ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	**Holcim (Germany) GmbH**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-HOC-20220204-IBD1-EN
Issue date	21.09.2022
Valid to	20.09.2027

Airium™ Spray: cement-based insulation foam

Holcim (Germany) GmbH

Institut Bauen und Umwelt e.V.

www.ibu-epd.com | https://epd-online.com

ECO PLATFORM EPD VERIFIED

1. General Information

Holcim (Germany) GmbH

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

Declaration number
EPD-HOC-20220204-IBD1-EN

This declaration is based on the product category rules:
cement-based foams, 05.2020
(PCR checked and approved by the SVR)

Issue date
21.09.2022

Valid to
20.09.2027

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

Dr. Alexander Röder
(Managing Director Institut Bauen und Umwelt e.V.))

Airium cement-based insulation foam

Owner of the declaration
Holcim (Deutschland) GmbH
Willy-Brandt-Straße 69
20457 Hamburg

Declared product / declared unit
1 m^3 of Airium™ cement-based insulation foam with an average wet density of 130 kg/m^3 and an average dry density of 100 kg/m^3.

The declared values can also be scaled to Airium™ cement-based insulation foam with an average wet density of 300 kg/m^3 and an average dry density of 250 kg/m^3.

Scope:
Airium™ Spray is a cement-based insulation foam produced on site by mixing two components: a dry slurry made with premix and water and a diluted solution of hydrogen peroxide. The life cycle assessment is based on components produced in different plants and on-site production data. The premix is produced by HASIT (plant located in Kissing, Germany) with cement produced by Holcim Germany (plant located in Dotternhausen, Germany), and additives produced by other suppliers. The diluted solution of hydrogen peroxide is produced by Solvay (the foreground data are primary production data from Solvay industrial sites in Europe).

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

Dr. Matthew Fishwick
(Independent verifier)

2. Product

2.1 Product description/Product definition

Airium™ Spray is an insulating technology that improves the energy efficiency of buildings as part of External Thermal Insulation Composite Systems (ETICS). Airium™ Spray is generated via a continuous chemical foaming reaction by mixing a cement-based dry slurry and a diluted solution of hydrogen peroxide with a dedicated equipment.

Airium™ Spray is the first mineral foam to offer a top-tier insulating performance and which can be applied on vertical surfaces. Airium™ Spray, within a full system approach developed through a partnership between Holcim and HASIT Group, aims to fulfil all core requirements of ETICS in new-build and in renovation projects:

- it is an efficient insulator in cold and hot weather. It also has a superior thermal phase shift (14 hours) than wool and polystyrene alternatives;
- it is ranked A1 and is fully fire resistant;

- it contains no harmful fibres, emits no volatile organic compounds (VOCs) and is a breathable material that limits the risk of mould;
- it provides a continuous insulation layer with no thermal bridges;
- it insulates efficiently over time as it is dimensionally stable and does not settle or sag;
- it accelerates the time required to place insulation on site by a factor of 2 while diminishing waste and storage space required on site;
- it is resistant to insects or rodents;
- it is highly insulating over time and recyclable, in cement, in concrete or in Airium™ with no separation phase.

For the use and application of the product the respective national provisions at the place of use apply, in Germany for example the building codes of the federal states and the corresponding national specifications.

2.2 Application

Airium™ Spray is a cement-based insulation foam produced on site and applied by hand. It can be used for retrofitting and new construction. The insulation after hardening can be covered with claddings or plastered with specialized mortar and components used for ETICS.
For use in old and new building insulation:

- As system component in the thermal insulation composite system (ETICS)
- Interior and exterior insulation of outside walls
- Double-wall masonry
- Wall cavity insulation
- Ventilated curtain facades

2.3 Technical Data

Constructional Data

Name	Value	Unit
Gross density (EN 1602)	90 - 110	kg/m^3
Dimensional stability (EN 1604)	-0.3	%
Thermal conductivity (EN 12667)	0.0415 - 0.0445	W/(mK)
Specific heat capacity (EN 10456)	1	kJ/kgK
Water vapour diffusion resistance factor (ISO 12572)	3	-
flexural stress mean value) (EN 998-1)	25	kPa
Melting point	> 1200	°C
Tensile strenght (EN 998-1)	0,007	N/mm^2
Moisture content after conditioning at 23 °C / 80 % R.H (EN 1602)	14,5	%
Reaction to fire (EN 13501))	A1	-
Compressive strength (mean value) (EN 998-1)	0,07	N/mm^2

Performance data of the product with respect to its characteristics in accordance with the relevant technical provision (no CE-marking).

2.4 Delivery status

Airium™ Spray is a cement-based insulation foam produced on site with an average wet density of 130 kg/m^3 and an average dry density of 100 kg/m^3. Several layers can be applied to reach the thermal resistance targeted.

2.5 Base materials/Ancillary materials

Airium™ Spray is produced on site by mixing two components: a dry slurry made with premix and water (25-35 %w of the premix) and a diluted solution of hydrogen peroxide. When both components are mixed, water and oxygen are generated in the slurry to obtain the cement-based foam.

The composition of the premix powder is indicated as follows:

- cement 70 - 80 w%
- limestone filler: 10 - 20 w%
- stabilizer: 3 - 7 w%
- water reducing agent: < 1 w%
- catalyst: < 1 w%
- accelerator: < 0,1 w%
- PP fibres: < 0,1 w%

The diluted solution of hydrogen peroxide has a H_2O_2 concentration of <8 w%.

1) This product/article/at least one partial article contains substances listed in the *ECHA candidate list* (date: 15.03.2022) exceeding 0.1 percentage by mass:

- no

2) This product/article/at least one partial article contains other carcinogenic, mutagenic or reprotoxic (CMR) substances in categories 1A or 1B which are not on the *ECHA candidate list*, exceeding 0.1 percentage by mass:

- no

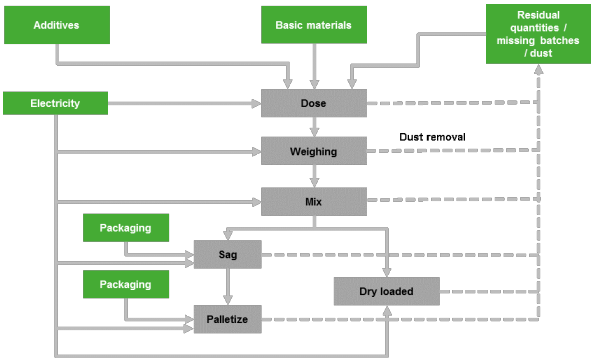
3) Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) *Ordinance on Biocide Products No. 528/2012*):

- no

2.6 Manufacture

The raw materials are stored at the manufacturing plant in silos or IBCs. From the silos, the raw materials are dosed and intensely mixed according to the formulation. The mixture is then packaged and shipped in packages or in a silo.

The manufacturing process of the premix is illustrated using the following graphic.



2.7 Environment and health during manufacturing

No environmental or health protection measures other than those specified by law are necessary.

2.8 Product processing/Installation

On the construction site, the components are mixed and water is added to produce the insulation foam ready to be applied. The product is then pumped/sprayed to the area of application.

2.9 Packaging

For larger applications, the two components of Airium cement-based insulation foam are brought to the construction site in a multi-use dual silo.
For smaller applications, the dry slurry is packed in paper bags including a PE-foil, which can be used for energy recovery.

2.10 Condition of use

During service life, Airium cement-based insulation foam re-absorbs (carbonation) CO_2 emitted during cement production (calcination).

For details, see clause 4.

2.11 Environment and health during use

The product is stable during use; its composition does not change, except for the uptake of CO_2 (carbonation).

The product does not contain harmful substances that could affect health or the environment.

2.12 Reference service life

A reference service life according to the I*SO 15686* series of standards is not declared.
When used as intended, the service life of the insulation boards is <50 years according to the Bundesinstitut für Bau-, Stadt- und Raumforschung *(BBSR 2017*) table “Service life of components for life cycle analyses according to the assessment system for sustainable building (BNB).

Cement-based insulation foams are not directly exposed to environmental conditions; relevant effects due to ageing cannot be observed over the reference service life.

2.13 Extraordinary effects

Fire
As a mineral-based material, Airium™ cement-based insulation foam is not inflammable.

Name	Value	Unit
Building material class	A1	-

Water
As a mineral-based material, Airium™ cement-based insulation foam is not sensitive to the influence of water, e.g., related to flooding.

Mechanical destruction
Not relevant.

2.14 Re-use phase

After crushing and sieving the insulated wall, Airium™ cement-based insulation foam powder can be recycled and used as a filler material in concrete or mortar production, substituting e.g., from milled limestone.

2.15 Disposal

In case recycling is not feasible, Airium™ cement-based foam can be disposed of in an inert material landfill together with other mineral de-construction waste.

Waste code according to the *European Waste Index*:
17 01 01 concrete

2.16 Further information

You can find more information about Airium™ cement-based insulation foam under: www.airium.com

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m^3 at a density of 100 kg/m^3 (after drying curing).

Declared Unit

Name	Value	Unit
Gross density (dry)	100	kg/m^3
Declared unit	1	m^3

3.2 System boundary

A life cycle assessment type „cradle to gate with options, with modules C1 – C4, and module D (A1-A3, C1-C3, D and additional modules” is calculated.

Modules A1-A3 contain the production of the dry slurry and the additive based on (H_2O_2) as well as the packaging (15% of the dry slurry packed in paper bags, 85% of the dry slurry filled into a dual silo together with the additive); it also includes the production of the silo (and the associated machinery for mixing/installation (allocated based on the estimated total turn-over over their service life).

Module A4 includes the transport of the two components and the silo/machinery to the construction site.

Module A5 covers the mixing of the two components, its installation, the landfilling of the installation (waste) as well as the thermal treatment of the paper bags used for packaging in a municipal waste incineration

part. Due to the very limited amount, no exported energy is declared in A5 nor considered in module D.

Module B1 includes the carbonation of the cementitious foam.

Module C1: Mechanical deconstruction is assumed, implying the consumption of diesel in a building machine and some dust emissions.

In ***Module C2***, it is assumed that the de-installed product is transported to an inert material landfill (scenario 1) or to a sorting platform over 50 km for recycling (scenario 2).

Module C3_2: For the 100% recycling scenario (scenario 2), it is assumed that the deconstructed wall including the insulation material are sorted in a sorting plant; during this process, the insulation material will be converted into a homogeneous powder that reaches “end-of-waste”. It can be further used as a filler in cement or mortar production.

Module C4_1: For the 100% landfilling scenario (scenario 1), it is assumed that the deinstalled product is disposed of in a landfill for inert materials.

Module D_2: For the recycling scenario, a substitution of milled limestone used in the production of cement or mortar is assumed.

3.3 Estimates and assumptions
No further assumptions and estimates relevant to the results had to be made beyond those described in sections 3 and 4.

3.4 Cut-off criteria
The applicable criteria for the exclusion of inputs and outputs are defined in *EN 15804*, clause 6.3.5, and in the IBU PCR part A (*IBU 2021b*), respectively.
All data were taken into account that resulted from the data collection procedure in the plants of the different project participants (Solvay, HASIT, Holcim France), including all components of the recipes, energy and water consumption, waste treatment, transport, main infrastructure for onsite preparation of the final product and its application, etc.
With this approach also mass and energy flows below 1 percent of total mass and energy flows caused by the declared products were included in the assessment.
Beyond that, no material or energy flows were neglected that would have been known by the persons re-sponsible for the project and that could have been expected to contribute significantly to the envi-ronmental indicators declared. Thus, it can be assumed that the total contribution of the neglected processes is not higher than 5 % of the declared impact categories.

3.5 Background data
ecoinvent v3.8 (cut-off) was used as the background database. For cement, a tool-generated, self-declaration in EPD format is used (*Holcim Süddeutschland GmbH, 2022*); for the additive based on H_2O_2, a producer-specific, aggregated dataset was used.

3.6 Data quality
The foreground data are based on extensive and detailed data collection at the production sites of Solvay (for H_2O_2), Holcim (recipes, self-declaration in EPD format for cement) and HASIT (mixing and installation). The foreground data could be fully linked with corresponding data sets from the background database *ecoinvent v3.8 (cut-off)*.
The background data were updated in 2021. The quality of the foreground and background data can therefore be assessed as very good.

3.7 Period under review
The data collected represents the specification of the product and the production conditions in 2021.

3.8 Allocation
No co-products are generated during the production of the two components nor during the mixing on the construction site.

No processes were modelled as part of the foreground model that would have required an allocation of multi-input processes. Background dataset on municipal waste incineration plants were taken from ecoinvent without any modification.

Reuse, recycling and recovery (recycling scenario 2) are modelled in line with *EN 15804* (see clause 5, Module D for details)

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.

Ecoinvent v3.8 (cut-off) was used as the background database.

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic Carbon

Name	Value	Unit
Biogenic carbon content in product	0	kg C
Biogenic carbon in packaging	0	kg C

The minimal quantities of biogenic carbon in methyl ethyl hydroxy-ethyl cellulose (MHEC) as well as in the small share of paper packaging are disregarded.

Transport from the gate to the site (A4)
Module A4 contains the average transport scenario from the production site to the construction site in Germany. A default distance of 80 km is assumed in accordance with manufacturer’s information.
The transport includes the two components (as installed) and the paper bags as packaging to the construction site. In addition, it includes the transport of the silo + machinery (2850 kg) to and from the

construction site over the default distance as mentioned above.

Name	Value	Unit
Transport distance	80	km
Capacity utilisation (including empty runs)	as in ecoinvent dataset	%

Assembly (A5)
On the construction site, the components are mixed and water added to produce the insulation foam ready to be applied. . Once installed, the insulation foam dries and gets inert.
Wastage of 3% is assumed, for its production, transport, mixing and disposal in a landfill (transport distance: 50 km) are taken into account. The machinery is cleaned with water twice a day.

The paper bags including a PE-foil are assumed to be transported 50 km with a lorry 16-32 metric ton, EURO6 to an incineration plant with an efficiency R1 < 0.6 (according to the ecoinvent dataset used); due to the negligible quantities, the recovered energy is not declared as exported energy.

Name	Value	Unit
Water consumption	0.0266	m^3
Electricity consumption	2.22	kWh
Other energy carriers	-	MJ
Material loss	3.9	kg
Output substances following waste treatment on site	3.9	kg

Use or application of the installed product (B1)
Carbonation is estimated based on *EN 16757*, Sustainability of construction works – Environmental product declarations – Product category rules for concrete and concrete elements, annex BB. Given the high porosity of the material, it is assumed that the potential to carbonate is fully used over the service life of the product (several decades).

Reference service life

Name	Value	Unit
Life Span (according to BBSR)	> 50	a

End of Life (C1-C4)
Two scenarios are declared:
Scenario 1: 100% landfilling
Scenario 2: 100% recycling via a sorting plant for mineral construction waste, separate of the pulverized Airium cement-based insulation material and use as a filler in cement or mortar production.

C1: Mechanical deconstruction is assumed, implying a consumption of diesel in a building machine and some dust emissions. The corresponding data has been taken from the UVEK-data base (*UVEK 2022*, to be published), commonly used for LCA of construction products in Switzerland.

C2: As a default, it is assumed that the de-installed product is transported to an inert material landfill or to a sorting platform over 50 km with lorries > 32 metric tons of emission classes EURO6.

C3: For the 100% landfill scenario (scenario 1), no processes are declared within module C3. The declared values are thus 0.
For the 100% recycling scenario (scenario 2), it is assumed that the deconstructed wall including the insulation material is sorted in a sorting plant; during this process, the insulation material will be converted into a powder that can be further used as a filler in cement or mortar production.

C4: For the landfilling scenario (scenario 1), it is assumed that the deinstalled product is disposed of in a landfill for inert materials.
This module is not relevant for the 100% recycling scenario.

Name	Value	Unit
Collected as mixed construction waste	119.9	kg
Recycling	-	kg
Scenario 1: landfilling	119.9	kg
Scenario 2: recycling	119.9	kg

(values including carbonates from carbonation during use phase)

Reuse, recovery and (or recycling potentials (D), relevant scenario information

This module is not relevant for the landfilling of inorganic materials (scenario 1); the amount of recovered energy from the thermal treatment of packaging waste is considered negligeable. Module D is thus declared to be “zero”.

For the recycling scenario, a substitution of milled limestone used in the production of cement or mortar is assumed.

5. LCA: Results

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; ND = 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	ND	MNR	MNR	MNR	ND	ND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m³ Airium™ cement-based insulation foam 100 kg/m³

Core Indicator	Unit	A1-A3	A4	A5	B1	C1	C2	C3/2	C4/1	D/1	D/2
GWP-total	[kg CO_2-Eq.]	4.07E+1	4.95E+0	6.74E-2	-1.99E+1	3.96E-1	9.77E-1	8.77E-1	5.09E-1	0.00E+0	-2.66E+0
GWP-fossil	[kg CO_2-Eq.]	4.07E+1	4.95E+0	6.74E-2	-1.99E+1	3.96E-1	9.76E-1	8.77E-1	5.09E-1	0.00E+0	-2.66E+0
GWP-biogenic	[kg CO_2-Eq.]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
GWP-luluc	[kg CO_2-Eq.]	9.02E-3	1.98E-3	2.02E-6	0.00E+0	3.95E-5	3.90E-4	2.31E-4	1.14E-4	0.00E+0	-3.99E-3
ODP	[kg CFC11-Eq.]	2.06E-6	1.15E-6	7.67E-10	0.00E+0	8.46E-8	2.26E-7	1.91E-7	2.52E-7	0.00E+0	-1.73E-7
AP	[mol H^+-Eq.]	8.61E-2	1.41E-2	4.06E-5	0.00E+0	4.11E-3	2.77E-3	7.40E-3	4.99E-3	0.00E+0	-2.18E-2
EP-freshwater	[kg P_4-Eq.]	1.42E-3	3.53E-5	6.04E-8	0.00E+0	1.31E-6	6.96E-6	5.87E-6	3.24E-6	0.00E+0	-2.00E-4
EP-marine	[kg N-Eq.]	1.04E-2	2.80E-3	1.72E-5	0.00E+0	1.82E-3	5.51E-4	3.05E-3	1.88E-3	0.00E+0	-4.23E-3
EP-terrestrial	[mol N-Eq.]	2.41E-1	3.12E-2	1.91E-4	0.00E+0	2.00E-2	6.14E-3	3.36E-2	2.07E-2	0.00E+0	-5.46E-2
POCP	[kg NMVOC-Eq.]	6.68E-2	1.20E-2	4.92E-5	0.00E+0	5.49E-3	2.36E-3	9.32E-3	5.92E-3	0.00E+0	-1.32E-2
ADPE	[kg Sb-Eq.]	9.27E-5	1.76E-5	1.80E-8	0.00E+0	2.04E-7	3.46E-6	3.11E-6	9.93E-7	0.00E+0	-1.14E-5
ADPF	[MJ]	2.84E+2	7.51E+1	3.57E-2	0.00E+0	5.43E+0	1.48E+1	1.39E+1	1.65E+1	0.00E+0	-4.40E+1
WDP	[m³ world-Eq deprived]	8.27E+0	2.29E-1	1.07E-3	0.00E+0	8.49E-3	4.51E-2	4.39E-2	5.21E-2	0.00E+0	-5.07E+0

Caption	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 Airium™ cement-based insulation foam 100 kg/m³

Indicator	Unit	A1-A3	A4	A5	B1	C1	C2	C3/2	C4/1	D/1	D/2
PERE	[MJ]	1.70E+1	1.06E+0	1.74E-3	0.00E+0	3.01E-2	2.08E-1	1.65E+0	3.26E-1	0.00E+0	-7.01E+0
PERM	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.70E+1	1.06E+0	1.74E-3	0.00E+0	3.01E-2	2.08E-1	1.65E+0	3.26E-1	0.00E+0	-7.01E+0
PENRE	[MJ]	2.88E+2	7.51E+1	3.58E-2	0.00E+0	5.43E+0	1.48E+1	1.39E+1	1.65E+1	0.00E+0	-4.43E+1
PENRM	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PENRT	[MJ]	2.88E+2	7.51E+1	3.58E-2	0.00E+0	5.43E+0	1.48E+1	1.39E+1	1.65E+1	0.00E+0	-4.43E+1
SM	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.20E+2
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m³]	1.14E-1	6.69E-3	5.52E-6	0.00E+0	3.09E-4	1.32E-3	9.27E-4	6.45E-4	0.00E+0	-5.53E-3

Caption	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 Airium™ cement-based insulation foam 100 kg/m³

Indicator	Unit	A1-A3	A4	A5	B1	C1	C2	C3/2	C4/1	D/1	D/2
HWD	[kg]	2.94E-4	1.96E-4	1.21E-7	0.00E+0	1.49E-5	3.86E-5	3.41E-5	1.83E-5	0.00E+0	-2.86E-5
NHWD	[kg]	6.63E+0	3.95E+0	3.10E-3	0.00E+0	9.03E-3	7.79E-1	3.78E-1	1.20E+2	0.00E+0	-2.06E-1
RWD	[kg]	1.64E-3	1.09E-3	3.30E-7	0.00E+0	8.07E-5	2.14E-4	2.19E-4	2.38E-4	0.00E+0	-5.19E-4
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.20E+2	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0

Caption	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; EEE = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m³ Airium™ cement-based insulation foam 100 kg/m³

Indicator	Unit	A1-A3	A4	A5	B1	C1	C2	C3/2	C4/1	D/1	D/2
PM	[Disease Incidence]	1.19E-6	3.13E-7	2.97E-10	0.00E+0	5.84E-7	6.17E-8	6.46E-7	1.08E-7	0.00E+0	-1.82E-7
IRP	[kBq U235-Eq.]	1.05E+2	3.26E-1	1.26E-4	0.00E+0	2.31E-2	6.43E-2	9.25E-2	7.07E-2	0.00E+0	-3.15E-1
ETP-fw	[CTUe]	1.37E+3	5.89E+1	2.02E-1	0.00E+0	3.18E+0	1.16E+1	9.45E+0	9.12E+0	0.00E+0	-3.06E+2
HTP-c	[CTUh]	3.20E-8	1.90E-9	2.64E-11	0.00E+0	1.23E-10	3.74E-10	4.34E-10	2.08E-10	0.00E+0	-1.35E-9
HTP-nc	[CTUh]	1.23E-6	5.96E-8	2.27E-10	0.00E+0	2.30E-9	1.17E-8	9.05E-9	4.32E-9	0.00E+0	-3.31E-8
SQP	[-]	1.47E+2	5.23E+1	1.49E-2	0.00E+0	6.91E-1	1.03E+1	7.49E+0	3.66E+1	0.00E+0	-1.32E+1

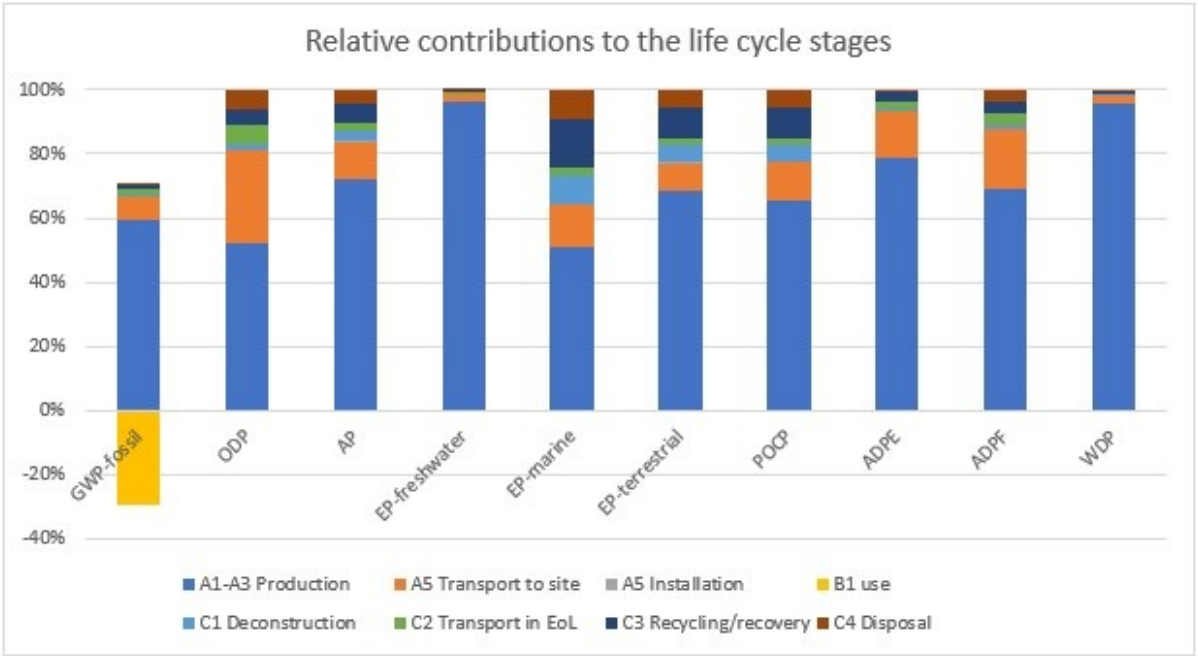
Caption	PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans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

Disclaimer 1 – for the indicator “Potential Human exposure efficiency relative to U235”.
This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Disclaimer 2 – for the indicators “abiotic depletion potential for non-fossil resources”, “abiotic depletion potential for fossil resources”, “water (user) deprivation potential, deprivation-weighted water consumption”, “potential comparative toxic unit for ecosystems”, “potential comparative toxic unit for humans – cancerogenic”, “Potential comparative toxic unit for humans - not cancerogenic”, “potential soil quality index”.
The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.

6. LCA: Interpretation

The following Figure illustrates the relative contributions of the different modules along the life cycle of the declared products.
The largest part of environmental impacts – usually more than 50% of total impacts - is caused during production (modules A1-A3). Comparably high impacts – between 10 % and 20 % of total impacts – results also from transport to the construction site (module A5). Carbonation recaptures around 40 % of the GWP caused during production (modules A1-A3).
Benefits and burdens beyond the system boundary (module D) are in the order of 10 % to 25 % of the impacts over the product life cycle (modules A1-A3).



The use of renewable primary energy is mainly caused by the share of renewable energy in the electricity mix, thus the production stage is the main drivers of this impact category; the same holds also for the use of non-renewable primary energy. Material use of primary energy is negligible.
Non-hazardous waste as the quantitatively most relevant waste flows is related to the landfilling of the product – in the recycling scenario this amount is reduced significantly; hazardous and radioactive waste are mainly caused by the electricity mix used in the production phase.

As mentioned before, Airium™ insulation foam can also be applied as a 2-layered system with a dry density of 250 kg/m^3. While the composition of the two

densities differs slightly, the values per kg are comparably close. The values for Airium™ insulation foam at a dry density of 250 kg/m³ vary between 81 % (for Eutrophication, marine) and 112 % (APDe) of the declared values for Airium™ insulation foam at a dry density of 100 kg/m³. This is considered reasonably close for scaling the values from a dry density of 100 kg/m³ to a dry density of 250 kg.

7. Requisite evidence

No specific test results are required by the PCR part B.

8. References

Product category rules of IBU

IBU (2021a)
IBU (2021): General Instructions for the EPD Programme of the Institut Bauen & Umwelt e.V. (General Instructions for the IBU EPD Programme). Version 2.0, Institut Bauen & Umwelt, Berlin.

IBU (2021b)
IBU (2021): PCR Part A: Calculation rules for the life cycle assessment and requirements for the project report according to EN 15804+A2:2019. Version 2.1., Institut Bauen & Umwelt, Berlin.

IBU (2020)
IBU (2020): PCR Part B: Requirements on the EPD for cement-based foams. Version 2020/05, Institut Bauen & Umwelt, Berlin.

Standards and legal documents

EN 15804
EN 15804+A2:2019+AC:2021, Sustainability of construction works - Environmental product declarations - Core rules for the product category construction products.

EN 16757
EN 16757:2017, Sustainability of construction works – Environmental product declarations – Product category rules for concrete and concrete elements.

ISO 14025
ISO 14025:2006-07, Environmental labels and declarations - Type III Environmental declarations - Principles and procedures.

ISO 14044
EN ISO 14044:2006-07, Environmental management - Life cycle assessment - Requirements and guidance (ISO 14044:2006); German and English versions EN ISO 14044:2006.

ISO 15686
ISO 15686, Service life planning (various parts)

EN 1602
DIN EN 1602:2013-05, Thermal insulating products for building applications - Determination of the apparent density; German version EN 1602:2013.

EN 1604
DIN EN 1604:2013-05, Thermal insulating products for building applications - Determination of dimensional stability under specified temperature and humidity conditions; German version EN 1604:2013.

EN 12667
DIN EN 12667:2001-05, Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance; German version EN 12667:2001.

EN 10456
DIN EN ISO 10456:2010-05, Building materials and products - Hygrothermal properties - Tabulated design values and procedures for determining declared and design thermal values (ISO 10456:2007 + Cor. 1:2009); German version EN ISO 10456:2007 + AC:2009.

ISO 12572
DIN EN ISO 12572:2017-05, Hygrothermal performance of building materials and products - Determination of water vapour transmission properties - Cup method (ISO 12572:2016); German version EN ISO 12572:2016.

EN 13501
EN 13501-1:2018, Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

EN 998-1
DIN EN 998-1:2017-02, Specification for mortar for masonry - Part 1: Rendering and plastering mortar; German version EN 998-1:2016.

COUNCIL REGULATION (EU) No 333/2011
COUNCIL REGULATION (EU) No 333/2011 of 31 March 2011 establishing criteria determining when certain types of scrap metal cease to be waste under Directive 2008/98/EC of the European Parliament and of the Council.

ECHA cadidate list
The Candidate List of substances of very high concern, available via https://echa.europa.eu/nl/-/four-newsubstances-added-to-the-candidate-list.

Regulation on biocidal products
REGULATION (EU) No 528/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 May 2012 concerning the making available on the market and use of biocidal products.

Regulation (EU) Nr. 305/2011(CPR)
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.

COUNCIL REGULATION (EU) No 333/2011
COUNCIL REGULATION (EU) No 333/2011 of 31 March 2011 establishing criteria determining when certain types of scrap metal cease to be waste under Directive 2008/98/EC of the European Parliament and of the Council.

European Waste Index
http://www.gesetze-im-internet.de/avv/anlage.html

Additional references

BBSR 2017
Bundesinstitut für Bau-, Stadt- und Raumforschung Service Life of Building Components; version 24.02.2017. https://www.nachhaltigesbauen.de/fileadmin/pdf/Nutzungsdauer_Bauteile/BNB_Nutzungsdauern_von_Bauteilen_2017-02-24.pdf

ecoinvent v3.8
ecoinvent v3.8, Ökobilanzdatenbank, 12/2021. ecoinvent, Zürich.

Friedrich & Stocker (2019)
Friedrich K. und Stocker R. (2019): Untersuchung der Recyclingfähigkeit und des End-of-Life-Verhaltens des neuen Dämmstoffproduktes „Airium. Studie im Auftrag der Lafarge Zementwerke GmbH, Wien, Version 2, Lehrstuhl für Abfallverwertungstechnik und Abfallwirtschaft, Leoben (A).

Holcim Süddeutschland GmbH (2022)
Holcim Süddeutschland GmbH (2022): Environmental data sheet / self-declaration basd on Environdec c-PCR -001 Cement and building limes (EN 16908): Holcim Optimo 5 % Dotternhausen; date of issue: 2022-01-25.

Stemmler K. (2018)
Stemmler K. (2018): Expulsion Tests on a on Wastes from Airium Foam Concrete. Internal project report P.82007.183, Lafarge Holcim, Mannersdorf (A).

Weidema et al. (2013)
Weidema, B., C. Bauer, R. Hischier, C. Mutel, T. Nemecek, J. Reinhard, C.O. Vadenbo, G. Wernet (2013): Overview and methodology, Data quality guideline for the ecoinvent database version 3. ecoinvent report no. 1 (v3), St. Gallen (CH).0

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

Tel +49 (0)30 3087748- 0
Fax +49 (0)30 3087748- 29
Mail info@ibu-epd.com
Web **www.ibu-epd.com**

Programme holder
Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Tel +49 (0)30 - 3087748- 0
Fax +49 (0)30 – 3087748 - 29
Mail info@ibu-epd.com
Web **www.ibu-epd.com**

Author of the Life Cycle Assessment
Dr. Frank Werner - Umwelt & Entwicklung
Kammelenbergstrasse 30
9011 St. Gallen
Switzerland

Tel + 41 (0)44 241 39 06
Fax + 41 (0)44 461 33 28
Mail frank@frankwerner.ch
Web **http://www.frankwerner.ch/**

Owner of the Declaration
Holcim (Deutschland) GmbH
Willy-Brand-Straße 69
20457 Hamburg
Germany

Tel +49 (0)5132 927 432
Fax +49 (0)5132 927 430
Mail technisches-marketing@lafargeholcim.com
Web **www.holcim.de**