ENVIRONMENTAL PRODUCT DECLARATION

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

Owner of the Declaration	Armacell GmbH
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-ARM-20200221-IBB1-EN
Issue date	12.03.2021
Valid to	11.03.2026

SH/ArmaFlex insulation for building equipment and industrial installations

Armacell GmbH

Institut Bauen und Umwelt e.V.

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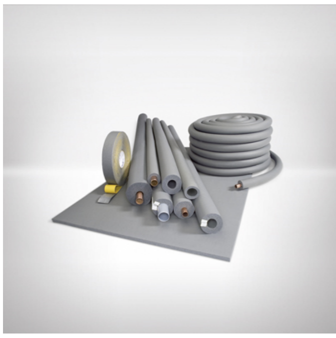

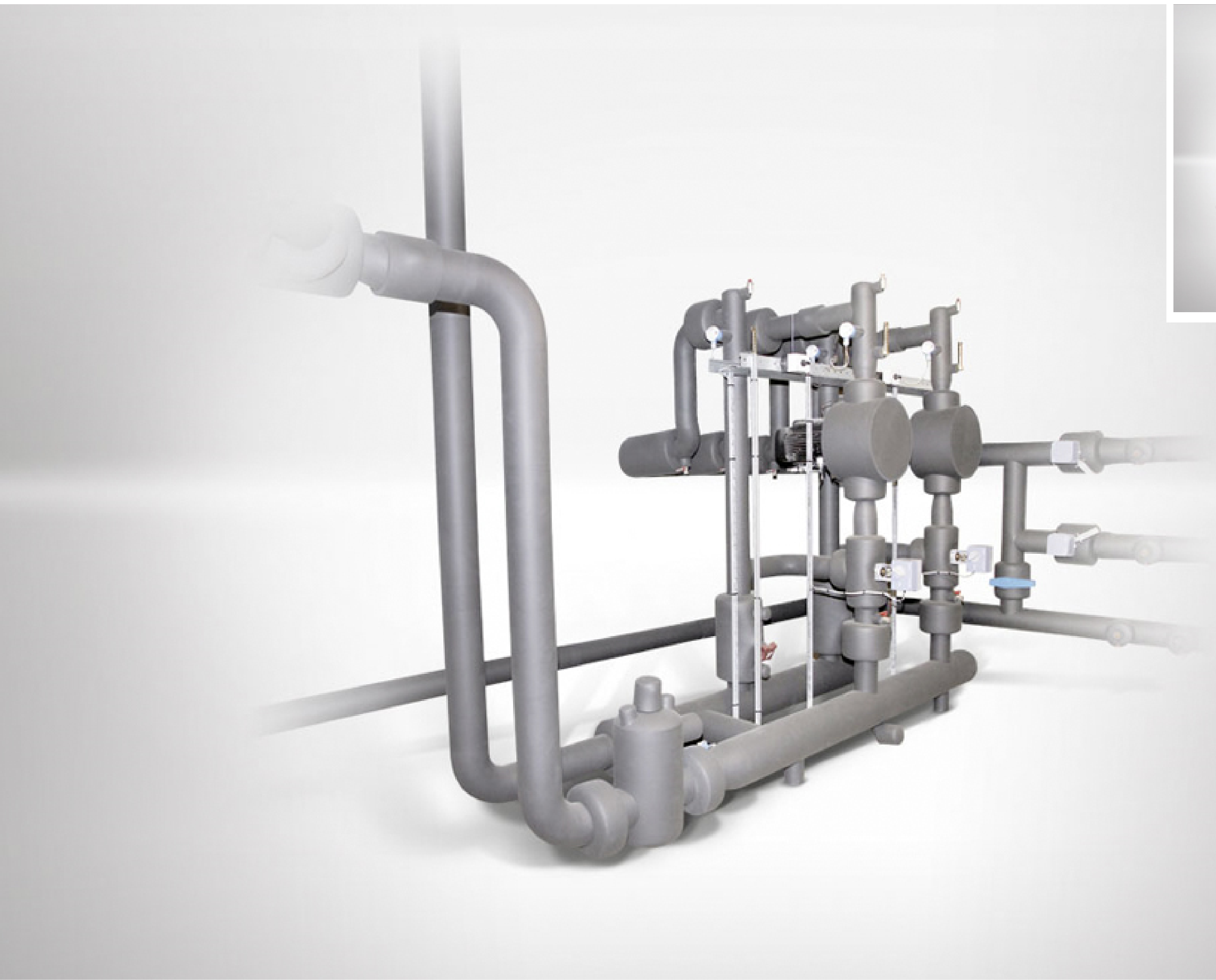

1. General Information

Armacell GmbH	SH/ArmaFlex
Programme holder IBU – Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the declaration** Armacell GmbH Robert-Bosch-Str. 10 48153 Münster - Germany
Declaration number EPD-ARM-20200221-IBB1-EN	**Declared product / declared unit** 1m³ insulation material SH/ArmaFlex
This declaration is based on the product category rules: Insulating materials made of foam plastics, 06.2017 (PCR checked and approved by the SVR) **Issue date** 12.03.2021 **Valid to** 11.03.2026	**Scope:** Product line SH/ArmaFlex Insulation material for industrial and building installations vulcanized in tubes and sheets. This declaration is an Environmental Product Declaration according to *ISO 14025* describing the average environmental performance of the product produced in Germany and Spain. The average has been calculated based on site specific annual production volumes. As the installation of the product is not restricted to countries where the products have been produced the validity of this EPD is considered at least EU wide 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*.
Dipl. Ing. Hans Peters (chairman of Institut Bauen und Umwelt e.V.)	**Verification** The standard *EN 15804* serves as the core PCR Independent verification of the declaration and data according to *ISO 14025:2010* ☐ internally ☒ externally
Dr. Alexander Röder (Managing Director Institut Bauen und Umwelt e.V.))	Mr Carl-Otto Neven (Independent verifier)

2. Product

2.1 Information about the enterprise

Armacell International GmbH is a producer of flexible insulation foams for the equipment insulation market and a provider of engineered foams which operates two main businesses:

- Advanced Insulation develops flexible foams for the insulation of technical equipment utilised for the transport of energy - such as heating, ventilation & air conditioning (HVAC) and heating & plumbing (H&P) in residential and commercial construction, process lines in the heavy- and oil & gas industry, equipment in transportation, as well as, acoustics.
- Engineered Foams develops high-performance foams for the use in a broad range of end markets including transportation, automotive, wind energy, sports and construction.

The product focus is insulation materials enhancing the energy efficiency of technical equipment, high-performance foams for technical and lightweight applications, 100% recycled PET products and next-generation aerogel technology.

2.2 Product description/Product definition

SH/ArmaFlex is the professional, highly-flexible, closed-cell elastomeric foam insulation (FEF) for continuous energy saving and condensation control purposes. The technical properties prevent long-term energy losses and a longer life time expectancy of the installation.

For the placing on the market of the product in the European Union/European Free Trade Association (EU/EFTA) (with the exception of Switzerland) *Regulation (EU) No. 305/2011* (CPR) applies. The product needs a declaration of performance taking into consideration *EN 14304:2013-04* and the CE-marking. For the application and use the respective national provisions apply.

2.3 Application
SH/ArmaFlex is used to insulate pipes, air ducts and vessels including fittings and flanges of industrial installations and building equipment.

- Energy saving according to local energy-saving laws, prevention of heat loss and noise reduction of heating and plumbing systems.
- Condensation control and noise reduction in service-water and waste-water systems.

2.4 Technical Data

Constructional data

Name	Value	Unit
Gross density	47.5	kg/m^3
Water vapour diffusion resistance factor acc. to EN 12086, EN 13469	not relevant	-
Thermal conductivity	0,036/0,040 (40°C)	W/(mK)
Maximum service temperature acc. to EN 14706, EN 14707	+110	°C
Reaction to fire acc. to EN 13501-1	Tubes: BL-s3, d0/ CL-s3, d0/Sheets: C-s3, d0/D-s3, d0	-
Structure-borne sound transmission acc. to EN ISO 3822-1	<= 28 dB(A)	

Insulation materials on the basis of synthetic rubber do not absorb moisture from the air. For this reason the normal building moisture does not lead to an increase in thermal conductivity.

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to *EN 14304:2013-04*

2.5 Delivery status
FEF made of cross-linked elastomer is supplied as sheets, tubes and shaped pieces. Products with self-adhesive backings/closures are available; these variations are not included in the calculations. Insulation thicknesses are available for all common pipe diameters up to an outer diameter of 114 mm (tubes).

2.6 Base materials/Ancillary materials

ArmaFlex is a highly flexible insulation material based on synthetic rubber, which consists of around 20 basic components. The following table displays the composition split into functional substance groups.

Name	Value	Unit
Rubber and polymers	26	%
Fillers and pigments	2	%
Blowing agent	13	%
Vulcanisation system, additives, plasticisers	32	%
Flame retardant	27	%

Synthetic rubber determines the flexibility;
Fillers determine the fire properties and firmness;
Blowing agent causes the expansion process during manufacturing;
Accelerator and sulphur enable the vulcanisation;
Plasticizers determine the flexibility;
Flame retardants ensure fire resistance.

According to the European Chemicals Regulation *REACH* manufacturer, importers and downstream users must register their chemicals and are responsible for their safe use on their own. For its production Armacell uses exclusively verifiably registered and approved substances / mixtures. According to available data and the information provided by preliminary suppliers, the product does not contain substances (SVHC) that are considered substances meeting the criteria for inclusion in annex XIV (List of Substances Subject to Authorisation) as laid down in Article 57 and article 59 of REACH (EC) 1907/2006.). Products manufactured and marketed by Armacell do not have to be registered. The products may contain traces of azodicarbonamide (ACDA). Possible minimal residual amounts are included in the polymer matrix. A health impairment can be excluded. For the production of insulation material based on synthetic rubber, there is presently no alternative to ADCA available.
SH/Armaflex is treated with the antimicrobial biocide pyrithione zinc.

2.7 Manufacture
ArmaFlex products are manufactured in a pressureless, continuous and discontinuous production process.
In the first step, a homogenous compound is produced with rubber, additives, ancillary materials, blowing and vulcanization agents. This is done on the rolling mill or in the internal mixer followed by the rolling mill.
Rubber extruders are used to process the compounds to produce raw profiles with defined dimensions. Here exact compliance with the dimensions for the raw profile is crucial for the dimensional accuracy of the foamed product.
In the case of the discontinuous, pressureless production process, the raw profiles are cut to length and then foamed in a hot-air oven. In the case of the continuous, pressureless process, the extruded profile is fed directly onto a vulcanization line whose energy source may be hot air, for example.
In foam production, vulcanization and blowing processes run alongside each other. Both reactions are regulated by temperature control. Recipe and temperature control determine the properties of the foam.

Quality assurance:
EC Certificate of conformity no. 0543 of the *Gütegemeinschaft Hartschaum e.V. Celle.*
Quality management system in accordance with *EN ISO 9001*.

2.8 Environment and health during manufacturing

During all manufacturing steps and at all production sites of Armacell, the production follows the national guidelines and regulations. A regenerative thermal oxidizer is installed to treat exhaust air.
Certification of the environmental management system is in accordance with *ISO 14001*.

2.9 Product processing/Installation

The product is installed by using knives. No special tools, nor specific protection is necessary.
When applying adhesives the information given in the relevant safety data sheets is to be heeded.
The recommendations for installing the product depend on the product and system and are described in the respective documents (e.g. Armaflex application manual) and on the data sheets. More details under www.armacell.com.

2.10 Packaging

As a rule, ArmaFlex products are packaged in cardboard boxes and transported on reusable pallets. Over-sized rolls of sheet material are packaged in polyethylene (PE) foil. The cardboard boxes can be recycled through Interseroh's dual system.

2.11 Condition of use

When the products are used for the purpose for which they are intended, there are no changes in the material composition during use, except in the event of extraordinary impacts (see 2.14).

2.12 Environment and health during use

Ingredients: There are no particular aspects of the material composition during use.
Eurofins Product Testing A/S has tested a wide range and varieties of typical FEF (Flexible Elastomeric Foam) products marketed in the EU from *CEFEP* (European Group of FEF manufacturers). Sampling, testing and evaluation were performed according to *CEN TS 16516, AgBB, ISO 16000-3, ISO 16000-6, ISO 16000-9, ISO 16000-11* in the latest versions. Based on the loading factor 0.05 m²/m³, which was determined after consideration of real life applications with FEF products (in living rooms) and recommendation of experts of the test institute, all results were clearly below the limit values. For example, the determined total volatile organic compound (TVOC) after 28 days was for all samples below 100 mg/m3. Certificates are available on request.

2.13 Reference service life

ArmaFlex products are long-lasting products. Findings show that when used and installed properly they can have an estimated service life of more than 50 years. It is practically only restricted by the service life of the equipment or whole building, which can extent that time period. The insulation performance is almost completely maintained over the entire service life. The insulation performance is only compromised by extraordinary impacts and damage during construction.

2.14 Extraordinary effects

Fire
According to *EN 13501*, ArmaFlex is classified as a combustible insulation material. Due to its material structure ArmaFlex does not contribute to an uncontrollable spread of fire under installation conditions typical on a building site. ArmaFlex does not drip under practical fire conditions, this means that fire spread is ruled out. The product is self-extinguishing and therefore only makes a minor contribution to the actual fire event. There is no possibility of the material self-igniting. ArmaFlex does not propagate the fire either horizontally or vertically.

Fire protection

Name	Value
Euro class	Tubes: DL, CL / Sheets: C, D
Burning droplets	Tubes/Sheets: d0
Smoke development	Tubes/Sheets: s3

Water
Armacell insulation materials have a high resistance to water vapour transmission which keeps possible water vapour transmission processes to a minimum permanently. Therefore, a significant reduction in the insulation effect can be ruled out permanently.
If the insulation material is exposed to water over a long period of time (e.g. flooding) it should be replaced.

Mechanical destruction
ArmaFlex insulation materials are flexible foams and thus display limited mechanical stability. Therefore, if the material will be subject to greater mechanical impact it should be protected appropriately, e.g. by a metal jacket or Arma-Chek covering.
ArmaFlex products (with the exception of HT/ArmaFlex) are not UV resistant. If the material is subject to UV-rays it should be protected accordingly.

2.15 Re-use phase

If removed properly the product can be re-used. Correctly sorted material can be ground and used to manufacture new products (e.g. ArmaSound).

2.16 Disposal

Dispose of the materials according to local regulations. Regulated by the *European Waste Catalogue*: Waste code 07 02 13 (waste plastic).
Note: Please observe *Commission Decision 2001/118/EC*.

2.17 Further information

Further information on **ArmaFlex®** can be found on the manufacturer's website www.armacell.com. Detailed specification clauses for the products are provided at www.armaflex.de.

3. LCA: Calculation rules

3.1 Declared Unit

The declaration refers to 1 m³ insulation product.
For the LCA calculations the average density per product brand is used.
As additional information and support for installers the thermal conductivity coefficient (lambda-value) and R-value per 20 cm thickness per product brand are given.

Declared unit

Name	Value	Unit
Declared unit	1	m^3
Gross density	47.5	kg/m^3
Conversion factor to 1 kg	0.021	-
Declared unit	-	λ

Thermal conductivity λ : 0.040 W/(mK (40°C)
R-value – thickness: 20 cm: 5.0 (m²K)/W

3.2 System boundary

The data collection refers to the yearly production in 2019. The following life cycle stages are considered:

Type of EPD: Cradle-to-Gate with options:

Production A1-A3:
The LCA calculation covers the production of the raw materials (supply chain – A1), the mixing of raw materials according to the respective recipes (MasterBatch) exclusively done in Münster, Germany, the transport (A2) of the MasterBatches to the production facility for foaming and the foaming process (A3) in Germany, Spain, Poland or Great Britain, including the packaging material.
Transport A4:
Average values for the transport from factory gate to construction site are assumed.
Installation A5:
The installation considers the production of off-cuts, incineration of these off-cuts and the disposal scenario for the packaging material. Auxiliaries like adhesives or tapes or energy for installation are not considered.
End-of-life C2, C3:
An incineration scenario for the used and demolished product, including an assumption for the transport to disposal, is covered.
Benefits for the next product system D:
Credits for electrical and thermal energy resulting from the waste incineration process of the off-cut material and packaging (A5) and the product (C3) are declared in module D.

3.3 Estimates and assumptions

Scenario assumptions:
Installation (A5):
The additional demand of material for installation depends on the specific frame conditions of the building and pipe system to be insulated. Parts of the product can be joined; thus installation off-cut is very small. A loss of 1% is assumed.
Transport to customer (A4):
Armacell's data collectors reported average figures for the distribution of their material. Depending on the country, the transport distance varies from 500 km to 800 km
End-of-life (C2, C3):
The transport from place of usage to a waste incineration plant is assumed as 100 km.
After the demolition of the product a current realistic End-of-life scenario is the incineration of the material. According to the reported net calorific value of the materials and the elementary composition, a partial stream consideration for the incineration process of PVC-products is applied as an approximation for all declared products.
Inventory estimations and approximations:
The reported recipes for the rubber mixes contain specific substances of the rubber industry. For these materials only partly life cycle inventories are available. Approximations are used with the consideration of similar supply chain effort or similar elementary composition. Partly an estimation is modelled using pre-products of the specific material and adding an energy effort as well as considering the treatment of production residues for this step in the supply chain.

3.4 Cut-off criteria

In the assessment, all reported data from the production process are considered, utilised thermal energy, and electric power consumption using best available life cycle inventory (LCI) datasets. Thus material and energy flows contributing less than 1% of mass or energy are considered.
No cut-off criteria are applied in the foreground data in this study.
For cut-off criteria in the background system, see information provided in the modelling principles and specific documentations (documentation.gabi-software.com).

3.5 Background data

The LCA model is created using the *GaBi* ts Software system (v9) for life cycle engineering, developed by Sphera. The *GaBi* LCI database provides the life cycle inventory data for several of the raw and process materials obtained from the background system. The most recent update of the database was 2020.

3.6 Data quality

The foreground data collected by the manufacturer are based on yearly production amounts and extrapolations of measurements on specific machines and plants. As the average environmental performance of the product brand has been calculated by a weighting of the site-specific production volumes the results also show a representative picture regarding site specific production technologies. The average results therefore can be assessed as robust.
Most of the necessary life cycle inventories for the basic materials are available in the *GaBi* database. The last update of the database was in 2020 (service pack 40).
Further LCIs for materials of the supply chain of the basic materials are approximated with LCIs of similar materials or estimated by the combination of available LCIs.
For electrical and thermal energy regional specific grid mixes and regional specific supply for natural gas are considered.

3.7 Period under review

The production data refer to an average of the year 2019.

3.8 Allocation

Allocation of upstream data:
For all refinery products, allocation by mass and net calorific value is applied. The specific manufacturing route of every refinery product is modelled and so the impacts associated with the production of these products are calculated individually.
Materials and chemicals used in the manufacturing process are modelled using the allocation rule most suitable for the respective product. For further information on a specific product see documentation.gabi-software.com.
Allocation in the foreground data:
Part of the production residues (ca. 2%) are used for the manufacturing of a non-declared product (ArmaSound). These materials leave the process without further consideration of any treatment and without credit (cut-off-approach).
No further allocation is applied in the software model.
The overall production of the Armacell production facilities comprises further products beside the products considered in this study. Data for thermal and electrical energy, as well as auxiliary material, refer to the declared products only. During data collection the allocation is done via mass, area, pieces or time spent in the machine, depending on the process step and reasonable split.. The data collectors at Armacell decided on the distribution basis.
Allocation for waste materials:
Production waste is sent to a waste incineration plant and to landfill (Spain). Resulting electrical and thermal energy from the incineration process is looped inside module A1-A3. The quality of the recovered energy is assumed to the same as that of the input energy.
Landfilling of plastic material is assumed not to deliver any landfill gas.
All applied incineration processes are displayed via a partial stream consideration for the combustion process, according to the specific composition of the incinerated material. For the waste incineration plant an R1-value of > 0.6 is assumed.
Environmental burden of the incineration of installation residues (off-cuts), packaging and the product in the end-of-life scenario are assigned to the system (A5 or C3); resulting credits for thermal and electrical energy are declared in module D.
The credits for thermal and electrical energy are calculated via inversion of the life cycle inventory of European average data.
Allocation for waste paper:
Paper/corrugated board is used as packaging material and this usually includes a mix of recycled and virgin fibres. When modelling the production of paper, the scrap paper that is used in this process has been assumed to be burden free. Similarly, waste paper arising in the product life cycle is assumed to be recycled. Robust data on paper and cardboard recycling are not promptly available and refer to a very complex system. Hence, to apply this methodology consistently throughout the model, a cut-off approach has been applied, i.e., input of waste paper is considered without environmental burden, resulting waste paper is not credited. The recycling process and the production process of paper are merged in the production process. The C-balance referring to fresh fibre is corrected via CO2 emissions (biotic) (assumption of final rotting or incineration in the time frame of 100 years).

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.

The used background dataset DB has been GaBi (service pack 40, 2020).

4. LCA: Scenarios and additional technical information

Characteristic product properties
Information on biogenic Carbon

The biogenic carbon content quantifies the amount of biogenic carbon in a construction product leaving the factory gate, and it shall be separately declared for the product and any accompanying packaging.If the total mass of biogenic carbon containing materials is less than 5 % of the total mass of the product and accompanying packaging, the declaration of biogenic carbon content may be omitted. The mass of packaging containing biogenic carbon shall always be declared.
Note: 1 kg biogenic Carbon is equivalent to 44/12 kg of CO2

Information on describing the biogenic Carbon Content at factory gate

Name	Value	Unit
Biogenic Carbon Content in product	0	kg C
Biogenic Carbon Content in accompanying packaging	25.62	kg C

The embodied biogenic carbon leaves the system in Module A5.

The following technical information serves as basis for the declared modules. The values refer to the declared unit of 1 m³.

Transport to the building site (A4)

Name	Value	Unit
Litres of fuel	0.11 - 0.14	l/100km
Transport distance	700 - 800	km
Capacity utilisation (including empty runs)	85	%

Installation into the building (A5)

Name	Value	Unit
Material loss	1	%

Estimated service life

Name	Value	Unit
Life Span according to the manufacturer	50	a

End of life (C1-C4)

Name	Value	Unit
Energy recovery in WIP	47,5	kg

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

Module D includes the credits of the incineration processes from A5 (off-cut of product installation, packaging waste) and C3 (incineration of the product). A waste incineration plant with an R1-value > 0.6 is assumed.

5. LCA: Results

The following information on environmental impacts is expressed with the impact category parameters of LCIA using characterisation factors. The chosen characterisation factors fulfil the requirements of *EN 15804*.

Disclaimer:
EP-freshwater: This indicator has been calculated as “kg P eq” as required in the characterization model (EUTREND model, Struijs et al., 2009b, as implemented in ReCiPe; http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml)

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	ND	ND	MNR	MNR	MNR	ND	ND	ND	X	X	ND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m³ SH/ ArmaFlex insulation for industrial and building installation

Core Indicator	Unit	A1-A3	A4	A5	C2	C3	D
Global warming potential - total	[kg CO_2-Eq.]	1.56E+2	3.15E+0	6.34E+1	2.27E-1	1.23E+2	-3.43E+1
Global warming potential - fossil fuels	[kg CO_2-Eq.]	2.14E+2	3.13E+0	3.93E+0	2.25E-1	1.23E+2	-3.42E+1
Global warming potential - biogenic	[kg CO_2-Eq.]	-5.79E+1	-5.34E-3	5.94E+1	-3.85E-4	-5.38E-2	-8.03E-2
GWP from land use and land use change	[kg CO_2-Eq.]	4.26E-1	2.53E-2	4.95E-3	1.82E-3	2.51E-2	-2.39E-2
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	1.08E-9	3.76E-16	1.09E-11	2.71E-17	1.88E-13	-3.56E-13
Acidification potential, accumulated exceedance	[mol H^+-Eq.]	9.63E-1	9.37E-3	1.20E-2	6.75E-4	3.66E-2	-4.78E-2
Eutrophication, fraction of nutrients reaching freshwater end compartment	[kg PO_4-Eq.]	2.52E-3	9.50E-6	2.61E-5	6.84E-7	3.16E-5	-4.40E-5
Eutrophication, fraction of nutrients reaching marine end compartment	[kg N-Eq.]	1.45E-1	4.17E-3	2.23E-3	3.01E-4	1.21E-2	-1.24E-2
Eutrophication, accumulated exceedance	[mol N-Eq.]	1.38E+0	4.67E-2	2.46E-2	3.37E-3	1.48E-1	-1.33E-1
Formation potential of tropospheric ozone photochemical oxidants	[kg NMVOC-Eq.]	1.27E+0	8.25E-3	1.49E-2	5.94E-4	3.43E-2	-3.56E-2
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	3.74E+3	4.16E+1	4.33E+1	3.00E+0	2.27E+2	-5.80E+2
Abiotic depletion potential for fossil resources	[MJ]	8.84E-1	2.24E-7	8.93E-3	1.61E-8	2.70E-6	-5.60E-6
Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	[m³ world-Eq deprived]	3.43E+1	2.79E-2	1.78E+0	2.01E-3	9.53E+0	-3.53E+0

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 m³ SH/ ArmaFlex insulation for industrial and building installation

Indicator	Unit	A1-A3	A4	A5	C2	C3	D
Renewable primary energy as energy carrier	[MJ]	1.26E+3	2.34E+0	1.05E+2	1.69E-1	4.71E+1	-1.26E+2
Renewable primary energy resources as material utilization	[MJ]	9.04E+1	0.00E+0	-9.04E+1	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	1.35E+3	2.34E+0	1.47E+1	1.69E-1	4.71E+1	-1.26E+2
Non-renewable primary energy as energy carrier	[MJ]	2.88E+3	4.17E+1	4.89E+1	3.00E+0	1.10E+3	-5.80E+2
Non-renewable primary energy as material utilization	[MJ]	8.75E+2	0.00E+0	-5.45E+0	0.00E+0	-8.69E+2	0.00E+0
Total use of non-renewable primary energy resources	[MJ]	3.75E+3	4.17E+1	4.34E+1	3.00E+0	2.27E+2	-5.80E+2
Use of secondary material	[kg]	3.40E+1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m³]	1.55E+0	2.71E-3	4.96E-2	1.95E-4	2.50E-1	-1.46E-1

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1 m³ SH/ ArmaFlex insulation for industrial and building installation

Indicator	Unit	A1-A3	A4	A5	C2	C3	D
Hazardous waste disposed	[kg]	2.26E-5	1.94E-6	2.60E-7	1.40E-7	1.03E-6	-2.31E-7
Non-hazardous waste disposed	[kg]	1.58E+1	6.38E-3	1.04E+0	4.59E-4	7.55E+1	-2.68E-1
Radioactive waste disposed	[kg]	9.23E-2	5.16E-5	1.17E-3	3.71E-6	7.21E-3	-4.31E-2
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	0.00E+0	3.01E+1	0.00E+0	0.00E+0	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	1.89E+1	0.00E+0	1.24E+2	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	3.40E+1	0.00E+0	2.26E+2	0.00E+0

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m³ SH/ ArmaFlex insulation for industrial and building installation

Indicator	Unit	A1-A3	A4	A5	C2	C3	D
Potential incidence of disease due to PM emissions	[Disease Incidence]	5.31E-5	5.19E-8	5.56E-7	3.74E-9	8.81E-7	-4.06E-7
Potential Human exposure efficiency relative to U235	[kBq U235-Eq.]	9.12E+0	7.46E-3	1.25E-1	5.37E-4	7.32E-1	-7.07E+0
Potential comparative toxic unit for ecosystems	[CTUe]	3.82E+3	2.94E+1	4.20E+1	2.12E+0	1.88E+2	-1.25E+2
Potential comparative toxic unit for humans - cancerogenic	[CTUh]	9.29E-8	6.16E-10	1.10E-9	4.44E-11	7.45E-9	-5.42E-9
Potential comparative toxic unit for humans - not cancerogenic	[CTUh]	8.64E-6	3.58E-8	9.88E-8	2.58E-9	7.92E-7	-2.01E-7
Potential soil quality index	[-]	4.08E+3	1.46E+1	4.26E+1	1.05E+0	5.15E+1	-9.08E+1

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

Disclaimer 2 – for the indicators ADPE, ADPF, WDP, ETP-fw, HTP-c, HTP-nc, SQP
The results of this environmental impact indicator shall be used with care as theuncertainties on these results are high or as there is limited experience with the indicator.

6. LCA: Interpretation

The supply chain, i.e. the production of the purchased materials, causes the highest influence on all impact categories and the primary energy.

Global Warming Potential
Looking at the **GWP** for the overall declared life cycle phases, including production (A1-A3), transport (A4, C2), installation (losses) (A5) and end-of-life (C3, D), the production (A1-A3) contributes to 50%.
The production in the supply chain (A1) already contributes 44% to the total GWP value. Thus, every increase in the production yield directly improves the environmental performance of the products.
The foaming process (A3), which includes the electrical and thermal energy for the mixing, the vulcanisation and blowing step as well as the production of the packaging materials, shows a significant influence on GWP of the life cycle with 6%.
Module A5 covers the production and disposal (=incineration) of the off-cut material assumed as 1% loss in respect to the required insulation material. Additionally, the emissions of the incineration of packaging material (plastic, wood) in a waste incineration plant are considered. The installation step contributes with 20% to the overall GWP.
As end-of-life scenario an incineration is considered. The emissions of the product (C3) contribute to 39% to the overall green house gas emissions. At the same time a credit (D) of 11% is given to the next system, due to the use of electrical and thermal energy, gained in the incineration processes for the product and the off-cut material.

Further impact categories
The end-of-life scenarios have less influence on the other considered impact categories than on GWP. The main contribution of the considered life cycle phases is concentrated on module A1-A3.
The energy consumption in the foaming step influences all impact categories; variations depend on the national grid mixes for electricity.

Primary Energy Demand
The total primary energy demand is for both categories (renewable and non-renewable) significantly (> 100%) influenced by the production of the module A1-A3. The other modules play a minor role (C3 with about 6%)

The share of primary energy bound as material accounts for about 20%, which is partly recovered and credited for in module D (-15%)

7. Requisite evidence

7.1 VOC emissions
Eurofins Product Testing A/S has tested a wide range and varieties of typical FEF (Flexible Elastomeric Foam) products marketed in the EU from *CEFEP* (European Group of FEF manufacturers). Sampling, testing and evaluation were performed according to *CEN TS 16516, AgBB, ISO 16000-3, ISO 16000-6, ISO 16000-9, ISO 16000-11* in the latest versions. Based on the loading factor 0.05 m²/m³, which were determined after consideration of real life applications with FEF products (in living rooms) and recommendation of the experts of the test institute, all results were clearly below the limit values. For example the determined total volatile organic compound (TVOC) after 28 days was for all samples below 100 mg/m3. Certificates are available on request.

7.2 Leaching performance
According to *EN 13468* is the content of water-soluble chloride ions for SH/Armaflex ≤ 300 ppm.

8. References

AgBB
Umweltbundesamt Germany, Health-related Evaluation of Emissions of Volatile Organic Compounds (VVOC, VOC and SVOC) from Building Products

CEFEP
The industry association for FEF and PEF insulation (Celle) in 2012

CEN TS 16516
CEN TS 16516:2013-12: Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air

Comission Decision 2001/118/EC
Amendment to European Waste Catalogue

CPR
Regulation (EC) No 305/2011, Construction Products Regulation

EN 826
EN 826: 2013-05: Thermal insulating products for building applications - Determination of compression behaviour

EN 1606
EN 1606: 2013-05: Thermal insulating products for building applications - Determination of compressive creep

EN 12091
EN 12091: 2013-06: Thermal insulating products for building applications - Determination of freeze-thaw resistance

EN 12086
EN 12086:2013-06: Thermal insulating products for building applications - Determination of water vapour transmission properties

EN 13468
EN 13468: 2001-12: Thermal insulating products for building equipment and industrial installations - Determination of trace quantities of water soluble chloride, fluoride, silicate, and sodium ions and pH

EN 13469
EN 13469:2013-01: Thermal insulating products for building equipment and industrial installations - Determination of water vapour transmission properties of preformed pipe insulation

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

EN 14304
EN 14304:2013-04: Thermal insulation products for building equipment and industrial installations – Factory made flexible elastomeric foam (FEF) products – Specification

EN 14706
EN 14706: 2013-01: Thermal insulating products for building equipment and industrial installations - Determination of maximum service temperature

EN 14707
EN 14707: 2013-01: Thermal insulating products for building equipment and industrial installations - Determination of maximum service temperature for preformed pipe insulation

EN 15801
EN 15801: 2010-04: Conservation of cultural property - Test methods - Determination of water absorption by capillarity

EN 15804
EN 15804:2012-04+A1 2013, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

EN 15804
EN 15804:2019+A2 (in press), Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

EN 29052
EN 29052: 1992-08: Acoustics; determination of dynamic stiffness; part 1: materials used under floating floors in dwellings

EU/EFTA
Regulation (EU) No. 305/2011 (CPR), European Union/European Free Trade Association (EU/EFTA)

Eurofins Product Testing A/S
Eurofins Miljo, Smedeskowej 38, 8464 Galten, Denmark

European Waste Catalogue
European Waste Catalogue and Hazardous Waste List, Commission Decision 2000/532/EC

GaBi
GaBi 9 software-system and databases, LBP, University of Stuttgart and Sphera, Leinfelden-Echterdingen, 2020 (http://documentation.gabi-software.com/)

IBU
Institut Bauen und Umwelt e.V.: General Programme Instructions for the Preparation of EPDs at the Institut Bauen und Umwelt e.V. Version 1., Berlin: Institut Bauen und Umwelt e.V., 2016. www.ibu-epd.com

IBU PCR Part A
PCR - Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report, Institut Bauen und Umwelt e.V., www.ibu-epd.com, 2019.

IBU PCR PART B
PCR – Part B: Requirements on the EPD for Insulation materials made of foam plastics, version 1.7, 01-2019 , Institut Bauen und Umwelt e.V., www.ibu-epd.com, 2019

ISO 3822-1
ISO 3822-1: 1999-05: Acoustics - Laboratory tests on noise emission from appliances and equipment used in water supply installations - Part 1: Method of measurement

ISO 9001
ISO 9001:2014-08: Quality management systems – Requirements

ISO 11654
ISO 11654: 1997-04: Acoustics - Sound absorbers for use in buildings - Rating of sound absorption

ISO 14001
ISO 14001:2015, Environmental management systems — Requirements with guidance for use

ISO 14025
ISO 14025:2011-10, Environmental labels and declarations — Type III environmental declarations — Principles and procedures.

ISO 14040
ISO 14040:2009-11: Environmental management – Life cycle assessment – Principles and framework

ISO 14044
ISO 14044:2006-10: Environmental management – Life cycle assessment – Requirements and guidelines

ISO 15868
ISO 15686:2011-05, Buildings and constructed assets - Service life planning

ISO 16000-11
ISO 16000-11: 2006-02: Indoor air - Part 11: Determination of the emission of volatile organic compounds from building products and furnishing - Sampling, storage of samples and preparation of test specimens

ISO 16000-3
ISO 16000-3:2011-10: Determination of formaldehyde and other carbonyl compounds in indoor air and test chamber air - Active sampling method

ISO 16000-6
ISO 16000-6:2011-12: Indoor air - Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA® sorbent, thermal desorption and gas chromatography using MS or MS-FID

ISO 16000-9
ISO 16000-9:2006-02: Indoor air - Part 9: Determination of the emission of volatile organic compounds from building products and furnishing - Emission test chamber method

REACH
Regulation (EC) No 1907/2006, Regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

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