

# Annex to the ENVIRONMENTAL PRODUCT DECLARATION EPD-BAU-20220210-CBC2-EN

Owner of the Declaration	Paul Bauder GmbH & Co. KG
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Valid to	09.11.2024

**BauderECO S/F (Mass Balance)**  
**Paul Bauder GmbH & Co. KG**



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## General Information

### Paul Bauder GmbH & Co. KG

#### Programme holder

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

#### Declaration number

Annex to EPD-BAU-20220210-CBC2-EN

#### This declaration is based on the product category rules:

Insulating materials made of foam plastics, 01.08.2021  
(PCR checked and approved by the SVR)

#### Issue date

10.11.2022

#### Valid to

09.11.2024



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



Florian Pronold  
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### BauderECO S/F (Mass Balance)

#### Owner of the declaration

Paul Bauder GmbH & Co. KG  
Korntaler Landstraße 63  
70499 Stuttgart  
Germany

#### Declared product / declared unit

1 m<sup>2</sup> BauderECO S/F (Mass Balance)

#### Scope:

This declaration applies to 1 m<sup>2</sup> of "BauderECO S/F" manufactured by Paul Bauder GmbH & Co. KG at the plant, located in 06188 Landsberg near Halle.

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*.

The standard EN 15804 serves as the core PCR

Independent verification of the declaration and data according to ISO 14025:2011

internally

externally



Dr. Eva Schmincke,  
(Independent verifier)

## Product

### Product description/Product definition

BauderECO S/F is a closed-cell ecological rigid foam and factory-made thermal insulating material, which is used in the form of insulation boards for building constructions - pursuant to EN 13165. This EPD refers to ecological rigid foam insulation boards laminated with covering layers of shell limestone on both sides.

The products need a declaration of performance taking into consideration the specification DIN EN 13165:2012+A2:2016 thermal insulation products for buildings - factory made rigid polyurethane foam (PU) products - as well as the CE-marking.

The respective national provisions apply to the use of the products. In Germany, the design values for use in building construction are specified in DIN 4108 - 10. Hygrothermal design values are regulated in DIN 4108-4.

### Application

The scope of application of BauderECO S/F includes thermal insulation in building construction (e.g., pitched roofs, flat roofs, floors, ceilings and exterior walls (inside and outside)).

### Technical Data

For determining technical data, the test methods stated in DIN EN 13165 are used. The gross density of BauderECO S/F with facing layers of shell limestone for building construction is approx. 29-32 kg/m<sup>3</sup>.

Depending on their thickness, the boards are manufactured with thermal conductivity levels WLS 024 up to WLS 028. These levels are equivalent to thermal conductivity design values from 0.023 W/(m·K) up to 0.027 W/(m·K). In addition to thermal conductivity, the nominal value of the thermal resistance can be specified ranging from R 2.20 (m<sup>2</sup>·K)/W at 60 mm to 7.80 (m<sup>2</sup>·K)/W at 180 mm.

Name	Value	Unit
Gross density	≥ 29	kg/m <sup>3</sup>
Compressive strength EN 826	≥ 120	N/mm <sup>2</sup>
Tensile strength EN 826	≥ 80	N/mm <sup>2</sup>
Modulus of elasticity EN 826	≥ 4	N/mm <sup>2</sup>
Calculation value for thermal conductivity DIN 4108 - 4	0.024 - 0.028	W/(mK)
Water vapour diffusion resistance factor EN 12088	40 - 200	-
Thermal conductivity EN 13165	0.023 - 0.027	W/(mK)
Creep behaviour or permanent compressive strength EN 1606	≥ 0.02	N/mm <sup>2</sup>
Long term water absorption acc. to EN 12087	max. 3	%
Short term water absorption acc. to EN 1609	max. 0.1	%
Fire behaviour acc. to EN 13501 - 1	E	

Nominal compressive stress or nominal compressive strength at 10% deformation is 120 kPa (dh) according to DIN 4108-10. Higher compressive strength is possible. Nominal tensile strength perpendicular to the insulation board plane is 80 kPa. Higher tensile strength is possible.

The water vapour diffusion resistance factor  $\mu$  of BauderECO S/F is between 40 and 200 according to DIN 4108-4.

Maximum moisture absorption of BauderECO S/F at diffusion and condensation is approx. 6 % by volume. Water absorption at total immersion of a 60 mm thick BauderECO S/F with shell limestone facings was measured at 1.3 % by volume after 28 days. Moisture absorption after freezing and thawing was between 2 % and 7 % by volume, measured at insulating material without facings.

BauderECO S/F is a distinctive thermosetting material and therefore cannot be melted.

### Base materials/Ancillary materials

The 120 mm thick BauderECO S/F insulation board with shell limestone facing layer consists of 3.48 kg/m<sup>2</sup> ecological hard foam and 0.55 kg/m<sup>2</sup> shell limestone layer.

The product composition is specified in the following table:

Name	Value	Unit
Polyol	23 - 28	%
MDI (Mass-Balance)	52 - 55	%
Water	≤ 0,3	%
Pentane	≤ 5	%
Catalyst	≤ 1,5	%
Flame retardants (halogen free)	≤ 2	%
Stabilizer	≤ 0,7	%
Facer	7 - 14	%

The raw material used for producing BauderECO S/F is mainly obtained from biomass undergoing several production stages. The biomass contained in the declared product (approx. 1.6 kg biogenic carbon) complies with the mass balance approach. Monitoring of the mass balance rate is certified by RedCert. In addition to fossil raw materials, another raw material is obtained from recycled saw and milling dust, which is a by-product of the manufacturing of the BauderECO S/F insulation boards and is partly re-used in a closed-loop. BauderECO S/F does not contain volatile isocyanates.

Under the current Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) BauderECO S/F is declared as follows:

- BauderECO S/F contains substances listed in the Candidate List for authorization on 16 January 2020 exceeding 0.1 percentage by mass: no.
- BauderECO S/F contains other carcinogenic, mutagenic, reprotoxic (CMR) substances in categories 1A or 1B, which are not on the candidate list, exceeding 0.1 percentage by mass: no.
- Biocide products were added to this construction product or it has been treated with biocide products (which would be considered a treated product under the definition set out in (EU) Ordinance on Biocide Products No 528/2012): no.

### Reference service life

The service life of BauderECO S/F insulation boards corresponds to the service life of the insulated building components when used properly. The function of the insulation material remains without limitations during the service life.

### Additional information

Additional information about BauderECO S/F insulation boards can be found at: [www.baudereco.de](http://www.baudereco.de)

## LCA: Calculation rules

### Declared Unit

The declaration refers to 1 m<sup>2</sup> "BauderECO S/F" (Mass Balance). For this product, MDI is used in compliance with the mass balance approach.

### Declared unit

Name	Value	Unit
Declared unit	1	m <sup>2</sup>
Gross density	29	kg/m <sup>3</sup>
Grammage product	4.03	kg/m <sup>2</sup>
Grammage (without lamination)	3.48	kg/m <sup>2</sup>
Grammage lamination (shell limestone layer)	0.55	kg/m <sup>2</sup>
Layer thickness	0.12	m

Type of EPD: Manufacturer EPD 1a) Declaration of one specific product from one plant of one manufacturer.

### System boundary

Type of EPD: Type of EPD: Cradle to gate with options, modules C1–C4 and module D (A1–A3 + C + D and additional modules: A4, A5). The following modules of the life cycle are shown in the LCA:

**Production stage (A1–A3):** The production stage includes:

- A1 Raw material supply and processing, processing of secondary material inputs, (e.g. recycling processes)
- A2 Transport of raw materials to the manufacturer (reference area Germany)
- A3 Production of BauderEco S/F in the factory (incl. provision of energy, water and auxiliary materials, disposal of production waste, production of packaging materials)

**Construction stage (A4–A5):** The construction stage of Paul Bauder GmbH & Co. KG, BauderEco S/F, includes:

- A4 Transport to the construction site

- A5 Disposal of the packaging after installing the insulation board in the building

**End-of-Life stage (C1–C4):** The end-of-life stage of Paul Bauder GmbH & Co. KG, BauderEco S/F, includes:

- C1 Manual de-construction
- C2 Transport to waste processing: 50 km by truck. Transport distance can be adjusted for the specific building if necessary (e.g., for 100 km actual transport distance: multiply LCA values by factor 2)
- C3 100 % thermal recovery
- C4 not relevant

### Benefits and loads beyond the system boundary (D):

Module D includes: Energy recovery potentials from thermal recycling of the packaging and BauderEco S/F at the end of life.

### Geographic Representativeness

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

### 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 background data is retrieved from the GaBi database /GaBi software/version CUP 2022.1

The IBU regulations provide that two EPDs have to be created for products with mass balance approach. The results without mass balance approach are declared in the main EPD above, which was published under EPD-BAU-20220210-CBC2-EN.

## LCA: Scenarios and additional technical information

### Characteristic product properties of biogenic carbon

Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO<sub>2</sub>.

### Information on describing the biogenic carbon content at factory gate (pro m<sup>2</sup>)

Name	Value	Unit
Biogenic carbon content in product	1.627	kg C
Biogenic carbon content in accompanying packaging	-	kg C

The following technical information provides the basis for the modules declared or can be used to develop specific scenarios as part of a building assessment.

### Transport to the construction site (A4)

Name	Value	Unit
Transport distance	100	km

### Installing inside building (A5)

Production and disposal of the following packaging materials is included in the LCA.

Name	Value	Unit
Shrink film	0.12	kg/m <sup>2</sup>

### End-of-Life (C1–C4) Deconstruction (C1)

Manual removal of the product from the building (without environmental impact)

### Transport to End-of-Life treatment (C2)

Transport to waste treatment: 50 km with truck.

### Thermal Recovery (C3)

100% thermal recovery of product from demolishing

### Disposal (C4)

Not relevant.

### Reuse, recovery and recycling potential (D), relevant scenario information

Name	Value	Unit
Energy Recovery (Product)	4.03	kg
Energy Recovery (Packaging)	0.12	kg

Module D includes: Energy recovery potentials from thermal recycling of the packaging and BauderEco S/F at the end of life. A waste incineration plant with an R1 value > 0.6 was assumed.

## LCA: Results

The following is a summary of the LCA results for BauderECO S/F (Mass Balance) PU insulation boards with a basis weight of 4.03 kg/m<sup>2</sup> and a thickness of 120 mm.

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

Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

### RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 m<sup>2</sup> BauderECO S/F (Mass Balance)

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
GWP-total	kg CO <sub>2</sub> eq	2.93E+00	2.68E-02	3.77E-01	0	1.39E-02	7.42E+00	0	-3.15E+00
GWP-fossil	kg CO <sub>2</sub> eq	8.32E+00	2.49E-02	3.77E-01	0	1.21E-02	2.03E+00	0	-3.13E+00
GWP-biogenic	kg CO <sub>2</sub> eq	-5.4E+00	1.78E-03	2.06E-05	0	1.77E-03	5.4E+00	0	-1.65E-02
GWP-luluc	kg CO <sub>2</sub> eq	1.04E-02	9.56E-05	6.83E-07	0	4.64E-05	3.25E-05	0	-3.57E-04
ODP	kg CFC11 eq	7.21E-11	5.09E-15	2.99E-14	0	2.47E-15	6.48E-13	0	-2.19E-11
AP	mol H <sup>+</sup> eq	2.54E-02	2.34E-05	5.76E-05	0	1.13E-05	4.61E-03	0	-4.05E-03
EP-freshwater	kg P eq	5E-05	4.95E-08	6.76E-09	0	2.4E-08	2.7E-07	0	-4.47E-06
EP-marine	kg N eq	7.54E-03	7.77E-06	9.18E-06	0	3.77E-06	2.23E-03	0	-1.12E-03
EP-terrestrial	mol N eq	8.1E-02	9.21E-05	2.69E-04	0	4.47E-05	2.56E-02	0	-1.2E-02
POCP	kg NMVOC eq	2.68E-02	2.09E-05	2.49E-05	0	1.01E-05	5.64E-03	0	-3.11E-03
ADPE	kg Sb eq	1.83E-06	2.49E-09	7.38E-10	0	1.21E-09	1.79E-08	0	-4.92E-07
ADPF	MJ	1.34E+02	3.29E-01	5.61E-02	0	1.6E-01	2.23E+00	0	-5.27E+01
WDP	m <sup>3</sup> world eq deprived	1.33E+00	1.07E-04	3.45E-02	0	5.18E-05	8.06E-01	0	-3.15E-01

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

### RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 m<sup>2</sup> BauderECO S/F (Mass Balance)

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PERE	MJ	2.88E+02	2.17E-02	1.4E-02	0	1.05E-02	5.76E+01	0	-1.47E+01
PERM	MJ	5.72E+01	0	0	0	0	-5.72E+01	0	0
PERT	MJ	3.45E+02	2.17E-02	1.4E-02	0	1.05E-02	4E-01	0	-1.47E+01
PENRE	MJ	9.23E+01	3.3E-01	5.13E+00	0	1.6E-01	3.94E+01	0	-5.27E+01
PENRM	MJ	4.22E+01	0	-5.07E+00	0	0	-3.71E+01	0	0
PENRT	MJ	1.35E+02	3.3E-01	5.61E-02	0	1.6E-01	2.24E+00	0	-5.27E+01
SM	kg	1.36E-01	0	0	0	0	0	0	0
RSF	MJ	1.31E-16	0	0	0	0	0	0	0
NRSF	MJ	1.77E-15	0	0	0	0	0	0	0
FW	m <sup>3</sup>	6.53E-02	1.68E-05	8.09E-04	0	8.15E-06	1.9E-02	0	-1.36E-02

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 m<sup>2</sup> BauderECO S/F (Mass Balance)

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
HWD	kg	4.43E-08	1.44E-12	5.6E-12	0	6.98E-13	2.92E-10	0	-7.25E-09
NHWD	kg	1.57E-01	5.36E-05	1.52E-03	0	2.6E-05	2.19E-01	0	-2.69E-02
RWD	kg	4.23E-03	4.14E-07	1.55E-06	0	2.01E-07	9.27E-05	0	-4.04E-03
CRU	kg	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0	0	0
EEE	MJ	0	0	6.84E-01	0	0	1.33E+01	0	0
EET	MJ	0	0	1.58E+00	0	0	2.38E+01	0	0

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

## RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional: 1 m<sup>2</sup> BauderECO S/F (Mass Balance)

Parameter	Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
PM	Disease incidence	2.24E-07	1.52E-10	3.59E-10	0	7.36E-11	1.43E-08	0	-3.34E-08
IR	kBq U235 eq	4.49E-01	4.21E-05	1.53E-04	0	2.04E-05	1.48E-02	0	-6.76E-01
ETP-fw	CTUe	5.8E+01	2.52E-01	2.2E-02	0	1.22E-01	8.51E-01	0	-1.14E+01
HTP-c	CTUh	2.95E-09	5.06E-12	2.47E-12	0	2.45E-12	5.74E-11	0	-5.33E-10
HTP-nc	CTUh	9.58E-08	2.54E-10	7.98E-11	0	1.23E-10	2.35E-09	0	-2.07E-08
SQP	SQP	4.82E+01	9.87E-02	1.56E-02	0	4.79E-02	4.88E-01	0	-9.56E+00

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 or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, 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 as there is limited experience with the indicator.

## References

### Standards

#### DIN 4108-4

DIN 4108-4:2020-11, Thermal insulation and energy economy in buildings - Part 4: Hygrothermal design values.

#### DIN 4108-10

DIN 4108-10:2015-11, Thermal insulation and energy economy in buildings - Part 10: Application-related requirements for thermal insulation materials - Factory-made products.

#### DIN EN 826

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

#### DIN EN 1606

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

#### DIN EN 1609

DIN EN 1609:2013-05, Thermal insulating products for building applications - Determination of short-term water absorption by partial immersion.

#### DIN EN 12087

DIN EN 12087:2013-06, Thermal insulating products for building applications - Determination of long-term water absorption by immersion.

#### DIN EN 12091

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

#### DIN EN 13165

DIN EN 13165:2016-09, Thermal insulation products for buildings – Factory-made rigid polyurethane foam (PU) products - Specification; German version EN 13165:2012. (This standard covers polyurethane rigid foam (PUR) and polyisocyanurate rigid foam (PIR)).

#### DIN EN 13501-1

DIN EN 13501-1:2019-05, Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests.

#### EN 12088

EN 12088:2013, Thermal insulation for building applications – Determination of long-term water absorption by diffusion.

#### DIN EN 15804

DIN EN 15804+A2:2019+AC:2021, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

#### ISO 14025

DIN EN ISO 14025:2011-10, Environmental designations and declarations – Type III Environmental Declarations – Basic principles and procedures.

#### Additional References:

#### AgBB

Committee for the health risk assessment of building products (AgBB): Evaluation scheme for VOCs from construction products; approach for assessing health risks caused by volatile organic compounds (VOCs and SVOCs), version of July 2012.

#### AVV

Regulation on the European List of Waste Materials 2011, last amended by Art. 5, Section 22 of the Law, dated 24 February 2012 (Federal Law Gazette [BGBl.] I, Page 2012).

#### 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/EC.

**GaBi software**

Sphera Solutions GmbH  
GaBi Software System and Database for Life Cycle  
Engineering  
CUP version: 2022.1  
University of Stuttgart  
Leinfelden-Echterdingen

**GaBi documentation**

GaBi life cycle inventory data documentation  
(<https://www.gabisoftware.com/support/gabi/gabidatabase2020lcidocumentation/>)

**IBU 2021**

Institut Bauen und Umwelt e.V. General programme instructions  
for the preparation of EPDs at the Institut Bauen und Umwelt  
e.V., version 2.0., Berlin: Institut Bauen und Umwelt e.V., 2021,  
<http://www.ibu-epd.com>

**PCR Part A**

Product category rules for building-related products and  
services. Part A: LCA calculation rules and project report  
requirements pursuant to EN 15804+A2:2019 (v1.2), Berlin:  
Institut Bauen und Umwelt e.V., [www.ibu-epd.com](http://www.ibu-epd.com), 2021.

**PCR Part B: Insulation materials made of foam plastics**

Product category rules for building-related products and  
services. Part B: EPD requirements for insulating materials  
made of foam plastics, version 1.2 Berlin: Institut Bauen und  
Umwelt e.V. (IBU), 06-2017.

**REACH**

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



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