ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 and EN 15804+A1 for:

FKL, FKL C1, FKL C2

From

KNAUF INSULATION

Program:	The International EPD® System www.environdec.com
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Programme:	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com
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EPD owner	Knauf Insulation Sprl Rue de Maestricht 95 4600 Visé Belgium
Product Category Rules:	PCR 2012:01. Construction products and construction services. Version 2.3 Sub-PCR-I Thermal insulation products (EN 16783: 2017).
Product group classification:	UN CPC 37
Reference year for plant data:	2018
Geographical application scope:	Europe

CEN standard EN 15804+A1 serves as the Core Product Category Rules (PCR)
Product category rules (PCR): Construction products and Construction services, 2012:01, version 2.3, Sub-PCR-I Thermal insulation products (EN 16783: 2017),
PCR review was conducted by: The Technical Committee of the International EPD@ System
Independent third-party verification of the declaration and data, according to ISO 14025:2006. ☒ EPD process certification ☐ EPD verification
Certified by: Bureau Veritas certification Sverige AB SE006629-1
Procedure for follow-up of data during EPD validity involves third party verifier: ☒ Yes ☐ No

General information

Information about the company

Description of the organisation:
Knauf Insulation has more than 40 years of experience in the insulation industry and is one of the most respected names in insulation worldwide. Knauf Insulation is manufacturing products and solutions mainly in glass and rock mineral wool, as well as wood wool. We operate more than 37 manufacturing sites globally in 15 countries and employ more than 5,000 people.

The Headquarters are located in Visé, in Belgium.

Product-related or management system-related certifications:
All Knauf Insulation sites, including the related site for this EPD, are ISO 9001, ISO 14001, ISO 50001 and ISO 45001 certified under the scope "Design, Development and Production of Insulation Materials and Systems".

Name and location of production site:
The application in construction of the concerned product is Europe. The data utilized for the production stage life cycle assessment are related to production plants located in Nova Bana (Slovakia) and St. Egidien (Germany).

Bahnhofstraße 25, 09356 St. Egidien, Germany

Železničný rad 24, 968 01 Nová Baňa-Priemyselný obvod, Slovakia

Information about Rock Mineral Wool production

The Rock Mineral Wool Products for Building Construction are available in the form of slabs, boards, lamellas and rolls. RMW slabs are used as a thermal, acoustical and fire insulation product.

In general, the density for rock mineral wool products ranges from 20 to 200 kg/m³. In terms of composition, the inorganic part (92-98%) is composed of volcanic rocks, typically basalt, and some dolomite and with an increasing proportion of recycled material in the form of briquettes, a mix of stone wool scrap, other secondary materials and cement.

The remaining fraction is the thermo set resin binder.

Product information

Product name: FKL, FKL C1, FKL C2

Product identification: The declared insulation product FKL, FKL C1, FKL C2, is a compact rock mineral wool, uncoated, one side coated and both sides coated surface, unfaced slab of 1 m^2 (considered for this EPD).

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 concerned products need Declarations of Performance /DoP R4308GPCPR, R4238GPCPR / taking into consideration the harmonized product standard /EN 13162/ and the /CE-mark/.

Product description: The declared insulation product FKL, FKL C1, FKL C2 are mainly used as a thermal, acoustical and fire insulation in ETICS.

UN CPC code:
37990: Non-metallic mineral products (including mineral wool, expanded mineral materials, worked mica, articles of mica, non-electrical articles of graphite or other carbon and articles of peat).

Geographical scope: The product is manufactured in Nova Bana (Slovakia) and St. Egidien (Germany) with related country energy mix for electricity. Regarding the market area, the product is mainly marketed in Europe.

Energy:
Electricity mix and gas inputs are taken from related country values taken from reference year 2016 (more recent year into GaBi tool).

Technical Characteristics:

Parameter	Value
Thermal conductivity/ EN 12667	0.04 W/(mK) at 10°C
Water vapor diffusion resistance (EN 12086)	1
Thermal Resistance (ISO 8301)	2.5 m^2K/W
Reaction to fire (EN 13501-1)	A1
Declared density range/ EN 1602	90 kg/m^3 (+/-10%)
Melting point of fibers DIN 4102-17	≥ 1000°C

LCA information

Functional unit / declared unit:

The declared unit is 1 m^2 of [unfaced, uncoated, coated] Rock Mineral Wool FKL, FKL C1, FKL C2 with a thickness of 100 mm. The declared lambda is 0.04 W/mK. The density used for the calculation of this specific LCA is 90 kg/m^3. For this calculation, the worst case scenario with double sided coating (C2) has been selected.

Reference service life: The RSL or durability of FKL, FKL C1, FKL C2 is as long as the lifetime of the building equipment in which it is used (at least 50 years).

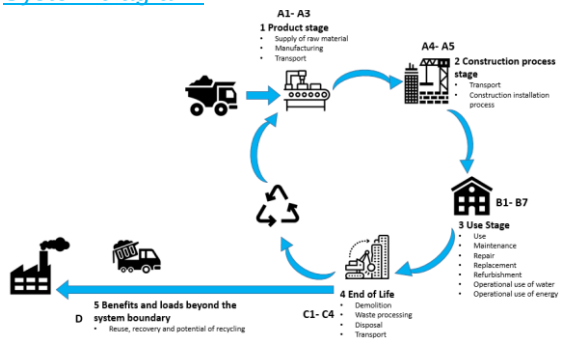
Time representativeness:

Plant production data for the complete year 2018.

Database(s) and LCA software used:

The LCA model, the data aggregation and environmental impacts are calculated with the software GaBi 10.0 and its Service Pack 40 databases.

System diagram:



Description of system boundaries:

The system boundary of the EPD follows the modularity approach defined by the /EN 15804+A1/.

The type of EPD is cradle-to-grave.

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 and
- 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.

Product Parameters	Value
Declared Density	90 kg/m^3
Rock mineral wool weight (without coating weight)	9 kg
Surface	1 m^2
Thickness	100 mm
Volume	0.1 m^3
Coating (kg/ m^2)	0.4
Packaging Plastic sheet	0.08 kg
Packaging Wooden pallet	0.9 kg

The construction process stage includes:

- A4 - transport to the construction site and
- A5 - installation into the building.

The transport to the building site (A4) and installation (A5) included in this LCA use the following parameters:

Parameter	Value
Average transport distance	600 km
Type of fuel and vehicle consumption or type of vehicle used for transport.	Truck Euro 6 (28 – 32 t / 22 t payload). 33 L for 100 km.
Truck capacity utilization (including 30% of empty returns)	28 % of the weight capacity
Loss of materials in construction site	2%
Packaging Wooden pallet	40% recycled, 60% incinerated
Packaging Plastic sheet	40% recycled, 60% incinerated

The treatment of the packaging waste after the installation of the product (A5) has been considered.

The Use stage (B1-B7) includes:

- B1: Use
- B2: Maintenance

- B3: Repair
- B4: Replacement
- B5: Refurbishment
- B6: Operational Energy Use
- B7: Operational Water Use

Once installation is complete, no actions or technical operations are required during the use stages until the end of life. Therefore, the mineral wool has no impacts (excluding potential energy savings) on this stage.

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. The common manual dismantling impact of insulation is considered as very small and can be neglected in C1.

Although Rock Mineral Wool products from Knauf Insulation are partly recycled at their end-of-life, an established collection system does not yet exist. Therefore, the assumption chosen in this study, 100% landfill (C4) after the use phase, is the most conservative approach.

Parameter	Value
Disposal type (mineral wool)	100% landfill
Average transport distance waste (C2)	50 km
Type of fuel and vehicle consumption or type of vehicle used for transport.	Truck-trailer, Euro 3, 34 - 40t gross weight / 27t payload capacity/ 40 L for 100 km. (if 100 % utilization).
Truck capacity utilization	50 % of the weight capacity

Module D includes reuse, recovery and/or recycling potentials. According to /EN 15804+A1/, 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. Benefits considered in module D originate from packaging recycling or incineration.

Content Declaration

The product does not contain substances on the "Candidate List of Substances of Very High Concern for Authorisation" under the REACH regulation (if above 0.1% of the mass).

Recycled material

The mineral wool waste that is originating from the manufacturing process is recycled internally through the use of briquettes (mineral wool waste and additional cement) that are reinjected into the batch.

For 2018 year, if considering only the Knauf Insulation Nova Bana manufacturing plant, the external recycled waste as raw material is 28 % originating (mainly) from slags.

Additional information:

All raw materials for the manufacturing of the declared product, the required energy, water consumption and the resulting emissions are considered into the LCA. Consecutively, the recipe components with a share even less than 1% are included. All neglected processes contribute less than 5% to the total mass or less than 5% to the total energy consumption. For information, the impact of the Rock Mineral Wool plant construction or machines, are not taken into account in the life cycle assessment. No allocation is carried out for this specific product.

Knauf Insulation adopts a “worst case” approach into its EPDs.

Knauf Insulation supports the Ten Principles of the United Nations Global Compact on human rights, labor, environment and anti-corruption.

More information:
www.knaufinsulation.com

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Declared Modules

Life cycle stages as defined in the European standard EN 15978 :2011 and the description of the system boundaries for the reference product LCA (X = included in the LCA, MND = module is not declared)

Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
Raw materials	Transport	Manufacturing	Transport	Construction Installation	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	X	X	X	X	X	X	X	X	X	X	X

Environmental performance

Potential environmental impacts: 1 m² of Rock Mineral Wool FKL, FKL C1, FKL C2 with a thickness of 100 mm.

PARAMETERS	UNIT	TOTAL A1-A3**	A4	A5	TOTAL B1-B2-B3-B4-B5-B6-B7	C1	C2	C3	C4	D*
Global warming potential (GWP)	kg CO_2 eq.	1.04E+01	7.86E-01	1.47E+00	0.00E+00	0.00E+00	3.29E-02	0.00E+00	1.28E-01	-5.00E-01
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq.	6.87E-14	1.94E-16	1.43E-10	0.00E+00	0.00E+00	8.27E-18	0.00E+00	7.06E-16	-7.04E-13
Acidification potential (AP)	kg SO_2 eq.	7.33E-02	1.55E-03	1.59E-03	0.00E+00	0.00E+00	1.42E-04	0.00E+00	8.23E-04	-6.79E-04
Eutrophication potential (EP)	kg PO_4^{3-} eq.	3.06E-03	3.74E-04	8.47E-05	0.00E+00	0.00E+00	3.51E-05	0.00E+00	9.27E-05	-9.94E-05
Formation potential of tropospheric ozone (POCP)	kg C_2H_4 eq.	4.72E-03	1.63E-04	1.05E-04	0.00E+00	0.00E+00	1.25E-05	0.00E+00	6.19E-05	-6.75E-05
Abiotic depletion potential – Elements	kg Sb eq.	6.24E-06	7.18E-08	1.38E-07	0.00E+00	0.00E+00	3.06E-09	0.00E+00	4.95E-08	-8.52E-08
Abiotic depletion potential – Fossil resources	MJ, net calorific value	1.57E+02	1.06E+01	3.32E+00	0.00E+00	0.00E+00	4.51E-01	0.00E+00	1.82E+00	-7.83E+00

*: *[Life Cycle D stage covers benefits and loads beyond the system boundary stage (reuse, recovery and recycling potential) therefore, when summing up results, this stage should be considered separately].*

**: *The indicators results are calculated with a reference product based on annual production volume (following the dedicated market share). The indicators results span between the reference product and the 100% sourced product from each dedicated plant may vary more than 10% (concerning A1- A3).*

Use of resources: 1 m² of Rock Mineral Wool FKL, FKL C1, FKL C2 with a thickness of 100 mm.

PARAMETER		UNIT	TOTAL A1-A3**	A4	A5	TOTAL B1-B2-B3-B4-B5-B6-B7	C1	C2	C3	C4	D*
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	1.84E+01	6.12E-01	3.46E-01	0.00E+00	0.00E+00	2.61E-02	0.00E+00	2.45E-01	-5.10E+00
	Used as raw materials	MJ, net calorific value	1.36E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	TOTAL	MJ, net calorific value	3.20E+01	6.12E-01	3.46E-01	0.00E+00	0.00E+00	2.61E-02	0.00E+00	2.45E-01	-5.10E+00
Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value	1.55E+02	1.06E+01	3.41E+00	0.00E+00	0.00E+00	4.53E-01	0.00E+00	1.88E+00	-9.12E+00
	Used as raw materials	MJ, net calorific value	1.08E+01	0.00E+00	1.45E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	TOTAL	MJ, net calorific value	1.66E+02	1.06E+01	3.55E+00	0.00E+00	0.00E+00	4.53E-01	0.00E+00	1.88E+00	-9.12E+00
Secondary material		kg	1.50E+00	0.00E+00	3.00E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Renewable secondary fuels		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Non-renewable secondary fuels		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Net use of fresh water		m3	3.95E-02	7.13E-04	3.73E-03	0.00E+00	0.00E+00	3.04E-05	0.00E+00	4.73E-04	-1.87E-03

*: *[Life Cycle D stage covers benefits and loads beyond the system boundary stage (reuse, recovery and recycling potential) therefore, when summing up results, this stage should be considered separately].*

**: *The indicators results are calculated with a reference product based on annual production volume (following the dedicated market share). The indicators results span between the reference product and the 100% sourced product from each dedicated plant may vary more than 10% (concerning A1- A3).*

Waste production and output flows: 1 m² of Rock Mineral Wool FKL, FKL C1, FKL C2 with a thickness of 100 mm.

Waste production

PARAMETER	UNIT	TOTAL A1-A3**	A4	A5	TOTAL B1-B2-B3-B4-B5-B6-B7	C1	C2	C3	C4	D*
Hazardous waste disposed	kg	1.79E-07	4.91E-07	0.00E+00	0.00E+00	0.00E+00	2.09E-08	0.00E+00	2.86E-08	-3.43E-09
Non-hazardous waste disposed	kg	1.23E+00	1.68E-03	2.22E-01	0.00E+00	0.00E+00	7.18E-05	0.00E+00	9.43E+00	-3.57E-03
Radioactive waste disposed	kg	3.53E-03	1.96E-05	9.37E-05	0.00E+00	0.00E+00	8.35E-07	0.00E+00	2.13E-05	-5.13E-04

*: *[Life Cycle D stage covers benefits and loads beyond the system boundary stage (reuse, recovery and recycling potential) therefore, when summing up results, this stage should be considered separately].*
**: *The indicators results are calculated with a reference product based on annual production volume (following the dedicated market share). The indicators results span between the reference product and the 100% sourced product from each dedicated plant may vary more than 10% (concerning A1- A3).*

Output flows

PARAMETER	UNIT	TOTAL A1-A3**	A4	A5	TOTAL B1-B2-B3-B4-B5-B6-B7	C1	C2	C3	C4	D*
Components for reuse	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Material for recycling	kg	0.00E+00	0.00E+00	4.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for energy recovery	kg	0.00E+00	0.00E+00	6.31E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, electricity	MJ	0.00E+00	0.00E+00	1.79E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Exported energy, thermal	MJ	0.00E+00	0.00E+00	3.62E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

*: *[Life Cycle D stage covers benefits and loads beyond the system boundary stage (reuse, recovery and recycling potential) therefore, when summing up results, this stage should be considered separately].*
**: *The indicators results are calculated with a reference product based on annual production volume (following the dedicated market share). The indicators results span between the reference product and the 100% sourced product from each dedicated plant may vary more than 10% (concerning A1- A3).*

LCA interpretation

ENVIRONMENTAL IMPACTS

All impact categories, except the Abiotic Depletion Potential Element and the Ozone Depletion Potential, are dominated by the manufacturing processes. This can be explained by the huge impact of the energy use (electricity, natural gas and coke) for Rock Mineral Wool production.

The Global Warming Potential (GWP) is dominated by the manufacturing in the cupola, mostly due to CO_2 emissions from raw materials and energy consumption (50%). The production of the binder represents more than 15% of the impact.

The Ozone layer Depletion Potential (ODP) results are under the high influence of the selected scenario for plastic sheets packaging incineration.

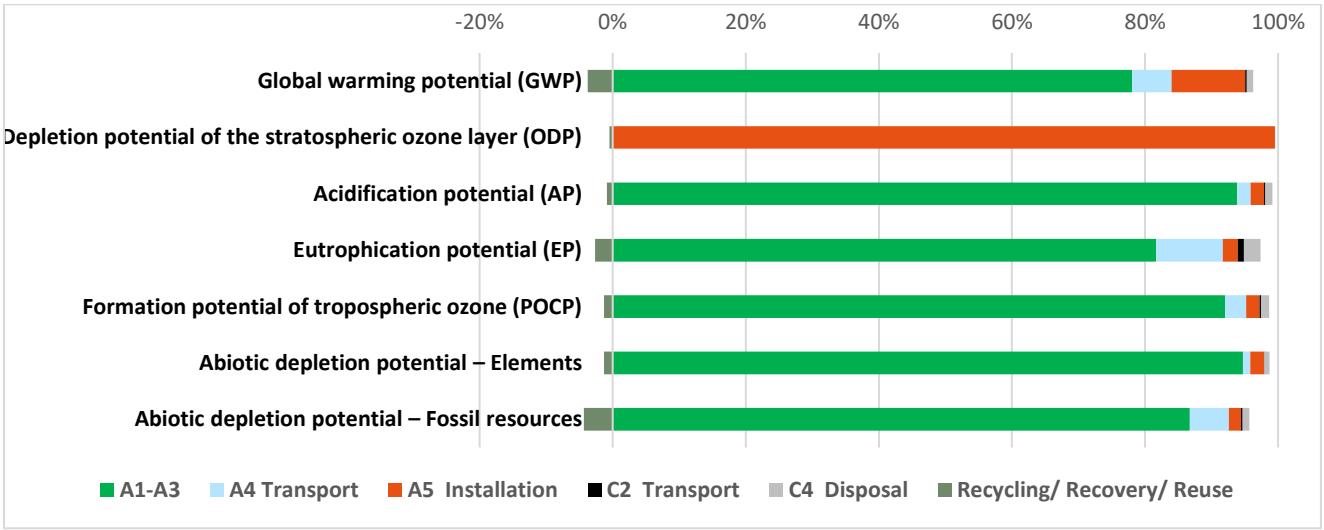
The Acidification Potential (AP) is also dominated by the manufacturing due to the emissions related to the processes and the energy consumption.

The Eutrophication Potential (EP) is significantly influenced by the manufacturing due to emissions from cupola furnace, curing oven and other unit processes.

The Photochemical Ozone Creation Potential (POCP) is particularly dominated by the manufacturing (emissions in the cupola furnace and other unit processes).

The Abiotic Depletion Potential Element (ADPe) is mainly due to the cement utilized in the briquettes production process in order to recycle secondary materials from the lines, the briquettes are reinjected into the melting batch. The impact of the raw materials in general, like the volcanic rock basalt, is very minor as this material is very abundant on Earth. The thermo set resin binder has also an important impact on ADPe indicator due to the fossil origin.

The Abiotic Depletion Potential Fossil (ADPf) is dominated by the use of coke as energy carrier. Next to the coke, we have also the impact of natural gas and upstream the electricity energy mix.



RESOURCES USE

Total Use of Non-Renewable Primary Energy Resources (PENRT) is dominated by the manufacturing of rock mineral wool products (especially due to the energy carrier, coke) and the binder.

Total Use of Renewable Primary Energy Resources (PERT) is dominated by the manufacturing, mostly due to electricity consumption and packaging.

For the Use of Secondary Material (SM), it consists of slags and some minor mineral wool waste.

References

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DoP R4308GPCPR, R4238GPCPR
Declaration of Performance

DIN 4102-17
Fire behaviour of building materials and building components - Part 17: Melting point of mineral wool insulating materials - Terms and definitions, requirements and test

Contact information:

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