods.
/General type approval No. Z-31.20-164/ of the Deutsches Institut für Bautechnik (DIBt).

2.5 Delivery status
The panels are sold in widths of 900 mm and lengths of 1200/1250/2400/2500 mm. Layer thickness is 12.5 mm.

2.6 Base materials / Ancillary materials

AQUAPANEL® Cement Board Outdoor/Indoor

Name	Value	Unit
Expanded shale	10-20	% by mass
Cement	20-30	% by mass
Limestone	35-45	% by mass
Recyclate	5-10	% by mass
Hydrophobing agent	< 1	% by mass
Glass fibre matting	< 2	% by mass

The main differences in composition between AQUAPANEL® Cement Board Indoor and Outdoor panels, befitting their different functions, is the use of limestone (between 35 and 45 % by mass) and expanded shale (between 10 and 20 % by mass). All other differences in composition add up to a total of ~ 1 %.

2.7 Manufacture

The aggregates and binders are stored in silos outside the production hall. The raw materials for the panel core are dosed over belt scales and loss-in-weight feeders according to formula and are conveyed to the weighing container over a central conveying system. The binder for producing the surface layer is directly conveyed by a screw conveyor to the slurry production unit. The glass fabric necessary for their production are stored in the basement of the production hall. The dry mixture in the weighing container is emptied into the compulsory mixer beneath it and water is added according to formula. The core mixture is mixed homogeneously and earth-moist and then conveyed by belt to the forming station. Concurrently, the slurry for the surface layer is premixed homogeneously and conveyed by screw pumps through hoses to the forming station. At the forming station, the three-layer element is produced endlessly in an extrusion process and then cut to the respective lengths at a cutter downstream. The cut-to-length panels are hardened in the high-bay store.
The production process is /DIN EN ISO 9001/ certified.

2.8 Environment and health during manufacturing

According to /Regulation (EC) No. 1907/2006/, cement and cement-containing mixtures may not be used or placed on the market if they contain, when hydrated, more than 2 mg/kg (0.0002 %) of soluble chromium (IV). Only low-chromium cements are used in production. No further special measures are required beyond these legal requirements.

2.9 Product processing/Installation

Knauf USG provides technical data sheets for the cement-bound building panels. This information can be obtained in printed form and from the Internet at www.knauf-perlite.de. The panels can be fastened to racks (aluminium/wood etc.). For cutting to length, smooth cut surfaces can be produced using a circular hand saw with dust extractor or a pendulum action jigsaw. It is recommended to use a carbide or diamond saw blade. It is also possible to score a line along the side of the panel with a knife in order to cut through the fabric. Break the panel along the cutting edge and cut through the fabric again with the knife. Openings (e.g. for cables or pipes) are to be cut out using a hole saw or jigsaw.

2.10 Packaging

The cement-bound building panels with glass fibre reinforcement are shipped on reusable Euro pallets, secured with metal strapping.

2.11 Condition of use

No changes in material composition occur during the service life.

2.12 Environment and health during use

There are no effects on environment or health during the service life. All results of the VOC analysis remain below the respective limit of detection. No chromium (VI)-containing substances are released. There is no danger to water, air or soil. In the state when used, the components of the product are firmly bonded. Dust emission is not possible.

2.13 Reference service life

From experience, service lives of approximately 50 years can be achieved when used as intended.

2.14 Extraordinary effects

Fire

Non-combustible building material of building material class A1 as per /DIN 4102-1/.

Fire protection

Name	Value
Building material class /DIN 4102-1/	A1

Water

Elution of chromium in non-relevant quantities (see Section 7.3) is to be expected upon unforeseen exposure to water. Elution of other heavy metals is not to be expected.

Mechanical destruction

No sharp break edges are created upon mechanical destruction.

2.15 Re-use phase

Once worked, the products are practically un-reusable, but are suitable for recycling as filling material if fully separated.

2.16 Disposal

The recommended /waste code as per the European Waste Catalogue/ is 17 09 04 “mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03”.

2.17 Further information

More information is available at www.knauf-perlite.de.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit of the study is 1 m² AQUAPANEL® Cement Board Indoor or AQUAPANEL® Cement Board Outdoor of 12.5 mm thickness.

Name	Value	Unit
Gross density	1152	kg/m^3
Dicke	12.5	mm
Gewicht	14.4	kg/m²

In the scope of the project, the results of the lifecycle assessment were calculated for both cement panels. The results of the outdoor panel exhibit a somewhat greater environmental impact than then indoor panel. The outdoor panel results were taken as the *worst case scenario* for both products.

3.2 System boundary

Type of EPD: cradle-to-gate.

The LCA assessed the production or preparation and transportation of the raw materials as well as the production of the final product. Packaging materials, transport and thermal recycling of the packaging material were not assessed since the quantities involved are small. Production-related wastes are fed back into the production process.

3.3 Estimates and assumptions

No estimates or assumptions were made in the assessment.

3.4 Cut-off criteria

The data involved in cement panel production were measured on location. The formula and raw materials employed, electrical energy consumed and all direct production wastes were assessed in the LCA. The transport routes of all assessed raw materials were factored in. The non-assessed wastes from raw material extraction and packaging materials involved in their transportation, and the packaging materials for the AQUAPANEL® panels were not assessed. These processes each contribute less than 5% to the assessed impact categories.

Machinery and systems involved in the production were also neglected.

3.5 Background data

The production data were gathered in 2011. The LCA calculations were performed in /GaBi 6/ (Version 6.0.1.0 DB 5.56).

3.6 Data quality

All background data sets relevant to the calculation were provided by KNAUF USG Systems GmbH & Co. KG, and the database of the lifecycle inventory software GaBi 6 (Version 6.0.1.0 DB 5.56) obtained from PE International. The latest revision of the background data used date back less than 10 years. The manufacturer-specific data used date back to 2011. 95% of all data are fully representative with regard to the timeframe and the technical and spatial conditions. All material and energy flows were fully recorded. It can therefore be assumed that the representativeness and quality of the data are excellent.

3.7 Period under review

The period under review was 2011.

3.8 Allocation

Allocations in the factory were applied in the present LCA. At the location in Iserlohn, exclusively the two products AQUAPANEL® Cement Board Indoor and Outdoor are produced with the specified formula and prepared for shipping. This allows clear allocation of the results to the two products respectively at 50% of the annual energy requirements. On an annual average, the products are manufactured and stored in ready-for-shipping form in equal quantities. Storage involves no assessable environmental impact. No secondary fuels are used.

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

No other scenarios were assessed in this EPD.

5. LCA: Results

The results presented in the tables below correspond to the lifecycle assessment of one declared unit of AQUAPANEL® Cement Board Outdoor. As described in Section 3.1, from the LCA results on the two types of AQUAPANEL®, a greater environmental impact was determined for the outdoor panel than for the indoor panel. For this reason, the results for the AQUAPANEL® Cement Board Outdoor were taken as a worst case scenario.

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 BOUNDARYS
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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m² AQUAPANEL® Cement Board Outdoor of 12.5 mm thickness

Parameter	Unit	A1	A2	A3
Global warming potential	[kg CO_2-Eq.]	4.475	0.372	0.284
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	4.51E-10	7.76E-12	1.65E-10
Acidification potential of land and water	[kg SO_2-Eq.]	0.014	0.002	0.001
Eutrophication potential	[kg $(PO_4)^{3-}$- Eq.]	1.24E-3	4.53E-4	5.56E-5
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	2.14E-3	2.02E-4	3.61E-5
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	4.77E-5	1.71E-8	4.47E-8
Abiotic depletion potential for fossil resources	[MJ]	22.83	5.08	2.89

RESULTS OF THE LCA - RESOURCE USE: 1 m² AQUAPANEL® Cement Board Outdoor of 12.5 mm thickness

Parameter	Unit	A1	A2	A3
Renewable primary energy as energy carrier	[MJ]	2.2	0.302	0.796
Renewable primary energy resources as material utilization	[MJ]	0	0	0
Total use of renewable primary energy resources	[MJ]	2.2	0.302	0.796
Non renewable primary energy as energy carrier	[MJ]	25.962	5.097	4.04
Non renewable primary energy as material utilization	[MJ]	0	0	0
Total use of non renewable primary energy resources	[MJ]	25.962	5.097	4.04
Use of secondary material	[kg]	0	0	0
Use of renewable secondary fuels	[MJ]	0	0	0
Use of non renewable secondary fuels	[MJ]	0	0	0
Use of net fresh water	[m³]	1.93	0.02	0.72

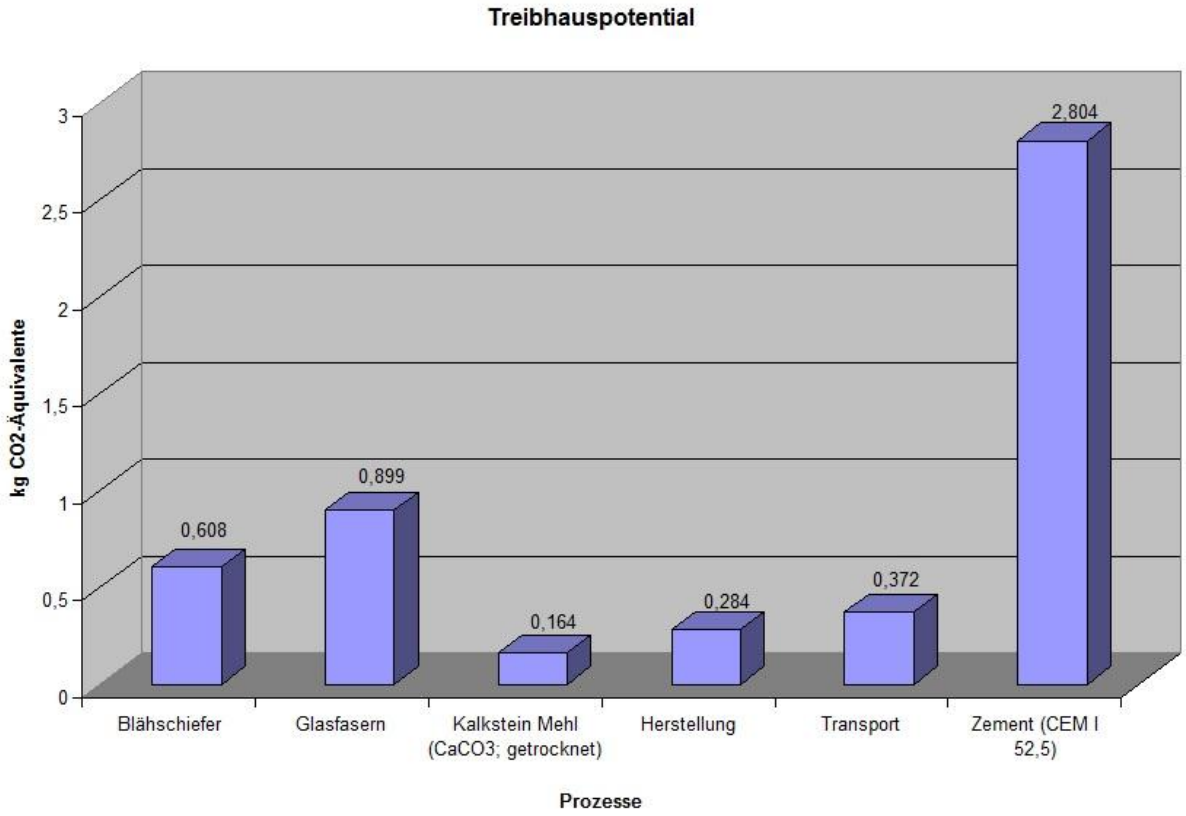
RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m² AQUAPANEL® Cement Board Outdoor of 12.5 mm thickness

Parameter	Unit	A1	A2	A3
Hazardous waste disposed	[kg]	14.01	0.032	0
Non hazardous waste disposed	[kg]	2	0	0
Radioactive waste disposed	[kg]	1.3E-3	7.31E-6	5.0E-4
Components for re-use	[kg]	-	-	-
Materials for recycling	[kg]	-	-	-
Materials for energy recovery	[kg]	-	-	-
Exported electrical energy	[MJ]	-	-	-
Exported thermal energy	[MJ]	-	-	-

Neither renewable nor non-renewable energy is used as material utilization during the declared lifecycle phases of the AQUAPANEL® Cement Board Outdoor. Nor are any renewable or non-renewable secondary fuels used. No components for reuse, recycling or energy recovery arise during the declared lifecycle phases of the AQUAPANEL® Cement Board Indoor / Outdoor. Furthermore, neither electric nor thermal energy is exported.

6. LCA: Interpretation

The dominance analysis of the use of resources reveals that the greatest impact on the climate of the AQUAPANEL® Cement Board is the raw material procurement/processing. The mineral raw materials used in this context are extracted as non-renewable resources (limestone, silica) and in certain cases also thermally treated (glass melting, expansion, cement burning). The cement used in the product, CEM I, is produced without the use of secondary fuels, but contributes to about 60% of the GWP due to the energy-intensive burning process, whereas the production process contributes only about 5% to the GWP (see graph).



The abovementioned manufacturing processes have the highest requirement of “Total non-renewable primary energy”. These processes are typically performed in furnaces fired by natural gas. The process with very high acidification potential is the production of expanded shale. Expanded shale is also produced without the use of secondary fuels.
The environmental impact of raw material procurement/processing is also seen in the potential of abiotic degradation of fossil fuels. By contrast, the transportation of raw materials and manufacture at the Iserlohn factory each contribute only approximately 10% to this.
The impact of the production processes in the actual factory can be regarded as relatively minor in the scope of the LCA. The processes used here are largely mixing and forming processes of hardly any environmental impact. Drying in the hardening store is done without the use of additional thermal energy, given the exothermic processes.

7. Requisite evidence

7.1 Radioactivity

The /Activity Concentration Index (ACI)/ was measured at 0.34. The product tested satisfies the official guideline value of A < 1 as well as the test requirement A < 0.75 of the Institut für Baubiologie Rosenheim (IBR).
Institut für Baubiologie Rosenheim GmbH Report No. 3006-214 from November 2006.

7.2 Heavy metal content

Test performed according to /DIN 38406-E29/ by ICP.

Name	Value	Unit
Arsenic	< 1	mg/kg
Lead	16	mg/kg
Cadmium	< 0.2	mg/kg
Chromium	16	mg/kg
Copper	26	mg/kg
Nickel	10	mg/kg
Mercury	< 0.5	mg/kg
Zinc	210	mg/kg
Cobalt	< 1	mg/kg
iron	8900	mg/kg
Manganese	260	mg/kg
Selenium	< 5	mg/kg
Tin	< 5	mg/kg

Institut für Baubiologie Rosenheim GmbH Report No. 3006-214 from November 2006.

7.3 Eluation

Analysis of eluate according to /DIN 38414, Part 4

Name	Value	Unit
Arsenic	< 0.005	mg/l
Lead	< 0.005	mg/l
Cadmium	< 0.001	mg/l
Chrom	0.05	mg/l
Kupfer	< 0.005	mg/l
Nickel	< 0.005	mg/l
Mercury	< 0.001	mg/l
Zinc	< 0.005	mg/l
Cobalt	< 0.005	mg/l
Iron	< 0.1	mg/l
Manganese	< 0.005	mg/l
Selenium	< 0.02	mg/l
Tin	< 0.01	mg/l

Institut für Baubiologie Rosenheim GmbH report from November 2006

7.4 VOC emissions

Without valid test methods, VOC emissions were analysed in 2006 using the dynamic headspace method, meaning sample material was heated to 50 °C and samples then taken in the flow over activated carbon. The adsorbed substances were eluted with carbon disulphide and then examined using gas chromatography.

Name	Value	Unit
TVOC (C6 - C16)	< 0.5	mg/kg
Total SVOC (C16 - C22)	< 0.5	mg/kg

Institut für Baubiologie Rosenheim GmbH Report No. 3006-214 from November 2006

8. References

DIN EN 12467
DIN EN 12467:2006-12, Fibre-cement flat sheets - Product specification and test methods

2000/532/EC
2000/532/EC: Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste

DIN EN 318
DIN EN 318:2002-06, Wood-based panels - Determination of dimensional changes associated with changes in relative humidity

DIN 4102
DIN 4102-1:1998-05, Fire behaviour of building materials and elements - Part 1: Classification of building materials; Requirements and testing

DIN 4108
DIN 4108-2: 2013-02, Thermal protection and energy economy in buildings - Part 2: Minimum requirements to thermal insulation

DIN EN ISO 10456
Building materials and products - Hygrothermal properties - Tabulated design values and procedures for determining declared and design thermal values

DIN EN 12467
DIN EN 12467:2012-12, Fibre-cement flat sheets - Product specification and test methods

DIN EN ISO 12572
DIN EN ISO 12572 - Hygrothermal performance of building materials and products - Determination of water vapour transmission properties

DIN 38406-29
DIN 38406-29:1999-05, German standard methods for the examination of water, waste water and sludge - Cations (group E) - Determination of 61 elements by inductively coupled plasma mass spectroscopy

DIN 38414-4
DIN 38414-4:1984-10, German standard methods for the examination of water, waste water and sludge; sludge and sediments (group S); determination of leachability by water (S 4)

DIN EN ISO 9001
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National technical approval Nr. Z-31.20-164 of the Deutsche Institut für Bautechnik (DIBt).

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IBR 2004
Institut für Baubiologie Rosenheim GmbH, Report No. 3004-119 according to the test seal "Tested and Recommended by IBR" including radioactivity and eluate analysis, Rosenheim, 2004

EC 2009
Natural Radioactivity and Radon in Building Materials European Commission Services considerations with regard to natural radiation sources in BSS Directive

Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC (OJ L 396, 30/12/2006, p. 1, corrected by OJ L 136, 29/5/2007, p. 3)

German ordinance on the European Waste Catalogue *(Abfallverzeichnis-Verordnung - AVV)*, 10/12/2001.

Institut Bauen und Umwelt 2011
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Institut Bauen und Umwelt e.V., Königswinter (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Background Report. April 2013
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: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

Product Category Rules for Construction Products Part B: Requirements on the EPD for fibre cement / fibre concrete. 2011-06

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