Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019 for:

TERBOND®

from

Politex s.a.s. di Freudenberg Politex S.r.l.

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-04186
Publication date:	2021-07-14
Valid until:	2026-07-13

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

General information

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
E-mail:	info@environdec.com

CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product category rules (PCR): Construction products, 2019:14, ver 1.11. CPC 27922
PCR review was conducted by: Technical committee of the International EPD® System. See www.environdec.com/TC for a list of members. Review chair: Claudia A. Peña, University of Concepción, Chile. The review panel may be contacted via the Secretariat www.environdec.com/contact.
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: *Adriana Del Borghi adry@unige.it* *Recognised* by The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☒ Yes ☐ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.
The LCA study and the present EPD have been issued by Eng. Francesca Intini with the technical scientific support of the University of Basilicata Matera (Italy).

EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. For further information about comparability, see EN 15804 and ISO 14025.

Company information

Owner of the EPD:
Politex s.a.s di Freudenberg Politex S.r.l.
Strada Provinciale Novedratese 17/a, 22060 Novedrate (CO), Italy

Contact:
Sara Viola, Communication Specialist, Sara.Viola@freudenberg-pm.com

Description of the organisation:
The Global Business Division (GBD) Building & Construction (B&C) belongs to the Freudenberg Performance Materials Group, world leader in the nonwovens market for different applications. The Division's core business, with its headquarters in Italy in Novedrate (Como), is the production of polyester nonwovens, made using both staple and spunbonded technology.

The Global Business Division Building & Construction develops, manufactures and sells high-performance products based on nonwovens, mainly used as carriers for waterproofing membranes as well as Enka Solutions high performance geosynthetics for use in construction and high-tech composites applications. The main market of the Group is the construction sector, where nonwovens of the "Roofing" division are sold as reinforcement for bituminous membranes for roofs waterproofing.

The majority of roofing products are manufactured using recycled raw materials, recovered and upgraded in-house, thanks to vertically integrated processes. The production of polyester starts with the recycling of post-consumer PET bottles, which are sorted, washed and ground to flakes. The flakes are then used in the production of fiber or directly in the spunbond process.

Freudenberg Performance Materials belongs to the Freudenberg Group, which comprises 10 Business Groups operating independently on various markets all over the world.

Product-related or management system-related certifications:

The Global Business Division B&C operations obtained the following certifications:

- ISO 9001 – Quality Management System
- ISO 14001 – Environmental Management System
- ISO 45001 – Health and Safety Management System

In Italy the Group joined Responsible Care, the voluntary programme of the global chemical industry, under which businesses commit themselves to the continuous improvement of products, processes and behaviour in the areas of Safety, Health and the Environment, in order to give a significant contribution to the sustainable development of industry, local communities and society.
All companies in the Division Building & Construction adopt Corporate Governance rules and Guiding Principles (www.freudenberg-pm.com), highlighting responsibility with regard to People, the Environment and Safety in all fields of activity.

Name and location of production site(s):

The Global Business Division B&C, with an organizational structure capable of creating products to meet the needs of diverse markets around the world, operates out of five production sites.
The division supplies the roofing market with Texbond® e Terbond® products from Novedrate and Pisticci (Italy), Colmar (France), Macon (USA), Nizhny Novgorod (Russia).
Colback and Enka products are manufactured in Obernburg (Germany), Arnhem (The Netherlands), Asheville-NC and Burlington-WA in USA, and Changzhou (China). Completing the organization of the Group are one trading companies in China at Shanghai and a comprehensive sales network.

Product information

Product name:
Terbond®

Product identification:
Terbond® with average weight of 150 g/m^2

Product description:
Terbond® is a range of polyester fiber nonwovens manufactured with spunbond technology, available in numerous weights capable of meeting a wide range of technical requirements to satisfy the different needs of global markets. Nonwovens are used as reinforcement for waterproofing membranes.
The fiber used is mainly produced in-house through the recycling of post-consumer PET bottles.

The EPD is based on **Terbond®** family produced in Colmar (France) and Pisticci (Italy). In LCA study was taken into account a weighted average of the production information of two sites during the 2020.
The final application of **Terbond®** nonwovens is the bituminous membrane, obtained from the process of bitumen impregnation at the production sites of membrane manufacturers and then used for the waterproofing of roofs. For the LCA study of the finished product reference has to be made to any analysis carried out by bituminous membranes manufacturers

Terbond®	Needlepunched and chemical bonded spunbond nonwovens Production: Pisticci (Italy) and Colmar (France)
Terbond® A	Needlepunched spunbond nonwovens Production: Colmar (France)
Terbond® TH	Needlepunched and thermal bonded spunbond nonwovens Production: Colmar (France)
Terbond® R	Needlepunched spunbond nonwovens reinforced with glass filaments Production: Pisticci (Italy)

Terbond® different types of weight and thickness:

	Terbond®	Terbond® A	Terbond® TH	Terbond® R	U.o.m.
Weight	from 100 to 300	from 50 to 275	from 100 to 250	from 110 to 270	g/m^2
Thickness	from 0,50 to 1,60	from 0,60 to 2,70	from 0,40 to 1,00	from 0,65 to 1,35	mm

This EPD is based on the LCA study carried out on the product **Terbond®** and reports data of the product with average weight of **150 g/m²**.
Here below are the technical features of the **Terbond®** products analysed in the study:

			Terbond® 150	Terbond® A 150	Terbond® TH 150	Terbond® R 150	U.o.m.
Weight	ISO 9073-1		150	150	150	150	g/m^2
Thickness	ISO 9073-2		0,90	0,70	0,65	0,85	mm
Max. tensile strength	ISO 9073-3	MD	59	50	43	50	daN/5cm
		CD	36	47	43	36	
Elongation at break	ISO 9073-3	MD	29	52	30	25	%
		CD	32	58	30	30	

As example the above values refer to average values for the product from Pisticci (Terbond®) and for the product A2TC (Terbond® A).

Further information about The Global Business Division Building & Construction and the **Terbond®** products are available on the web https://buildingmaterials.freudenberg-pm.com.

UN CPC code:
27922: Nonwovens for other purposes than clothing

Geographical Scope:
Global

LCA information

Functional unit / declared unit:
The declared unit of the study is represented by **1 m²** of **Terbond®** in 150 g/m^2 grammage.

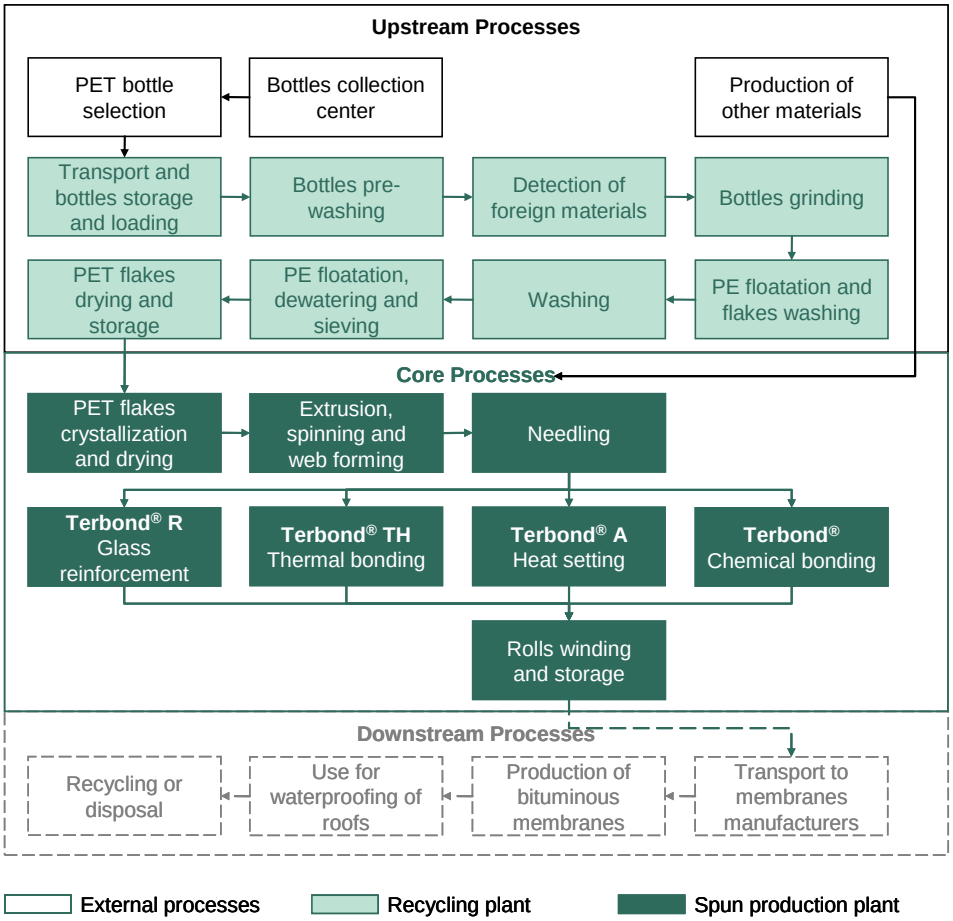
Reference service life:
Terbond® is distributed all over the world and the lifecycle of a bituminous membrane, installed on a roof, is estimated to be over 20 years. In some cases, the old damaged roofs are repaired with new additional layers, therefore the lifecycle of the membrane is prolonged and consequently also that of the nonwoven. In other cases, the old roof is completely removed and the waste material is recovered mainly sending it to energy valorisation or with the reuse in road applications.

Time representativeness:
Data refer to the year 2020 and were collected in Global Business Division B&C plants located in Colmar (France) and Pisticci (Italy).

Database(s) and LCA software used:
The analysis and monitoring of environmental performance took place using the SimaPro vs 9.0 software and the Ecoinvent vs 3.5 database.

Description of system boundaries:
The LCA developed is a “Cradle to Gate” type, measuring from A1 phase (production of raw materials) to A3 phase (production). The phases from A4 to C4 depend from the applications of the final product.

System diagram:



More information:

In the case of energy valorisation, each kilo of finished product has a calorific value (feedstock energy) of about 33 MJ which can be converted into useful energy. This feedstock energy is included in the energy from waste present in recycled PET bottles and represents the energy savings that is achieved by using recycled raw materials for the production of the nonwoven.

The use of recycled raw material for the production of nonwovens allows an upstream energy saving. **Terbond®** fits in at the end of a virtuous cycle which increases the value and concretises the activities of the recycling chain and the efforts of citizens in sorting waste.

Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation:

The Upstream Processes include the phase A1 (raw materials extraction and secondary raw materials treatment).
The Core Processes include the A2 (transportation to the factory) and A3 phase (production).

X= Included ND = Not Declared

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE	END-OF-LIFE STAGE				BENEFITS and LOADS BEYOND SYSTEM BOUNDARY
Raw Material Supply	Transport	Manufacturing	Transport	Construction/Installation	Use. Maintenance. Repair. Replacement. Refurbishment. Operational energy use. Operational water use	Deconstruction/Demolition	Transport	Waste processing	Disposal	Reuse. Recycling potential
A1	A2	A3	A4	A5	B1 to B7	C1	C2	C3	C4	D
X	X	X	ND	ND	ND	ND	ND	ND	ND	ND

Upstream Processes include:

- extraction and production of raw materials for components and packaging;
- manufacturing of semi-finished goods;
- manufacturing of additives (caustic soda, floating, surface-active, etc.);
- production processes for components and packaging;
- process of post-consumer PET bottles collection and selection (transports included);
- generation of electricity.

Core Processes include:

- transports: from the supply of semi-finished goods and of consumables to the conveyance of waste recovery;
- internal transports;
- manufacturing of input materials;
- manufacturing processes for the production;
- consumption of water.

The Downstream Processes including distribution, use and end of life management, have been considered from a qualitative point of view because of the impossibility to outline a realistic reference scenario with appropriate data.

Data concerning energy aspects refers to the energy mix of the French site in Colmar and the production process for the electrical energy from palm oil in Pisticci.

The processes contributing for less than 1% of the total environmental impact for each impact category have been omitted from the inventory. In the study the allocation is used only for the part concerning utilities (electrical energy, thermal power, methane gas) on the basis of the consumption of the distinct departments.

Content information

Product components	Terbond®		Terbond® A		Terbond® TH		Terbond® R	
	Weight, %	Post-consumer material, weight-%	Weight, %	Post-consumer material, weight-%	Weight, %	Post-consumer material, weight-%	Weight, %	Post-consumer material, weight-%
POLYESTER PET	83	100	100	43	100	21	77	100
SYNTHETIC RESINS	14						16	
BIO RESIN	3						6	
GLASS FIBERS							5	
TOTAL	100		100		100		100	

The product does not contain substances that are listed in the “Candidate List of Substances of Very High Concern (SVHC) for authorization”.

Environmental Information

Potential environmental impact – mandatory indicators according to EN 15804 - Terbond®

Results per functional or declared unit - Terbond®						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
GWP-fossil	kg CO_2 eq.	$1,27*10^{-1}$	$1,89*10^{-3}$	$6,22*10^{-2}$	$1,91*10^{-1}$	1,27
GWP-biogenic	kg CO_2 eq.	$4,18*10^{-4}$	$7,32*10^{-6}$	$6,10*10^{-4}$	$1,04*10^{-3}$	$6,90*10^{-3}$
GWP-luluc	kg CO_2 eq.	$4,79*10^{-3}$	$7,95*10^{-7}$	$3,32*10^{-2}$	$3,80*10^{-2}$	$2,53*10^{-1}$
GWP-total	kg CO_2 eq.	$1,32*10^{-1}$	$1,89*10^{-3}$	$9,61*10^{-2}$	$2,30*10^{-1}$	1,53
ODP	kg CFC 11 eq.	$5,94*10^{-9}$	$3,64*10^{-10}$	$1,50*10^{-8}$	$2,13*10^{-8}$	$1,42*10^{-7}$
AP	mol H^+ eq.	$4,85*10^{-4}$	1,15*10-5	$5,42*10^{-4}$	$1,04*10^{-3}$	$6,93*10^{-3}$
EP-freshwater	kg PO_4^{3-} eq.	$6,26*10^{-5}$	$1,02*10^{-6}$	$4,48*10^{-5}$	$1,08*10^{-4}$	$7,23*10^{-4}$
EP-marine	kg N eq.	$2,08*10^{-4}$	$2,55*10^{-6}$	$2,77*10^{-4}$	$4,88*10^{-4}$	$3,25*10^{-3}$
EP-terrestrial	mol N eq.	$1,14*10^{-3}$	$3,68*10^{-5}$	$1,72*10^{-3}$	$2,89*10^{-3}$	$1,93*10^{-2}$
POCP	kg NMVOC eq.	$3,17*10^{-4}$	$8,32*10^{-6}$	$2,00*10^{-4}$	$5,25*10^{-4}$	$3,50*10^{-3}$
ADP-minerals&metals*	kg Sb eq.	$1,11*10^{-7}$	$3,66*10^{-9}$	$5,89*10^{-8}$	$1,73*10^{-7}$	$1,16*10^{-6}$
ADP-fossil*	MJ	2,55*10	$2,84*10^{-2}$	2,82	5,40	$3,60*10^{+1}$
WDP	m^3	$9,48*10^{-2}$	$4,86*10^{-4}$	$5,26*10^{-2}$	$1,48*10^{-1}$	$9,86*10^{-1}$
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption					

Potential environmental impact – mandatory indicators according to EN 15804 - Terbond® A

Results per functional or declared unit - Terbond® A						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
GWP-fossil	kg CO_2 eq.	$3{,}19*10^{-1}$	$2{,}65*10^{-3}$	$2{,}49*10^{-2}$	$3{,}46*10^{-1}$	2,31
GWP-biogenic	kg CO_2 eq.	$6{,}42*10^{-4}$	$8{,}88*10^{-7}$	$8{,}93*10^{-5}$	$7{,}32*10^{-4}$	$4{,}88*10^{-3}$
GWP-luluc	kg CO_2 eq.	$1{,}24*10^{-3}$	$7{,}06*10^{-7}$	$2{,}02*10^{-5}$	$1{,}26*10^{-3}$	$8{,}40*10^{-3}$
GWP-total	kg CO_2 eq.	$3{,}21*10^{-1}$	$2{,}65*10^{-3}$	2,50*10-2	$3{,}48*10^{-1}$	2,32
ODP	kg CFC 11 eq.	$1{,}86*10^{-8}$	$6{,}24*10^{-10}$	2,21*10-8	$4{,}13*10^{-8}$	$2{,}75*10^{-7}$
AP	mol H^+ eq.	$1{,}51*10^{-3}$	$1{,}49*10^{-5}$	1,54*10-4	$1{,}68*10^{-3}$	$1{,}12*10^{-2}$
EP-freshwater	kg PO_4^{3-} eq.	$2{,}79*10^{-4}$	$6{,}58*10^{-7}$	$3{,}24*10^{-5}$	$3{,}12*10^{-4}$	$2{,}08*10^{-3}$
EP-marine	kg N eq.	$3{,}20*10^{-4}$	$3{,}50*10^{-6}$	$3{,}89*10^{-5}$	$3{,}63*10^{-4}$	$2{,}42*10^{-3}$
EP-terrestrial	mol N eq.	$2{,}95*10^{-3}$	$3{,}87*10^{-5}$	$3{,}42*10^{-4}$	$3{,}33*10^{-3}$	$2{,}22*10^{-2}$
POCP	kg NMVOC eq.	$9{,}67*10^{-4}$	$1{,}22*10^{-5}$	$6{,}81*10^{-5}$	$1{,}05*10^{-3}$	$6{,}98*10^{-3}$
ADP-minerals&metals*	kg Sb eq.	$1{,}17*10^{-6}$	$4{,}63*10^{-9}$	$6{,}97*10^{-8}$	$1{,}24*10^{-6}$	$8{,}30*10^{-6}$
ADP-fossil*	MJ	7,13	$4{,}16*10^{-2}$	5,38	$1{,}26*10^{+1}$	$8{,}37*10^{+1}$
WDP	m^3	$1{,}52*10^{-1}$	$3{,}07*10^{-4}$	$5{,}14*10^{-2}$	$2{,}04*10^{-1}$	1,36
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption					

Potential environmental impact – mandatory indicators according to EN 15804 - Terbond® TH

Results per functional or declared unit - Terbond® TH						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
GWP-fossil	kg CO_2 eq.	$4{,}24*10^{-1}$	$9{,}03*10^{-3}$	$2{,}24*10^{-2}$	$4{,}56*10^{-1}$	3,04
GWP-biogenic	kg CO_2 eq.	$8{,}69*10^{-4}$	$4{,}49*10^{-6}$	$8{,}78*10^{-5}$	$9{,}61*10^{-4}$	$6{,}41*10^{-3}$
GWP-luluc	kg CO_2 eq.	$7{,}70*10^{-4}$	$3{,}53*10^{-6}$	$1{,}84*10^{-5}$	$7{,}92*10^{-4}$	$5{,}28*10^{-3}$
GWP-total	kg CO_2 eq.	$4{,}26*10^{-1}$	$9{,}04*10^{-3}$	$2{,}25*10^{-2}$	$4{,}58*10^{-1}$	3,05
ODP	kg CFC 11 eq.	$2{,}51*10^{-8}$	$1{,}96*10^{-9}$	$2{,}00*10^{-8}$	$4{,}71*10^{-8}$	$3{,}14*10^{-7}$
AP	mol H^+ eq.	$2{,}00*10^{-3}$	$1{,}33*10^{-4}$	$1{,}39*10^{-4}$	$2{,}27*10^{-3}$	$1{,}51*10^{-2}$
EP-freshwater	kg PO_4^{3-} eq.	$3{,}68*10^{-4}$	$2{,}91*10^{-6}$	$2{,}94*10^{-5}$	$4{,}01*10^{-4}$	$2{,}67*10^{-3}$
EP-marine	kg N eq.	$3{,}71*10^{-4}$	$2{,}81*10^{-5}$	$3{,}53*10^{-5}$	$4{,}34*10^{-4}$	$2{,}90*10^{-3}$
EP-terrestrial	mol N eq.	$3{,}85*10^{-3}$	$3{,}13*10^{-4}$	$3{,}10*10^{-4}$	$4{,}47*10^{-3}$	$2{,}98*10^{-2}$
POCP	kg NMVOC eq.	$1{,}26*10^{-3}$	$8{,}60*10^{-5}$	$6{,}17*10^{-5}$	1,41*10-3	$9{,}38*10^{-3}$
ADP-minerals&metals*	kg Sb eq.	$1{,}56*10^{-6}$	$9{,}66*10^{-9}$	$6{,}34*10^{-8}$	$1{,}63*10^{-6}$	$1{,}09*10^{-5}$
ADP-fossil*	MJ	9,48	$1{,}36*10^{-1}$	4,89	$1{,}45*10^{+1}$	$9{,}67*10^{+1}$
WDP	m^3	$2{,}51*10^{-1}$	$9{,}48*10^{-4}$	4,68*10-2	$2{,}99*10^{-1}$	1,99
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption					

Potential environmental impact – mandatory indicators according to EN 15804 - Terbond® R

Results per functional or declared unit - Terbond® R						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
GWP-fossil	kg CO_2 eq.	$1{,}22*10^{-1}$	$1{,}84*10^{-3}$	$1{,}45*10^{-1}$	$2{,}69*10^{-1}$	1,79
GWP-biogenic	kg CO_2 eq.	$3{,}57*10^{-4}$	$1{,}63*10^{-5}$	$9{,}64*10^{-4}$	$1{,}34*10^{-3}$	$8{,}91*10^{-3}$
GWP-luluc	kg CO_2 eq.	$7{,}87*10^{-3}$	$1{,}20*10^{-6}$	$1{,}72*10^{-1}$	$1{,}80*10^{-1}$	1,20
GWP-total	kg CO_2 eq.	$1{,}30*10^{-1}$	$1{,}85*10^{-3}$	$3{,}18*10^{-1}$	$4{,}50*10^{-1}$	3,00
ODP	kg CFC 11 eq.	$6{,}30*10^{-9}$	$2{,}42*10^{-10}$	$1{,}79*10^{-8}$	$2{,}45*10^{-8}$	$1{,}63*10^{-7}$
AP	mol H^+ eq.	$5{,}58*10^{-4}$	$1{,}60*10^{-5}$	$1{,}28*10^{-3}$	$1{,}86*10^{-3}$	$1{,}24*10^{-2}$
EP-freshwater	kg PO_4^{3-} eq.	$5{,}95*10^{-5}$	$1{,}76*10^{-6}$	$6{,}87*10^{-5}$	$1{,}30*10^{-4}$	$8{,}67*10^{-4}$
EP-marine	kg N eq.	$1{,}67*10^{-4}$	$2{,}79*10^{-6}$	$1{,}25*10^{-3}$	$1{,}42*10^{-3}$	$9{,}47*10^{-3}$
EP-terrestrial	mol N eq.	$1{,}38*10^{-3}$	$5{,}11*10^{-5}$	$4{,}38*10^{-3}$	$5{,}82*10^{-3}$	$3{,}88*10^{-2}$
POCP	kg NMVOC eq.	$3{,}28*10^{-4}$	$8{,}27*10^{-6}$	$6{,}36*10^{-4}$	$9{,}73*10^{-4}$	$6{,}49*10^{-3}$
ADP-minerals&metals*	kg Sb eq.	$1{,}71*10^{-7}$	$3{,}33*10^{-9}$	$1{,}49*10^{-7}$	$3{,}24*10^{-7}$	$2{,}16*10^{-6}$
ADP-fossil*	MJ	2,12	$2{,}57*10^{-2}$	2,05	4,20	$2{,}80*10^{+1}$
WDP	m^3	$1{,}23*10^{-1}$	$6{,}69*10^{-3}$	$6{,}25*10^{-2}$	$1{,}92*10^{-1}$	1,28
Acronyms	GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption					

Potential environmental impact – additional mandatory and voluntary indicators – Terbond®

Results per functional or declared unit - Terbond®						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
GWP-GHG	kg CO2 eq.	$1,26*10^{-1}$	$1,88*10^{-3}$	$9,52*10^{-2}$	$2,23*10^{-1}$	1,49
Particulate Matter Emissions	disease inc.	$4,90*10^{-9}$	$1,54*10^{-10}$	$4,56*10^{-9}$	$9,62*10^{-9}$	$6,41*10^{-8}$
Ionising radiation, HH	kBq U-235 eq	$1,71*10^{-2}$	$1,80*10^{-4}$	$1,03*10^{-1}$	$1,20*10^{-1}$	$8,01*10^{-1}$
Ecotoxicity freshwater	CTUe	$1,26*10^{-1}$	$4,43*10^{-3}$	$3,64*10^{-2}$	$1,67*10^{-1}$	1,11
Cancer human health effects	CTUh	$2,61*10^{-9}$	$3,10*10^{-11}$	$5,10*10^{-10}$	$3,15*10^{-9}$	$2,10*10^{-8}$
Additional voluntary indicators e.g. the voluntary indicators from EN 15804 or the global indicators according to ISO 21930:2017						

Potential environmental impact – additional mandatory and voluntary indicators – Terbond® A

Results per functional or declared unit - Terbond® A						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
GWP-GHG	kg CO2 eq.	$3,12*10^{-1}$	$2,64*10^{-3}$	$2,47*10^{-2}$	$3,39*10^{-1}$	2,26
Particulate Matter Emissions	disease inc.	$1,42*10^{-8}$	$2,30*10^{-10}$	$1,51*10^{-9}$	$1,59*10^{-8}$	$1,06*10^{-7}$
Ionising radiation, HH	kBq U-235 eq	$2,98*^{10-2}$	$2,04*10^{-4}$	$2,55*10^{-1}$	$2,85*10^{-1}$	1,90
Ecotoxicity freshwater	CTUe	$2,57*10^{-1}$	$8,30*10^{-3}$	$1,75*10^{-2}$	$2,83*10^{-1}$	1,89
Cancer human health effects	CTUh	$5,78*10^{-9}$	$1,76*10^{-11}$	$6,05*10^{-10}$	$6,41*10^{-9}$	$4,27*10^{-8}$
Additional voluntary indicators e.g. the voluntary indicators from EN 15804 or the global indicators according to ISO 21930:2017						

Potential environmental impact – additional mandatory and voluntary indicators – Terbond ® TH

Results per functional or declared unit - Terbond® TH						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
GWP-GHG	kg CO2 eq.	$4{,}14*10^{-1}$	$8{,}98*10^{-3}$	$2{,}21*10^{-2}$	$4{,}45*10^{-1}$	2,97
Particulate Matter Emissions	disease inc.	$1{,}83*10^{-8}$	$5{,}44*10^{-10}$	$1{,}38*10^{-9}$	$2{,}02*10^{-8}$	$1{,}34*10^{-7}$
Ionising radiation, HH	kBq U-235 eq	$3{,}44*10^{-2}$	$7{,}44*10^{-4}$	$2{,}32*10^{-1}$	2,67*10-1	1,78
Ecotoxicity freshwater	CTUe	$2{,}78*10^{-1}$	$1{,}60*10^{-2}$	$1{,}59*10^{-2}$	$3{,}10*10^{-1}$	2,07
Cancer human health effects	CTUh	$6{,}05*10^{-9}$	$5{,}73*10^{-11}$	5,50*10-10	$6{,}66*10^{-9}$	$4{,}44*10^{-8}$
Additional voluntary indicators e.g. the voluntary indicators from EN 15804 or the global indicators according to ISO 21930:2017						

Potential environmental impact – additional mandatory and voluntary indicators – Terbond® R

Results per functional or declared unit - Terbond® R						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
GWP-GHG	kg CO2 eq.	$1{,}25*10^{-1}$	1,83*10-^{3}	$3{,}16*10^{-1}$	$4{,}43*10^{-1}$	2,96
Particulate Matter Emissions	disease inc.	$5{,}40*10^{-9}$	$1{,}30*10^{-10}$	$1{,}43*10^{-8}$	$1{,}99*10^{-8}$	$1{,}32*10^{-7}$
Ionising radiation, HH	kBq U-235 eq	$5{,}54*10^{-3}$	$2{,}27*10^{-4}$	$9{,}41*10^{-3}$	$1{,}52*10^{-2}$	$1{,}01*10^{-1}$
Ecotoxicity freshwater	CTUe	$1{,}10*10^{-1}$	$1{,}81*10^{-3}$	$1{,}40*10^{-1}$	2,52*10-1	1,68
Cancer human health effects	CTUh	$2{,}03*10^{-9}$	$5{,}49*10^{-11}$	$9{,}58*10^{-10}$	$3{,}04*10^{-9}$	$2{,}03*10^{-8}$
Additional voluntary indicators e.g. the voluntary indicators from EN 15804 or the global indicators according to ISO 21930:2017						

Use of resources – Terbond®

Results per functional or declared unit – Terbond®						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
PERE	MJ	$1,46*10^{-1}$	$1,99*10^{-3}$	$3,28*10^{-1}$	$4,76*10^{-1}$	3,17
PERM	MJ	$4,00*10^{-3}$	0,00	0,00	$4,00*10^{-3}$	$2,67*10^{-2}$
PERT	MJ	1,50*10-1	$1,99*10^{-3}$	$3,28*10^{-1}$	$4,80*10^{-1}$	3,20*
PENRE	MJ	2,75	$1,83*10^{-2}$	2,63*	5,39	$3,60*10^{+1}$
PENRM	MJ.	0,00	0,00	0,00	0,00	0,00
PENRT	MJ	2,75	$1,83*10^{-2}$	2,63	5,39	$3,60*10^{+1}$
SM	kg	$1,31*10^{-1}$	0,00*10+00	0,00*10+00	$1,31*10^{-1}$	$8,73*10^{-1}$
RSF	MJ	0,00	0,00	0,00	0,00	0,00
NRSF	MJ	0,00	0,00	0,00	0,00	0,00
FW	m^3	$6,42*10^{-4}$	0,00	0,00	$6,42*10^{-4}$	$4,28*10^{-3}$
Acronyms	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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water					

Use of resources – Terbond® A

Results per functional or declared unit – Terbond®						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
PERE	MJ	$2,35*10^{-1}$	$4,50*10^{-4}$	$2,94*10^{-1}$	$5,29*10^{-1}$	3,53
PERM	MJ	$6,10*10^{-3}$	0,00	0,00	$6,10*10^{-3}$	$4,06*10^{-2}$
PERT	MJ	$2,41*10^{-1}$	$4,50*10^{-4}$	$2,94*10^{-1}$	$5,35*10^{-1}$	3,57
PENRE	MJ	4,67	$4,42*10^{-2}$	5,40	$1,01*10^{+1}$	$6,74*10^{+1}$
PENRM	MJ.	2,97	0,00	0,00	2,97	$1,98*10^{+1}$

PENRT	MJ	7,64	$4,42*10^{-2}$	5,40	$1,31*10^{+1}$	$8,72*10^{+1}$
SM	kg	$6,52*10^{-2}$	0,00	0,00	$6,52*10^{-2}$	$4,34*10^{-1}$
RSF	MJ	0,00	0,00	0,00	0,00	0,00
NRSF	MJ	0,00	0,00	0,00	0,00	0,00
FW	m^3	$1,95*10^{-4}$	0,00*10+00	0,00	$1,95*10^{-4}$	$1,30*10^{-3}$
Acronyms	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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water					

Use of resources – Terbond® TH

Results per functional or declared unit – Terbond® TH						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
PERE	MJ	v	$2,19*10^{-3}$	$2,67*10^{-1}$	$5,83*10^{-1}$	3,89
PERM	MJ	$4,27*10^{-3}$	0,00	0,00*	$4,27*10^{-3}$	2,85*10-2
PERT	MJ	$3,18*10^{-1}$	$2,19*10^{-3}$	$2,67*10^{-1}$	$5,88*10^{-1}$	3,92
PENRE	MJ	6,00	$1,44*10^{-1}$	4,91	$1,11*10^{+1}$	$7,37*10^{+1}$
PENRM	MJ.	4,18	0,00	0,00	4,18	$2,79*10^{+1}$
PENRT	MJ	$1,02*10^{+1}$	$1,44*10^{-1}$	4,91	$1,52*10^{+1}$	$1,02*10^{+2}$
SM	kg	$3,42*10^{-2}$	0,00	0,00	$3,42*10^{-2}$	$2,28*10^{-1}$
RSF	MJ	0,00	0,00	0,00	0,00	0,00
NRSF	MJ	0,00	0,00	0,00	0,00	0,00
FW	m^3	$9,90*10^{-5}$	0,00	0,00	$9,90*10^{-5}$	$6,60*10^{-4}$
Acronyms	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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water					

Use of resources – Terbond® R

Results per functional or declared unit – Terbond® R						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
PERE	MJ	v	$5{,}80*10^{-2}$	$3{,}43*10^{-1}$	$5{,}42*10^{-1}$	3,61
PERM	MJ	$1{,}34*10^{-3}$	$8{,}43*10^{-4}$	$8{,}43*10^{-4}$	$3{,}03*10^{-3}$	$2{,}02*10^{-2}$
PERT	MJ	$1{,}42*10^{-1}$	$5{,}89*10^{-2}$	$3{,}44*10^{-1}$	$5{,}45*10^{-1}$	3,63
PENRE	MJ	2,30	1,19	1,86	5,35	$3{,}57*10^{+1}$
PENRM	MJ.	0,00	0,00	0,00	0,00	0,00
PENRT	MJ	2,30	1,19	1,86	5,35	$3{,}57*10^{+1}$
SM	kg	$1{,}17*10^{-1}$	0,00	0,00	$1{,}17*10^{-1}$	$7{,}77*10^{-1}$
RSF	MJ	0,00	0,00	0,00	0,00	0,00
NRSF	MJ	0,00	0,00	0,00	0,00	0,00
FW	m^3	$1{,}31*10^{-3}$	$9{,}88*10^{-6}$	$9{,}88*10^{-6}$	$1{,}33*10^{-3}$	$8{,}84*10^{-3}$
Acronyms	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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water					

Waste production and output flows

Waste production - Terbond®

Results per functional or declared unit - Terbond®						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
Hazardous waste disposed	kg	0,00	0,00	0,00	0,00	0,00
Non-hazardous waste disposed	kg	$5{,}06*10^{-2}$	0,00	0,00	$5{,}06*10^{-2}$	$3{,}37*10^{-1}$
Radioactive waste disposed	kg	0,00	0,00	0,00	0,00	0,00

Waste production - Terbond® A

Results per functional or declared unit - Terbond® A						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
Hazardous waste disposed	kg	0,00	0,00	0,00	0,00	0,00
Non-hazardous waste disposed	kg	$3,15*10^{-2}$	0,00	$1,47*10^{-2}$	$4,62*10^{-2}$	$3,08*10^{-1}$
Radioactive waste disposed	kg	0,00	0,00	0,00	0,00	0,00

Waste production - Terbond® TH

Results per functional or declared unit - Terbond® TH						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
Hazardous waste disposed	kg	0,00	0,00	0,00	0,00	0,00
Non-hazardous waste disposed	kg	$1,67*10^{-2}$	0,00	$1,48*10^{-2}$	$3,14*10^{-2}$	$2,1*10^{-1}$
Radioactive waste disposed	kg	0,00	0,00	0,00*	0,00	0,00

Waste production - Terbond® R

Results per functional or declared unit - Terbond® R						Results per kg
Indicator	**Unit**	**A1**	**A2**	**A3**	**Tot.A1-A3**	**Tot.A1-A3**
Hazardous waste disposed	kg	0,00	0,00	0,00	0,00	0,00
Non-hazardous waste disposed	kg	$1,85*10^{-2}$	$3,85*10^{-3}$	0,00*	$2,24*10^{-2}$	$1,49*10^{-1}$
Radioactive waste disposed	kg	0,00	0,00	0,00	0,00	0,00

The **Terbond® R** contains negligible biogenic carbon content. No output flows are shown for the thoughtful phases.

Other environmental indicators

As an indication, here below the values of Carbon Footprint are represented for the different weights for m^2 of product.

Terbond®	120	**150**	170	180	220	250	270	g/m^2
GWP-GHG	0,18	**0,22**	0,25	0,27	0,33	0,37	0,40	$kgCO_2$ eq./m^2
Terbond® A	120	**150**	170	180	220	250	270	g/m^2
GWP-GHG	0,27	**0,34**	0,38	0,41	0,50	0,56	0,61	$kgCO_2$ eq./m^2
Terbond® TH	120	**150**	170	180	220	250	270	g/m^2
GWP-GHG	0,36	**0,44**	0,50	0,53	0,65	0,74	0,80	$kgCO_2$ eq./m^2
Terbond ® R	120	**150**	170	180	220	250	270	g/m^2
GWP-GHG	0,35	**0,44**	0,50	0,53	0,65	0,74	0,80	$kgCO_2$ eq./m^2

References

General Programme Instructions of the International EPD® System. Version 3.01.

PCR 2019:14 Construction products and construction services (v1.11 del 05/02/2021).

Life Cycle Assessment (LCA) applied for the product Terbond®, rev. 1.1, July 2021.

EN 15804:2012 + A2:2019 Sustainability of construction works — Environmental product declarations

EPD®

www.environdec.com