ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	Xella Baustoffe GmbH
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-XEL-20230353-IBA1-EN
Issue date	06/09/2023
Valid to	05/09/2028

Hebel autoclaved aerated concrete, reinforced

Xella Baustoffe GmbH

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1. General Information

Xella Baustoffe GmbH

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-XEL-20230353-IBA1-EN

This declaration is based on the product category rules:

Aerated concrete, 01/08/2021
(PCR checked and approved by the SVR)

Issue date

06/09/2023

Valid to

05/09/2028

Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

Hebel autoclaved aerated concrete, reinforced

Owner of the declaration

Xella Baustoffe GmbH
Düsseldorfer Landstraße 395
47259 Duisburg
Germany

Declared product / declared unit

1 m³ autoclaved aerated concrete (AAC) with an average gross density of 528 kg/m³ and including 20 kg reinforcement.

Scope:

The LCA is based on the consumption data from three manufacturing plants of Xella Baustoffe GmbH and the database for 2021.
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.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Matthias Klingler,
(Independent verifier)

2. Product

2.1 Product description/Product definition

The products under review are reinforced elements of various formats made of autoclaved aerated concrete (AAC). AAC is classified as a porous, steam-cured, lightweight concrete.

(EU) Directive No. 305/2011 (*CPR*) applies for placing the product on the market in the EU/EFTA (with the exception of Switzerland). The product requires a Declaration of Performance taking consideration of the *DIN EN 12602:2016-12*, Prefabricated reinforced components of autoclaved aerated concrete standard, and CE marking. Use is governed by the respective national regulations.

2.2 Application

Reinforced components for roofs, ceilings and supporting and non-supporting walls. Direct contact with water is avoided for technical structure reasons.

2.3 Technical Data

See the Declaration of Performance for the respective product. The following table includes general data.

Structural data

Name	Value	Unit
Gross density	350 - 600	kg/m^3
Compressive strength	2 - 5	N/mm^2
Tensile strength	0.24 - 1.2	N/mm^2
Modulus of elasticity	1000 - 3250	N/mm^2
Moisture content at 23 °C, 80%	< 4	M.-%
Shrinkage nach EN 680	< 0.4	mm/m
Thermal conductivity nach EN 12664	0.08 - 0.16	W/(mK)
Water vapour diffusion resistance factor nach DIN 4108-4	5/10	-
Sound insulation acc. to DIN 4109-32 für m' ≤ 150 [kg/m²]	32-48	[dB]
Sound insulation acc. to DIN 4109-32 für m' > 150 [kg/m²]	48-56	[dB]

The product's performance values correspond with the Declaration of Performance in terms of its essential properties in accordance with *DIN EN 12602:2016-12*, Prefabricated reinforced components of autoclaved aerated concrete.

2.4 Delivery status

Products in accordance with *EN 12602* and *DIN 4223*.
L · W · H
L = max. 8300 mm
W = max. 750 mm
H = max. 500 mm

2.5 Base materials/Ancillary materials

Name	Value	Unit
Sand	50–70	% by mass
Cement (CEM I und CEM II)	15–30	% by mass
Unhydrated lime	8–20	% by mass
Anhydrite/Gypsum	2–5	% by mass
Aluminium	0,05–0,1	% by mass
Mould oil as an ancillary material		

50 - 70% water by mass (with reference to the solid materials) is also used. An average of 20 kg reinforced steel is also installed per m³.

Sand: The sand used is a natural raw material which contains quartz (SiO_2) as a primary mineral as well as natural minor and trace minerals. It is an essential base material for the hydrothermal reaction during steam curing.

Cement: In accordance with *EN 197-1*; cement serves as a binding agent and is largely manufactured from lime marl or a mixture of lime and clay. The natural raw materials are burned before being ground.

Unhydrated lime: In accordance with *EN 459-1*; unhydrated lime serves as a binding agent and is manufactured by burning natural lime.

Anhydrite / Gypsum: In accordance with *EN 13279-1*; the sulphate agent used serves towards influencing the curing time for the AAC and originates from natural reserves or is produced technically.

Aluminium: Aluminium powder or paste serves as a pore-forming agent. Metallic aluminium reacts in the alkaline environment, whereby gaseous hydrogen is formed which generates the pores and then vents after the expansion process.

Steel: Produced in an electric light arc furnace, manufactured to wire rod, connected to steel mats by means of spot welding and assembled as cages.

Anti-corrosive agents: Anti-corrosive agents prevent reinforcement corrosion in autoclaved aerated concrete components.
Water-soluble varnishes are used.

Water: The availability of water is a fundamental basis for the hydraulic reaction undergone by the binding agents. Water is also required for manufacturing a homogeneous suspension.

Mould oil: Mould oil is used as a release agent between the mould and the raw AAC mixture. PAC (polycyclic aromatic carbons) are used – free mineral oils plus long-chain additives for increasing viscosity. This prevents it from running down in the mould and permits economical application.

Waterproofing agents: Waterproofing agents reduce water absorption by assembly components and are applied if so requested by the customer. Water-soluble methyl siliconates are used.

The product / At least one partial product contains substances from the *ECHA list* of candidates of Substances of Very High Concern (SVHC) exceeding 0.1% by mass: no
The product / At least one partial product contains other CMR substances in categories 1A or 1B which are not on the candidate list, exceeding 0.1% by mass in at least one partial product: no
Biocide products were added to this construction product, or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) *Regulation on Biocide Products* No. 528/2012): no

2.6 Manufacture

The ground quartz sand is mixed with unhydrated lime, cement, small quantities of a sulphate agent in the form of gypsum or anhydrite, and autoclaved aerated concrete powder (crushed or ground autoclaved aerated concrete) as production residue, with the addition of water and aluminium powder or paste, in a mixer to form an aqueous suspension and poured into casting moulds. The water slakes the lime under heat generation. Steel reinforcement is manufactured in the autoclaved aerated concrete plant. Prior to installation in the casting moulds, the reinforcing elements are treated by dipping in anti-corrosive agent. The aluminium reacts in an alkaline environment, whereby gaseous hydrogen is formed which generates the pores in the raw mixture and vents without residue. The pores usually have a diameter of 0.5 – 1.5 mm and are exclusively filled with air. The initial binding process results in semi-solid ingots from which the autoclaved aerated concrete components are automatically cut at high accuracy.

The final characteristics of the autoclaved aerated concrete are formed during the subsequent steam curing process over 6 to 12 hours at approx. 190 °C and pressure of approx. 12 bar in steam pressure chambers, so-called autoclaves, where the substances used form calcium silicate hydrates which correspond to the mineral tobermorite prevailing in nature. The material reaction is concluded on removal from the autoclave. The steam is used for other autoclave cycles once the curing process is finished. The condensate incurred is used as process water. This saves energy and avoids pollution by hot steam and waste water.

2.7 Environment and health during manufacturing

The applicable regulations of the professional liability associations apply; no special measures need to be taken to protect employee health.

2.8 Product processing/Installation

The reinforced AAC elements are processed using lifting gear. The components are not divided as the reinforced elements are already cut to size in the manufacturing plant. High-speed tools, such as angle grinders, must be equipped with a corresponding extraction unit as they release fine dust. The AAC components are usually connected to the supporting construction using anchors; in special cases, with thin-bed mortar in accordance with *EN 998-2* or with normal or lightweight mortar.

The autoclaved aerated concrete components can be plastered, coated or painted. Panelling with small-format parts in a curtain-type facade or fair-face cavity brickwork in accordance with *EN 1996-1-1* is also possible. The corresponding IBU Declarations are to be considered for assessing mortar, coatings and adhesive.

The professional liability associations' rules apply. No special environmental protection measures need to be taken while processing the building product.

2.9 Packaging

Hebel elements are stacked on pallets or squared timbers and strapped. Packaging and pallets incurred on the building site must be collected separately. The reusable wooden pallets are taken back by the building materials trade (remunerated in the German deposit system), which returns them to the autoclaved aerated concrete plants.

2.10 Condition of use

As outlined under 2.6 'Manufacturing', autoclaved aerated concrete primarily comprises tobermorite. It also contains non-reacting starting components, primarily coarse quartz and possibly carbonates. Autoclaved aerated concrete recarbonates for decades after leaving the autoclave. This does not adversely affect the product properties. The pores are full of air.

2.11 Environment and health during use

In accordance with the current state of knowledge, autoclaved aerated concrete does not emit any harmful substances such as VOC, for example.
The naturally ionising radiation of autoclaved aerated concrete products is extremely low permitting unlimited use of this material from a radiological perspective (see 7.1 'Radioactivity').

2.12 Reference service life

Autoclaved aerated concrete displays unlimited resistance properties when used as designated. The average service life of solid buildings made of autoclaved aerated concrete corresponds to that of solid buildings in general. According to the available data, the reference service life (RSL) is set at 80 years (*Xella 2021*).

2.13 Extraordinary effects

Fire

In the event of a fire, no toxic gases or vapours can arise.

Fire safety acc. to EN 13501-1

Name	Value
Building material class	A1
Smoke gas development	s1
Burning droplets	d0

Water

When exposed to water (e.g. flooding), autoclaved aerated concrete reacts slightly alkaline. No substances are washed out which could be hazardous to water.

Mechanical destruction

Not of relevance.

2.14 Re-use phase

Autoclaved aerated concrete offcuts from construction sites can be taken back by the AAC plant via a take-back system. Other sorted residual autoclaved aerated concrete can also be taken back by the AAC manufacturers and reused or recycled. This practice has been applied with broken products and construction site waste for decades. This material is either processed as granulate products or added to the AAC mixture as a substitute for sand.

After the elements of Hebel AAC have been crushed, the reinforcing steel used can be mechanically or magnetically separated from the mineral fraction and fed into metal recycling.

AAC products are fully recyclable. Based on research results, processed AAC demolition material can be used for various recycling paths: e.g. for the bioactivation of autoclaved aerated concrete and calcium silicate units (CSU) recycling granulates with methane-oxidising bacteria to reduce methane outgassing from domestic waste landfills (*Fb 118 2015*, *Hlawatsch et al., 2018*).

2.15 Disposal

In accordance with the European Landfill Directive of 27.04.2009 (*DepV*), valid in Germany, autoclaved aerated concrete must be disposed of in Class I landfills (see 7.2 'Leaching').
Waste key as per *EAKV*: 17 01 01

Reinforcing steel itself is practically completely recycled and not landfilled.
Waste key as per *EAKV*: 17 04 05

2.16 Further information

More information is available at www.ytong-silka.de.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m³ reinforced autoclaved aerated concrete with a gross density of 528 kg/m³ and 20 kg reinforcement. The average gross density was determined by averaging the data from the factory production control (FPC), the amount of reinforcement from the material used in the reference year.

Declared unit

Name	Value	Unit
Declared unit	1	m^3
Gross density	548	kg/m^3
Conversion factor to 1 kg	0.0018	-

3.2 System boundary

Type of EPD: cradle to factory gate, with options

Description of the life cycle phases:

Product stage (A1-A3)
Raw material supply and truck transport of raw materials to the plant Production expenses, in particular the provision and use of energy sources and auxiliary materials, as well as packaging materials Treatment of production waste and waste water Allocation of all environmental burdens by mass between associated co-products (e.g. broken material for use and marketing as cat litter or oil binder) and main product.

Construction process stage (A4-A5)
Module A4: transport by truck to the construction site (100 km). Transport distance can be adjusted at building level if necessary (e.g. for 200 km actual transport distance: multiplication of the LCA values by a factor of 2).
Module A5: Thermal packaging treatment and ensuing credits in module D. Offcuts were not taken into account, as they strongly depend on the building context. Offcuts can be estimated approximately via the declared values for the product stage (e.g. 5% offcuts: multiplication of the LCA values by a factor of 0.05).

Installation of the actual products is usually done using lifting equipment. The energy required for this is not known. As an alternative, the same amount of energy is used for assembly as for disassembly (C1).
Mortar is not considered in this EPD.

Use stage (B1)
Recarbonation of reactive product components (e.g. CaO). A recarbonation rate of 95% is assumed (Walther, 2022).

End-of-life stage (C1-C4)
Module C1: Mechanical demolition (excavator).
Module C2: transport by truck to waste processing (50 km). Transport distance can be adjusted at building level if necessary (e.g. for 100 km actual transport distance: multiplication of the LCA values by a factor of 2).
Module C3: (material recycling scenario): waste processing and material recycling as fill material (incl. credits for substitution of gravel in Module D).
Module C4: (landfilling scenario): average emissions from landfilling.

Benefits and loads beyond the system boundaries (D)
Credits from saved expenses through substitution of gravel as fill material (from Module C3) and credits for energy substitution from packaging treatment.

3.3 Estimates and assumptions

The product system does not contain any important assumptions or estimates with regard to interpretation of the LCA results. Few auxiliary materials with a combined mass share of less than one per cent by mass of the total system were estimated with technologically similar upstream processes.

3.4 Cut-off criteria

All data from the operating data survey was taken into consideration in the analysis, i.e. all starting materials used according to the recipe, the thermal energy used, as well as electricity and diesel consumption.
Specific transport distances were considered for all raw materials.
Accordingly, material and energy flows accounting for a share < 1% were also considered.
The manufacture of machinery, plants and other infrastructure required for production of the items under review was not taken into consideration in the LCA.
It can be assumed that the processes ignored would have contributed less than 5% to the impact categories under review.

3.5 Background data

The software system for comprehensive analysis GaBi 10.5 (*GaBi ts*) developed by Sphera Solutions GmbH was used for modelling the manufacture of autoclaved aerated concrete. In terms of the background system, GaBi data sets with Content Update (CUP) 2021.1 were used.

3.6 Data quality

All of the background data sets of relevance for manufacturing were taken from the GaBi 10.5 CUP 2021.1 (*GaBi ts*) software database. The background data used was last revised less than 3 years ago.

3.7 Period under review

The data basis of the present LCA is based on data recordings for reinforced autoclaved aerated concrete production from the year 2021 in the AAC plants Alzenau, Kringelsdorf and Rotenburg located in Germany.

3.8 Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product´s lifespan: Germany

3.9 Allocation

In two of the three plants considered, AAC blocks are produced in addition to reinforced elements. Raw and auxiliary materials are allocated by mass, taking the recipe into account (*Walther, 2023*).
In addition, the production process produces broken AAC, which is further refined into AAC granulate (*EPD autoclaved aerated concrete granulate*). The environmental impacts of autoclaved aerated concrete manufacturing and the waste used for manufacturing AAC granulate were allocated by mass.
During the production process, AAC waste and AAC powder are also incurred which are redirected to the production process (closed-loop recycling). This internal recycling was considered in the calculation.

3.10 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. In terms of the background system, GaBi data sets with Content Update (CUP) 2021.1 were used.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

The analysis includes 2.02 kg of returnable wooden pallets and 0.33 kg of squared timber (packaging material).

Information describing the biogenic carbon content at the plant gate

Name	Value	Unit
Biogenic carbon content in product	-	kg C
Biogenic carbon content in accompanying packaging	0.96	kg C

The following technical information forms the basis for the declared modules or canbe used for developing specific scenarios in the context of a buildingevaluation if modules are not declared (MND).

Transport to construction site (A4)

Name	Value	Unit
Litres of fuel	0.597	l/100km
Transport distance	100	km
Capacity utilisation (including empty runs)	61	%
Gross density of products transported	549	kg/m^3

Construction installation process (A5)

Packaging materials are thermally treated in Module A5. The credits due to saved expenses are allocated to Module D.

Use (B1)

See 2.10 Condition of use and 2.12 Reference service life.

Name	Value	Unit
Recarbonation rate (Walther 2022)	95	%

Reference Service Life

Name	Value	Unit
Life Span according to (Xella 2021)	80	a

End of Life (C1–C4)

Name	Value	Unit
Diesel consumption for demolition (excavator) Module C1	0,06	kg je dekl. Einheit
Transport distance to disposal / waste processing (Module C2)	50	km
Recycling (Module C3, net flow quantity)	532	kg
Landfilling (Module C4)	548	kg

Further details on the scenarios can be found in section 3.2 'System boundary'.

5. LCA: Results

The environmental impacts of 1 m³ reinforced autoclaved aerated concrete with a gross density of 528 kg/m³ and an additional 20 kg/m³ reinforcement are outlined below. The modules marked 'x' in accordance with *EN 15804* in the overview are addressed; the modules marked 'MND' (Module not declared) do not form a component of the analysis.
The following tables depict the results of the indicators concerning impact estimates, use of resources as well as the waste and other output flows with reference to the declared unit.

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

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	Refurbishment	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	X	X	X	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m³ AAC with an average gross density of 528 kg/m³ and including 20 kg reinforcement

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	2.49E+02	3.36E+00	4.62E+00	-9.03E+01	3.58E-01	1.67E+00	1.47E+00	8.32E+00	-2.62E+00
GWP-fossil	kg CO_2 eq	2.52E+02	3.3E+00	4.17E-01	-9.03E+01	3.55E-01	1.64E+00	1.46E+00	8.29E+00	-2.63E+00
GWP-biogenic	kg CO_2 eq	-3.19E+00	3.56E-02	4.2E+00	0	5.29E-04	1.77E-02	3.76E-03	3.29E-04	1.86E-02
GWP-luluc	kg CO_2 eq	1.01E-01	2.73E-02	2.83E-03	0	2.79E-03	1.36E-02	8.01E-03	2.44E-02	-4.91E-03
ODP	kg CFC11 eq	6.12E-13	6.59E-16	6.23E-16	0	6.73E-17	3.28E-16	6.52E-15	3.22E-14	-1.94E-14
AP	mol H^+ eq	2.07E-01	3.54E-03	2.31E-03	0	1.71E-03	1.76E-03	1.36E-02	5.91E-02	-9.45E-03
EP-freshwater	kg P eq	1.17E-04	9.91E-06	1.09E-06	0	1.01E-06	4.94E-06	3.33E-06	1.39E-05	-5.1E-06
EP-marine	kg N eq	7.23E-02	1.13E-03	9.99E-04	0	8.01E-04	5.63E-04	6.75E-03	1.53E-02	-3.63E-03
EP-terrestrial	mol N eq	7.93E-01	1.34E-02	1.17E-02	0	8.87E-03	6.68E-03	7.41E-02	1.68E-01	-3.98E-02
POCP	kg NMVOC eq	2.15E-01	3.08E-03	2.78E-03	0	2.25E-03	1.53E-03	1.96E-02	4.64E-02	-1.04E-02
ADPE	kg Sb eq	1.49E-05	2.96E-07	3.87E-08	0	3.02E-08	1.47E-07	1.61E-06	7.82E-07	-3.29E-07
ADPF	MJ	1.88E+03	4.44E+01	5.46E+00	0	4.54E+00	2.21E+01	2.76E+01	1.1E+02	-4.51E+01
WDP	m^3 world eq deprived	4.75E+00	3.1E-02	4.42E-01	0	3.16E-03	1.54E-02	2.46E-01	8.9E-01	-1.64E-01

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential)

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 m³ AAC with an average gross density of 528 kg/m³ and including 20 kg reinforcement

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C3	C4	D
PERE	MJ	1.84E+02	2.56E+00	3.5E+01	0	2.61E-01	1.27E+00	2.44E+00	1.48E+01	-5.99E+00
PERM	MJ	3.46E+01	0	-3.46E+01	0	0	0	0	0	0
PERT	MJ	2.19E+02	2.56E+00	4.4E-01	0	2.61E-01	1.27E+00	2.44E+00	1.48E+01	-5.99E+00
PENRE	MJ	1.88E+03	4.46E+01	5.48E+00	0	4.56E+00	2.22E+01	2.76E+01	1.1E+02	-4.51E+01
PENRM	MJ	0	0	0	0	0	0	0	0	0
PENRT	MJ	1.88E+03	4.46E+01	5.48E+00	0	4.56E+00	2.22E+01	2.76E+01	1.1E+02	-4.51E+01
SM	kg	3.91E+01	0	0	0	0	0	0	0	5.32E+02
RSF	MJ	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0
FW	m^3	2.44E-01	2.93E-03	1.06E-02	0	2.99E-04	1.46E-03	7.16E-03	2.71E-02	-8.27E-03

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 m³ AAC with an average gross density of 528 kg/m³ and including 20 kg reinforcement

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C3	C4	D
HWD	kg	3.69E-07	2.35E-09	4.07E-10	0	2.4E-10	1.17E-09	1.6E-09	1.17E-08	-6.84E-09
NHWD	kg	2.35E+00	7E-03	3.12E-02	0	7.15E-04	3.48E-03	7.95E-03	5.49E+02	-2.22E+01
RWD	kg	4.97E-02	8.09E-05	5.94E-05	0	8.27E-06	4.03E-05	2.03E-04	1.16E-03	-3.64E-03

CRU	kg	0	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	5.48E+02	0	0
MER	kg	0	0	0	0	0	0	0	0	0
EEE	MJ	0	0	6.13E+00	0	0	0	0	0	0
EET	MJ	0	0	1.1E+01	0	0	0	0	0	0

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m³ AAC with an average gross density of 528 kg/m³ and including 20 kg reinforcement

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C3	C4	D
PM	Disease incidence	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR	kBq U235 eq	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	CTUe	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-nc	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP	SQP	ND	ND	ND	ND	ND	ND	ND	ND	ND

PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Limitation note 1 – applies to the indicator 'Potential impact of exposure to people to U235':
This impact category mainly addresses the potential impact of low-dose ionising radiation on human health in the nuclear fuel cycle. This does not consider impacts attributable to possible nuclear accidents and occupational exposure, nor to the disposal of radioactive waste in underground facilities. Potential ionising radiation from soil, radon and some building materials is also not measured by this indicator.

Limitation note 2 – applies for the indicators: 'Potential for Abiotic Resource Depletion – Non-Fossil Resources', 'Potential for Abiotic Resource Depletion – Fossil Fuels', 'Water Depletion Potential (User)', 'Potential Ecosystem Toxicity Comparison Unit', 'Potential Human Toxicity Comparison Unit – Carcinogenic Effect', 'Potential Human Toxicity Comparison Unit – Non-Carcinogenic Effect', 'Potential Soil Quality Index'.
The results of this environmental impact indicator must be used with caution, as the uncertainties in these results are high or there is only limited experience with the indicator.

This EPD was created using a software tool.

6. LCA: Interpretation

The manufacturing phase (Modules A1-A3) is of highest importance for the environmental profile of the product. All impact categories with the exception of GWP-biog. are dominated by the binding agents used.

The energy sources used are also of great importance for the environmental profile. Both the use of thermal energy and electrical energy make relevant contributions in all impact categories.

In the case of biogenic global warming potential, the uptake of atmospheric carbon dioxide during plant growth is shown in connection with the packaging (wooden pallet). Packaging makes moderate contributions in all impact categories.

Relevant contributions to the indicators acidification, resource consumption (minerals and metals), and water consumption arise from the use of aluminium powder.

The upstream chain processes from the aggregate used (sand) make low contributions overall in all impact categories, although it is the largest fraction by mass.

7. Requisite evidence

Manufacturer's declarations are available according to which the composition of base materials, the manufacturing process and product features of the autoclaved aerated concrete products under review have remained unchanged since the evidence outlined below was issued. Accordingly, the evidence applies in full.

7.1 Radioactivity

Method: Measurements of the nuclide content in Bq/kg, determining the Activity Index I
Summarising report: *BfS-SW-14/12*, Salzgitter, November 2012
Result: The samples were evaluated in accordance with the European Commission Guideline "*Radiation Protection 112*" (Radiological Protection Principles concerning the Natural Radioactivity of Building Materials, 1999). The Index values I established are in all cases lower than the exclusion level which dispenses with a requirement for any additional controls. From a radiological perspective, the natural radioactivity of the building material permits unlimited use thereof.

7.2 Leaching performance

Leaching by landfilled autoclaved aerated concrete is of significance for assessing its environmental impact after use.
LGA 2007, *LGA 2011*
Measuring agency: LGA Institut für Umweltgeologie und Altlasten GmbH, Nuremberg
Result: All criteria for landfilling in class I landfills are complied with in accordance with the Landfill Directive *DepV* dated 27.04.2009 applicable in Germany. In accordance with the Council Decision (2003/33/EC) dated 19 December 2002, autoclaved aerated concrete is to be allocated to the 'Non-hazardous waste' landfill class.

8. References

Standards, directives and regulations

Biocidal Products Regulation
Regulation (EU) No. 528/2012 concerning the making available on the market and use of biocidal products

CPR
Construction Products Regulation (EU) No 305/2011 of the European parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

DepV
Directive 1999/31/EC on the landfill of waste – Landfill Directive dated 27 April 2009 (BGBI I, p. 900), last amended by Article 7 V dated 26.11.2010

DIN 4108-4
DIN 4108-4: 2020-11, Thermal insulation and energy economy in buildings – Part 4: Technical thermal and moisture protection rated values

DIN 4109-32
DIN 4109-32:2016-07, Sound insulation in buildings – Part 32: Input data for verifying sound insulation by calculation (parts catalogue) – Solid structures

DIN 4223
DIN 4223-100:2014-12, Application of prefabricated reinforced components of autoclaved aerated concrete – Part 100: Properties and requirements of materials and components

EAKV
European Waste Catalogue (EWC) in the version of the Commission Decision 2001/118/EC dated 16 January 2001 amending Decision 2000/532/EC on a waste directory

ECHA list
Candidate list of Substances of Very High Concern (SVHC) for authorisation (published in accordance with Article 59, paragraph 10 of the REACH Directive), https://echa.europa.eu/de/candidate-list-table; last amended on 13 December 2021

EN 197-1
DIN EN 197-1: 2011-11; Cement – Part 1: Composition, specifications and conformity criteria for common cements

EN 459-1
DIN EN 459-1: 2010-12, Building lime – Part 1: Definitions, specifications and conformity criteria

EN 680
DIN EN 680: 2005-12; Determination of the drying shrinkage of autoclaved aerated concrete

EN 998-2
DIN EN 998-2:2017-02, Specifications for mortar for masonry – Part 2: Masonry mortar; German version EN 998-2:2016

EN 12602
DIN EN 12602:2016-12, prefabricated reinforced components of autoclaved aerated concrete; German version EN 12602:2016

EN 12664
DIN EN 12664:2001-05, Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Dry and moist products with medium and low thermal resistance

EN 13279-1
DIN EN 13279-1:2008-11, Gypsum binders and gypsum plasters – Part 1: Definitions and requirements

EN 13501-1
DIN EN 13501-1:2010-01 +A1:2009: Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests

EN 15804+A2
EN 15804:2012+A2:2019, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

EN 1996-1-1
DIN EN 1996-1-1: 2013-02, Eurocode 6: Design of masonry structures – Part 1-1: General rules for reinforced and unreinforced masonry structures

EN 1996-1-1/NA
DIN EN 1996-1-1/NA: 2019-12, National Annex - Nationally determined parameters - Eurocode 6: Design of masonry structures – Part 1-1: General rules for reinforced and unreinforced masonry structures

EN 1996-2
DIN EN 1996-2 2010-12, Eurocode 6: Design of masonry structures – Part 2: Design considerations, selection of materials and execution of masonry; German version EN 1996-2:2006 + AC:2009

EN 1996-2/NA
DIN EN 1996-2/NA: 2012-01, National Annex - Nationally determined parameters - Eurocode 6: Design of masonry structures – Part 2: Design considerations, selection of materials and execution of masonry

ISO 14025
DIN EN ISO 14025:2011-10, Environmental labels and declarations – Type III Environmental Declarations – Principles and processes (ISO 14025:2006).

PCR: Autoclaved aerated concrete
Product category rules for building-related products and services Part B: Requirements on an EPD for autoclaved aerated concrete; version 01.08.2021; Berlin; Institut Bauen und Umwelt e.V. (pub.); www.ibu-epd.com

PCR, Part A
Product category rules for building-related products and services Part A: Calculation rules for the Life Cycle Assessment and requirements on the project report, in accordance with EN 15804+A2:2019 (version 1.3, 2021 Berlin), Institut Bauen und Umwelt e.V. (pub.) www.ibu-epd.com

Directive 2008/98/EC
of the European Parliament and Council dated 19 November 2008 on waste; published on 19 November 2008

Radiation Protection 112
European Commission guideline European Commission: Radiological Protection Principles concerning the Natural

Radioactivity of Building Materials, 1999

Other literature

BfS-SW-14/12
K. Gehrke, B. Hoffmann, U. Schkade, V. Schmidt, K. Wichterey: Natürliche Radioaktivität in Baumaterialien und die daraus resultierende Strahlenexposition (Natural radioactivity in building materials and the ensuing exposure to radiation), Federal Office for Radiation Protection, SW-14-/12, urn:nbn:de:0221-201210099810, Salzgitter, 2012

EPD autoclaved aerated concrete granulate
Ytong® - Granulate EPD-XEL-20170148-IAD-1-DE

Fb 118 2015
W. Eden, H. Kurkowski, J.J. Lau, B. Middendorf: Bioaktivierung von Porenbeton- und Kalksandsteingranulaten mit methanoxidierenden Bakterien zur Reduktion von Methanausgasungen aus Hausmülldeponien – ein Beitrag zum Klima- und Ressourcenschutz – Methanox II (Bioactivation of autoclaved aerated concrete and calcium-silicate granulates with methane-oxidising bacteria to reduce methane outgassing from domestic waste landfills – A contribution to climate and resource protection – Methanox II). Research report no. 118 of Forschungsvereinigung Kalk-Sand e.V. on the AiF research project 16637 N, Hanover 2015

GaBi ts
GaBi ts dataset documentation for the software system and databases, LBP (University of Stuttgart) and thinkstep AG, Leinfelden-Echterdingen, 2016 (http://www.gabi-software.com/deutsch/databases/gabi-databases/)

Hlawatsch et al., 2018
F. Hlawatsch, H. Aycil, J. Kropp: Hochwertige Verwertungswege für Porenbetonbruch in Mörteln und Leichtsteinen aus Mauerwerk (High-quality recycling routes for autoclaved aerated concrete waste in mortars and lightweight masonry blocks), Bremen 2018

LGA 2007
Ch. Kluge: Auslaugtests an Porenbeton zur Bewertung von Umweltrisiken im Bezug zu den Geringfügigkeitsschwellen (GFS) der LAWA (Leaching tests on AAC for evaluating environmental risks in relation to the limit thresholds of the LAWA) (IUA 2007249), LGA Institut für Umweltgeologie und Altlasten GmbH, Nuremberg 2007, 19 pages

LGA 2011
Ch. Kluge: Untersuchung von Porenbeton hinsichtlich der Entsorgung (Testing AAC with regard to disposal) (IUA2011170), LGA Institut für Umweltgeologie und Altlasten GmbH, Nuremberg 2011, 10 pages

Walther, 2022
H.B. Walther: CO2 absorption during the use phase of autoclaved aerated concrete by recarbonation, AAC worldwide, 1/2022, pp. 18-29

Walther, 2023
H.B. Walther: Calculation of EPD for individual AAC product classes, 2023

Xella, 2021
H. Walther: Nutzungsdauer von Porenbeton (Service life of autoclaved aerated concrete), LB-RS-461, Xella Technologie- und Forschungsgesellschaft mbH, 2021

Xella LCA Tool
This Declaration is based on calculations by Xella Baustoffe GmbH using a pre-verified LCA tool based on GaBi Envision: Xella LCA Tool, version 1.0, 2021

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