ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Knauf Insulation**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-KIN-20150185-CBB3-EN
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FKD-MAX C1 / FKD-MAX C2 / FKD-U C2 / FKD-S / FKD-S C1 / FKD-S C2 / FKD-S Thermal / FKD-N / FKD-N C1 / FKD-N C2 / FKD-N Thermal / SMARTwall N C1 / SMARTwall N C2 / SMARTwall S C1 / SMARTwall S C2 / SmartWall FireGuard
OUT-Therm / OUT-Therm C1 / OUT-Therm C2
Rock Mineral Wool for ETICS
(External Thermal Insulation Composite Systems)

Knauf Insulation

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

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD EN 15804 VERIFIED

General Information

Knauf Insulation

FKD-MAX C1 / FKD-MAX C2 / FKD-U C2 / FKD-S / FKD-S C1 / FKD-S C2 / FKD-S Thermal / FKD-N / FKD-N C1 / FKD-N C2 / FKD-N Thermal / SMARTwall N C1 / SMARTwall N C2 / SMARTwall S C1 / SMARTwall S C2 / SmartWall FireGuard

OUT-Therm / OUT-Therm C1 / OUT-Therm C2

Programme holder
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Declaration number
EPD-KIN-20150185-CBB3-EN

Declared product / Declared unit
1 m³ of product

This Declaration is based on the Product Category Rules:
Mineral insulating materials, 07.2014
(PCR tested and approved by the SVR)

Scope:
The declared unit is 1 m³ FKD-MAX C1 / FKD-MAX C2 / FKD-U C2 / FKD-S / FKD-S C1 / FKD-S C2 / FKD-S Thermal / FKD-N / FKD-N C1 / FKD-N C2 / FKD-N Thermal / SMARTwall N C1 / SMARTwall N C2 / SMARTwall S C1 / SMARTwall S C2 / SmartWall FireGuard / OUT-Therm / OUT-Therm C1 / OUT-Therm C2 rock mineral wool uncoated, one side coated or both sides coated. They comply with the requirements of /EN 13162/. The thickness is ranging from 40 mm to 300 mm. The manufacturing company is Knauf Insulation - plants Sankt Egidien (Germany) and Nova Bana (Slovakia) - with averages following production share.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.

Issue date
8/17/2015

Valid to
8/16/2020

Verification

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

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

Dr. Burkhart Lehmann
(Managing Director IBU)

Matthias Schulz
(Independent verifier appointed by SVR)

Product

Product description
Knauf Insulation manufactures rock mineral wool (RMW) insulation products. They are available in the form of lamellas, slabs or boards, and also possibly rolls. The density range for RMW goes from 25 to 200 kg/m³. In terms of composition, inorganic rocks are the main components (typically 97%) of RMW, with a remaining fraction of organic content which is generally a thermosetting resin binder. The binder content is typically less than 4%. The inorganic part is made of volcanic rocks, typically basalt, also dolomite and with an increasing proportion of recycled material in form of briquettes, a mix of stone wool scrap and cement.

RMW slabs are used as a thermal, acoustical and fire insulation product. They are produced with an uncoated, one side coated or both sides coated surface. This EPD has been developed for a double side coated product, this is the worst case scenario in terms of environmental impacts.

For the placing on the construction products market in the European Union/EFTA (with exception of

Switzerland), the Regulation /(EU) No 305/2011/ applies. The products need Declarations of Performance / DoP R4308LPCPR / DoP R4308MPCPR / DoP R4308KPCPR / DoP R4238LPCPR / R4238MPCPR / R4238KPCPR / taking into consideration the harmonized product standard /EN 13162/ and the /CE-mark/.

Application
Main applications for the RMW slabs are:
ETICS (External Thermal Inslation Composite Sytems). For the application and use national regulations apply, in Germany the /*Allgemeine bauaufsichtliche Zulassung Z-33.4-1351 / Z-33.4-1395 (building inspection approval) issued by the Deutsches Institut für Bautechnik (DIBt), Berlin*.

Technical Data
The FKD-MAX C1 / FKD-MAX C2 / FKD-U C2 / FKD-S / FKD-S C1 / FKD-S C2 / FKD-S Thermal / FKD-N / FKD-N C1 / FKD-N C2 / FKD-N Thermal / SMARTwall N C1 / SMARTwall N C2 / SMARTwall S C1 / SMARTwall S C2 / SmartWall FireGuard / OUT-Therm / OUT-Therm C1 / OUT-Therm C2 slabs and its technical characteristics meet a number of technical requirements. The most important ones are summarized in the table here below, which also includes references to testing methods.

Technical characteristics

Name	Value	Unit
Water vapour diffusion resistance factor /SIST EN 13162/	1	-
Gross density /DIN 1602/	90 - 110	kg/m³
Water absorption Wp /EN 1609/	< 1	kg/m²
Water absorption Wlp /EN 12087/	< 3	kg/m²
Reaction to fire /EN 13501-1/	Euroclass A1	-
Specific heat capacity /EN ISO 10456/	1030	J/kgK
Melting point /DIN 4102 / T17/	> 1000	°C
Specific heat capacity /EN ISO 10456	1030	J/kgK
Compressive stress FKD-T /EN 826/	10	kPa
Thermal conductivity FKD-MAX / FKD-N Thermal / SMARTwall N /EN 12667/	0.034	W/(mK)
Thermal conductivity FKD-U / FKD-N / FKD-S Thermal / SMARTwall S / OUT-Therm /EN 12667/	0.035	W/(mK)
Thermal conductivity FKD-S / SmartWall FireGuard /EN 12667/	0.036	W/(mK)
Compressive stress FKD-S / FKD-S Thermal /SMARTwall S / SmartWall FireGuard /EN 826/	30	kPa
Compressive stress FKD-U / FKD-N / FKD-N Thermal /EN 826/	20	kPa
Compressive stress SMARTwall N / OUT-Therm /EN 826/	25	kPa
Tensile strength FKD-MAX /EN 1607/	5	kPa
Tensile strength FKD-U / FKD-N / FKD-N Thermal / SMARTwall N / OUT-Therm /EN 1607/	7.5	kPa
Tensile strength FKD-S / FKD-S Thermal / SMARTwall S / SmartWall FireGuard /EN 1607/	10	kPa
Acoustic absorption	not relevant	

Base materials / Ancillary materials
The main raw materials are diabase (a rock that is similar to volcanic rock basalt), dolomite and briquette. The briquette is made of rock mineral wool waste (internal or external), waste of raw materials and cement. Additionally, coke is also added in the cupola as an energy carrier. Further down the manufacturing line, a binder (thermo set resin) is spread onto the fibers. Then, the polymerization contributes to fix the products dimensions and mechanical properties. After cutting, the slabs are sprayed with a mineral silicate coating on the surface.

Reference service life
When used correctly, the reference service life of Knauf Insulation rock mineral wool is merely limited by the service life of the components and/or building in which it is incorporated; this is substantiated by current industry findings, for example in case of deconstruction of buildings. As a minimum, we consider a reference service life of 50 years.

LCA: Calculation rules

Declared Unit
The declared unit is 1 m³ of rock mineral wool both sides coated. The density used for the calculation of the LCA is 100 kg/m³.

Declared unit

Name	Value	Unit
Declared unit	1	m³
Gross density	100	kg/m³
Conversion factor to 1 kg	0.01	-

System boundary
The system boundary of the EPD follows the modular approach defined by /EN 15804/.
The type of EPD is cradle-to-gate-with options.

List and explanation of the modules declared in the EPD.

The product stage (A1-A3) includes:
- A1 - raw material extraction and processing, processing of secondary material input (e.g. recycling processes),
- A2 - transport to the manufacturer
- A3 - manufacturing.

This includes provision of all materials, products and energy, packaging processing and its transport, as well as waste processing up to the end-of waste state or disposal of final residues during the product stage.

The LCA results are given in an aggregated form for the product stage, meaning that the modules A1, A2 and A3 are considered as **a unique module A1-A3**.

The construction process stage includes:
- A4 - transport to the construction site and
- A5 - installation into the building.

The transport to the building site (A4) is included in the LCA calculation. For the considered product, the average transport distance is assumed to be 500 km with a truck capacity utilization of 40%.
Module A5 has neither been included nor declared in this EPD, since it depends on the application, and method or tools used, which can be very diverse as a multi-purpose product. Therefore, the treatment of the packaging waste after the installation of the product has not been considered.

The use stage
Because they are specific to the building, its use and location, none of the modules related to the building fabric (B1-B5) nor the operation of the building (B6 and B7) have been taken into account in this EPD.

The end-of-life stage includes:
- C1 - de-construction, demolition,
- C2 - transport to waste processing,
- C3 - waste processing for reuse, recovery and/or recycling and
- C4 - disposal.

This includes provision of all transports, materials, products and related energy and water use, but only modules C2 and C4 are reported, as they are considered the most relevant scenarios for rock mineral wool products.
Although rock mineral wool products from Knauf Insulation are partly recycled at end-of-life, there is not yet an established collection system, and as such, the assumption chosen in this study,100% landfilled after the use phase, is the most conservative approach.

Module D includes reuse, recovery and/or recycling potentials.
According to /EN 15804/, any declared benefits and loads from net flows leaving the product system not allocated as co-products and having passed the end-of-waste state shall be included in module D.
No benefits and loads are considered: module D is not included in the background model.

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.

LCA: Scenarios and additional technical information

The following information forms the basis for declared modules or can be used for specific scenarios development in building assessment context.

Transport to the building site (A4)

Name	Value	Unit
Litres of fuel	0.0025	l/100km
Transport distance	500	km
Capacity utilisation (including empty runs)	40	%
Gross density of products transported	100	kg/m^3

Reference service life

Name	Value	Unit
Reference service life	50	a

End-of-life (C1 - C4)

Name	Value	Unit
Landfilling	100	kg
Transport distance	50	km
Capacity utilization	50	%

LCA: Results

Environmental impacts associated with losses from installation of the product in A5 are not included in the LCA results. This is due to the fact that installation losses vary depending on installation practice and building project specifics. In order to include the potential environmental impacts associated with installation losses, a factor can be applied to the LCA results. E.g. installation losses = 1%, multiplication of EPD results with 1.01.

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	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	MND	MND	MND	MNR	MNR	MNR	MND	MND	MND	X	MND	X	MND

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 m³ FKD-MAX/FKD-U/FKD-S/FKD-N/SMARTwall/OUT-Therm

Parameter	Unit	A1-A3	A4	C2	C4
Global warming potential	[kg CO_2-Eq.]	112.00	5.29	0.36	1.41
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	2.13E-9	2.53E-11	1.73E-12	1.92E-11
Acidification potential of land and water	[kg SO_2-Eq.]	1.25E+0	1.60E-2	2.38E-3	8.99E-3
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	5.96E-2	3.38E-3	5.69E-4	1.23E-3
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	6.81E-2	-4.51E-3	-9.53E-4	8.44E-4
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	6.95E-5	1.99E-7	1.36E-8	5.30E-7
Abiotic depletion potential for fossil resources	[MJ]	1750.00	73.00	4.99	18.60

RESULTS OF THE LCA - RESOURCE USE: 1 m³ FKD-MAX/FKD-U/FKD-S/FKD-N/SMARTwall/OUT-Therm

Parameter	Unit	A1-A3	A4	C2	C4
Renewable primary energy as energy carrier	[MJ]	277.00	IND	IND	IND
Renewable primary energy resources as material utilization	[MJ]	0.00	IND	IND	IND
Total use of renewable primary energy resources	[MJ]	277.00	2.88	0.20	1.60
Non-renewable primary energy as energy carrier	[MJ]	1.71E+3	IND	IND	IND
Non-renewable primary energy as material utilization	[MJ]	159.00	IND	IND	IND
Total use of non-renewable primary energy resources	[MJ]	1.87E+3	7.32E+1	5.00E+0	1.94E+1
Use of secondary material	[kg]	13.00	IND	IND	IND
Use of renewable secondary fuels	[MJ]	0.00	0.00	0.00	0.00
Use of non-renewable secondary fuels	[MJ]	0.00	0.00	0.00	0.00
Use of net fresh water	[m³]	4.37E-1	2.03E-3	1.39E-4	-7.41E-2

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 m³ FKD-MAX/FKD-U/FKD-S/FKD-N/SMARTwall/OUT-Therm

Parameter	Unit	A1-A3	A4	C2	C4
Hazardous waste disposed	[kg]	1.03E-1	1.67E-4	1.14E-5	8.72E-4
Non-hazardous waste disposed	[kg]	1.94E+1	9.21E-3	6.29E-4	1.04E+2
Radioactive waste disposed	[kg]	4.48E-2	9.59E-5	6.55E-6	3.39E-4
Components for re-use	[kg]	IND	IND	IND	IND
Materials for recycling	[kg]	IND	IND	IND	IND
Materials for energy recovery	[kg]	IND	IND	IND	IND
Exported electrical energy	[MJ]	IND	IND	IND	IND
Exported thermal energy	[MJ]	IND	IND	IND	IND

INTERPRETATION

RESOURCES USE

The primary energy demand from non-renewable resources is dominated by the production of rock mineral wool products (especially due to the energy carrier, coke) and the thermosetting resin binder. The renewable energy demand regarding the products FKD-MAX C1 / FKD-MAX C2 / FKD-U C2 / FKD-S / FKD-S C1 / FKD-S C2 / FKD-S Thermal / FKD-N / FKD-N C1 / FKD-N C2 / FKD-N Thermal / SMARTwall N C1 / SMARTwall N C2 / SMARTwall S C1 / SMARTwall S C2 / OUT-Therm / OUT-Therm C1 / OUT-Therm C2 is dominated by the production, mostly due to electricity consumption, and packaging.

ENVIRONMENTAL IMPACT

Every impact category except the abiotic ADP elements is dominated by the production. This is due to the consumption of energy (electricity and thermal energy) during the production.
The **Abiotic Depletion Potential elements** (ADPe) are dominated by the coating production followed by the binder production and by the supply of raw materials such as cement for briquettes.

The **Global Warming Potential** (GWP) is dominated by the production, mostly due to CO2 emissions from raw materials and energy consumption. The production of the thermosetting resin binder represents more than 10% of the impact.
The **Ozone Depletion Potential** (ODP) is most notably influenced by the production and the binder.
The **Acidification Potential** (AP) is also dominated by the production due to the emissions related to the processes and the energy consumption. Mostly, the impact refers to emissions to air: 75% from sulphur dioxide and 20% from nitrogen oxides.
The **Eutrophication Potential** (EP) is significantly influenced by the production due to emissions from the cupola furnace, curing oven and other unit processes.
The **Potential Ozone Photochemical Oxidants** (POCP) is particularly dominated by the production (emissions in the cupola furnace and other unit processes). The results from the transport are negative due to the NO emissions; NO counteracts the POCP.

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approval) issued by the Deutsches Institut für Bautechnik (DIBt), Berlin.

DoP R4308LPCPR / R4308MPCPR / R4308KPCPR / R4238LPCPR / R4238MPCPR / R4238KPCPR
Declarations of Performance

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